

CHIP START | UK

the semiconductor incubator

managed by [SiliconCatalyst.UK](https://www.SiliconCatalyst.UK)



Funded by
UK Government



WELCOME



Sean Redmond - Managing Partner SiliconCatalyst.UK

Launched in October 2024, the ChipStart UK early stage semiconductor startup incubator run by SiliconCatalyst.UK has been an overwhelming success.

Fully funded by the UK Government's Department for Science Innovation and Technology, the incubator provides nine months of access to the full Silicon Catalyst Global ecosystem. This includes over 60 In Kind Partners giving UK based semiconductor startups all of what they need to be successful to reach their first all important seed funding round. They can access free Electronic Design Automation Tools from Synopsys, Siemens EDA and Cadence. These would typically cost hundreds of thousands of pounds. Free design IP from industry leaders Arm, Imagination Technologies and SureCore. They can also get free access to advanced node TSMC multi-project wafer runs to manufacture prototypes. To mitigate the risks of bad decisions early in the company's growth, we assign one of our executive Silicon Catalyst advisors to each company to shepherd them through the incubation. Each startup can also access our 300+ strong global executive advisor base to ask questions, discuss "go to market" challenges, supply needs and even get introduced to potential co-founders and CEO's. Our semiconductor industry specific training course delivers 3 deep dive sessions per month that are then workshopped to the specific needs of the startups to improve their value proposition, their leadership skills, team building, presentation, IP strategy and negotiation skills. The objective is to develop these entrepreneurs into the next generation of semiconductor leaders in the UK with the ability to effortlessly and professionally negotiate their investment term sheets, £million EDA supplier contracts and customer engagement contracts.

SiliconCatalyst.UK has hosted its now famous forming, storming, norming and performing of semiconductor startups events around the chip design clusters of the UK. Each of these events are attended by over 100 semiconductor industry executives and investors, giving the ChipStart UK cohort the opportunity to pitch their startups creating customer opportunities, partnership opportunities and most importantly investment interest. These incredibly popular semiconductor events have been delivered in London, Glasgow, Oxford, Edinburgh and Cambridge over the last several months.

The first Cohort of ChipStart UK, helped by the extended team of Silicon Catalyst.UK, are well on their way to raising over £15M of pre-seed and seed funding. The impact to the UK semiconductor startup economy is significant. New semiconductor investors are engaging with our startups. Ones that traditionally would have only invested in FinTech and SaaS companies, now see the significant opportunities for the global semiconductor industry that is racing towards a \$1Trillion a year revenue. An industry that was created by startups not much more than 50 years ago is now being completely disrupted by startups. As advanced CMOS Silicon fabrication is clearly failing to deliver the power, performance and area reduction benefits that have fueled the industry since its beginnings, the world is looking for new innovations in materials, chip design architectures and advanced packaging. There has never been a better time to be in the semiconductor industry.

Before Silicon Catalyst came to the UK just over 2 years ago, the number of semiconductor startups being created and funded from the UK had fallen to a miserable sixth place behind Switzerland. The UK was the pride of Europe in the early 2000's standing head and shoulders above all other European countries for semiconductor startups. Last year we received 27 applications for the ChipStart UK incubator, this year Silicon Catalyst.UK expects approaching 50 new semiconductor startups to apply.

SILICONCATALYST.UK TEAM



Sean Redmond

Sean Redmond has nearly 40 years of experience in the semiconductor and software industries. Starting his career as a chip designer, he led two market leading design teams. Firstly in digital stereo sound for television and then the first embedded mobile phone chip with VLSI technology. Sean was VP Europe for Verisity Design Inc, taking them from a standing start to over 160 customer sites

throughout Europe in 5 years. He instigated and led the strategic partnership with Arm, fueling its meteoric rise and successful IPO. Following their acquisition by Cadence, Sean became VP & GM of Cadence EMEA, doubling its business in 3 years. As VP WW Sales and Marketing for ARC, he helped turn its cash flow positive, leading to the eventual sale to Synopsys. Sean, a Managing Partner at SiliconCatalyst.UK, has recently worked closely with the UK government on industrial digital strategy, co-chairing the ElecTech council and became a core member of the Secretary of State's industrial digital leadership team. In 2021, Sean single handedly launched SiliconCatalyst.UK, bringing several years of successful Silicon Valley semiconductor startup incubation and acceleration knowledge to the UK semiconductor startup community. Sean has a BSc(hons), MSc EE from Kings College, London and MBA from Henley Management College.



Russell Haggar

Mr. Russell Haggar is a Co-Founder and serves as Executive Chair at VyperCore. He also co-founded Xsilon and served as its Chief Executive Officer. He is also an Angel Investor. He was previously a Partner at Esprit Capital Partners and Prelude Ventures. Russell has been active in the high-tech commercial industry for well over 20 years, graduating from deep technical roles into commercial and operational leadership

activities and including a productive six-year spell as a venture capital principal. Former companies include Element 14, Marconi, Madge Networks, 3Way Networks, Sagentia, XMOS, SiConnect, Prelude Ventures and DFJ Esprit. Russell is responsible for business development, marketing and product management activities.



Henry Nurser

Henry has 40 years of international senior leadership experience in commercial, R&D (HW & SW) and high-volume manufacturing roles within the semiconductor industry. In addition to his role at Silicon Catalyst UK, he serves as an advisor to technology start-ups. Henry is passionate about building highly innovative, productive and motivated teams within both corporate and start-up environments, and has always been

driven by a desire to constantly look for ways in which things can be done better – whether this be around design flows, program management methodologies or business models.

Starting his career designing memories at Mitsubishi in Japan, Henry spent >25 years leading multi-national R&D projects and business organisations within STMicroelectronics. As founding CEO of Blu Wireless Technology, Henry built the company into an award-winning supplier of millimetre wave semiconductors and system solutions for multi-Gigabit 5G communication.

Henry has an MA in Electrical and Electronics Engineering from Cambridge University and 4 patents.



Ross Addinall, PhD

Ross has 30 years of international experience in a range of multi-national and startup IC and EDA companies with experience ranging from high-speed bipolar process and component design (ESD protection) through integrated circuits (Bluetooth, WiFi, DECT) to software systems (Connected Vehicles) and cloud based software products. Ross has held roles in pure research and development (CTO of a software

tool startup), services (Cadence VCAD) and technical sales. In all of these roles Ross has been drawn to either working with or supporting startup companies and is continually excited by getting the next great idea off the ground with a team of like minded individuals, by working smart as well as hard.

For the almost the last decade Ross has been a technical evaluator of funding proposals for commercialisation funds and disruptive technology funds.

Ross has a PhD in semiconductor physics (III-V compounds) from Imperial College, London and 3 patents.

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Forming, Storming, Norming and Performing

A Silicon Catalyst event hosted by Arm in Cambridge

With the enthusiasm for semiconductor startups firmly re-established in the UK, we conceived a “Forming, Storming, Norming and Performing” theme for a series of events to tease out those founders that have gone before to share their learnings with new startup teams. The event was kindly hosted by Arm (a Silicon Catalyst strategic partner and In Kind Partner) at the address of legends, 110 Fulbourn Road, Cambridge. We had one of SiliconCatalyst.UK advisors, the great Malcolm Penn, take us through the concept that no company is an island when testing their value proposition.

We then kicked off with Phillip Burr describing the hugely generous Arm Flexible Access program that releases the potential of semiconductor startup designers to get market leading design IP. Two legends of our UK semiconductor startups Phil O’Donovan co-founder CSR Plc and Jerry Loraine talked about “how bad things happen to good people” with stories about patent trolls and go to market challenges. This led naturally into “the importance of the team” with a single person invention idea from Bruno Johnson. Where Cascoda invented a radio architecture to increase range by 3x for Thread Group #iotdevices and is now shipping Arm based products

into #smartcities #smartbuildings all around the world. This section concluded with a compelling presentation from the illustrious Jim Nicholas walking us through the inventive team idea from Uniphy Ltd

The last session before the break had the wonderful Vaysh Kewada from Salience Labs (a Silicon Catalyst portfolio company) share her deep insights into “creating relentlessly repeatable processes from day 1” of your startup journey. Followed by a hugely insightful deep dive by Pete Hughes the foremost semiconductor product operations executive in the UK on how to ship high volume semiconductor products with the level of quality that your market leading customers will demand. Back from the break where the Arm catering team laid on a spread that would not look out of place at the Ritz, we leapt into “what problem are you solving?” Patrick Camilleri shared his learnings on how to build semiconductor design IP combined SaaS product offerings and then Gary Spittle founder of Sonical Inc (A Silicon Catalyst portfolio company) projected the huge opportunity in their end to end system play to command the compute in the ear application space. We concluded the presentations with the eternal “how much money



BUILDING ON SUCCESS

Following the launch of SiliconCatalyst.UK in summer '21 we have focused on increasing awareness and understanding of the semiconductor community here to the benefits of our startup accelerator.

To connect the UK semiconductor startup community, we continued to build on the success



of our physical launch event at the historic Bletchley Park, home of Alan Turing's code breakers. We hosted a leadership dinner at the 5-star Whatley Manor Cotswold resort. Our startup CEO's, including Vaysh Kewada of Salience Labs and Huw Davies of Trameto, were engaged with great insights from industry luminaries such as Jalal Bagherli, ex-CEO Dialog Semiconductor, Ray Bingham, Executive Chairman of Imagination Technologies and Owen Metters of Foresight Williams one of the leading Semiconductor early-stage VC's.

We gathered again at the Annual General Meeting of our UK



partner Techworks NMI, where we hosted a table for our Portfolio Companies, Advisors, Strategic Partners and In Kind Partners. Sean Redmond contributed to a lively panel discussion, providing insights on how Silicon Catalyst helps semiconductor startup to de-risk access to foundry, design automation, IP and investment.

will you need?” The marvellous Tony Milbourn who leads u-blox corporate venturing shared in detail how they look for the secret sauce of semiconductor startup success. Then Owen Metters Foresight Group Williams, the leading semiconductor VC investor in the UK took us through three compelling case studies. The final panel session led us into a lively debate into what we need to do to make UK Semiconductor great again and make sure we create an open and inclusive industry where everybody can thrive.

The day was topped off with a VIP wine tasting at Hotel Du Vin in Cambridge to thank all those that contributed to the hugely successful event. The guests were treated to our very own Lance Bell telling the fascinating story of a horse called “Never Say Die” which has been used for the branding of the very first UK bourbon. Amongst the wines in the “bake-off” between American and Italian red wines was Castello Redmond, the organic red made by our UK managing partner Sean.



Silicon Catalyst continued to build mutual respect and trust with the UK government team working on Semiconductor policy interventions. We accompanied the UK government team over to the Tyndall National Institute in Ireland to help demonstrate the art of the possible with respect to national semiconductor research institutes. We met with the Rt hon Chris Philp, the minister of technology twice and hosted meetings with both Jodi Shelton, CEO of GSA and Mark Edelstone from Morgan Stanley to help provide a global perspective to their semiconductor deep dive. will you need?” The marvellous Tony Milbourn who leads u-blox corporate venturing shared in detail how they look for the secret sauce of semiconductor startup success. Then Owen Metters Foresight Group Williams, the leading semiconductor VC investor in the UK took us through three.

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Forming, Storming, Norming and Performing

A Silicon Catalyst event hosted at Heriot-Watt University in Edinburgh

Silicon Catalyst and Heriot-Watt University GRID delivered the second in the series of the forming storming norming and then performing of UK semiconductor startup companies in Edinburgh yesterday to a sold-out event!

These events have been conceived to help new semiconductor founders learn from the legends of our UK semiconductor industry.

Steve McLaughlin kicked us off with a wonderful insight into the strengths of Heriot-Watt University semiconductor research, entrepreneurship and startup commercialisation

The legend Jed Hurwitz Fellow from Analog Devices took us through how bad things “nearly” happen to good people with a deep insight into how he achieved three successful semiconductor start-up exits. Just fantastic.

Then it was all about the team from a very thought provoking Keith Muir Founder and CEO of the brilliant Cytomos backed up by the gregarious Richard Ord from hot new startup Quantum Power Transformation Ltd explaining how their tiny packed revolution in power drive semiconductors is born from years of ingenuity and unique experiences gained by its founder Rob Gwynne

After a well received break of refreshments, with opportunity to see our exhibitors Synopsys Inc., Imagination Technologies, 360WORK, IC Resources, TechWorks, NMI, and IoTSE, we were given a great



introduction to the hugely generous Arm University and Flexible Access program by the very knowledgeable Andrew Pickard and Nivetha Sundararajan

We then dived into “What problem are you solving” with the legend Donald McClymont who with the spectacular indie Semiconductor has achieved the holy grail of semiconductor startups by floating on Nasdaq. Wow! This talk makes the hairs on the back of your neck stand up on end. Don’t miss the video.

Our Silicon Catalyst advisor and In Kind Partner Asen Asenov stormed through how he performed with perfection to create the world leading GSS ltd as a part-time CEO whilst still working as professor University of Glasgow He was followed by the fascinating technology from Brian Gerardot CEO of Atomic Architects on the Heriot-Watt University campus that has the potential to transform feature rich semiconductor manufacturing

We concluded the presentations with the legend Pete Hutton Chairman of our In Kind Partner Agile Analog and Cambridge GaN Devices Ltd providing the gold-dust of advice for raising semiconductor startup funding from Angel or VC investors backed up by an early stage and very exciting Heriot-Watt University semiconductor startup @Infinct and the passionate Samuel Rotenberg delivering the first hybrid flat panel antenna for broadband satellite technology

A huge thank you to all those that attended, contributed and most importantly not forgetting the hard work from Leanne Gunn and the fantastic team at Heriot-Watt University GRID. Great to see David Richardson the instigator of our fruitful collaboration with Heriot-Watt University to help create more exciting semiconductor startups in Scotland.

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Forming, Storming, Norming and Performing

A SiliconCatalyst.UK event hosted by the Mazumdar-Shaw Advanced Research Centre at the University of Glasgow



Over100gatheredforourSiliconCatalyst.UK #ChipStartUK forming, storming, norming and performing of early stage semiconductor UK startups at the wonderful University of Glasgow Advanced Research Centre yesterday.

Leading off with a great insight into their world leading semiconductor research at University of Glasgow vice principal Chris Pearce set the pace for this semiconductor startup packed day.

The very impressive Eva I. joint head of the semiconductor branch of Department for Science, Innovation and Technology showed us how the UK is leading the dance by delivering on our targeted semiconductor strategy.

Following in the footsteps of women semiconductor leaders Gabriella Giuffrida from our Silicon Catalyst strategic partner Arm projected how their flexible access for startups delivers industry leading design IP and support to semiconductor startups.

Taner Dosluoglu CEO of weeteq shared his hard learned experience from his previous startup that set weeteq on a path to success by being accepted into the Silicon Catalyst 2 year accelerator and using the Arm flexible access for startups.

Our startup audience leaned in to drink from the fire hydrant of semiconductor startup knowledge as the serially successful Jed Hurwitz showed us all how it should be done.

Then 10 of our SiliconCatalyst.UK ChipStartUKearlystagesemiconductor startups in our 9 month incubator programme projected their value with their 3 slide 5 minute pitches:

- Yameng Cao - HydraVision spinning out of National Physical Laboratory
- Helen Duncan - Blueshift Memory
- Mark Rushworth - Finchetto
- Tanya M. - HyperCIM
- Noel Hurley - Mignon
- Dorian Haci, PhD - MintNeuro
- James Lewis - RED Semiconductor

- Rahul Tyagi - SECQAI
- Aravind Venugopalan Nair
- Jalajakumari - Singular Photonics
- James Lewis - Wave Photonics

This wave of UK semiconductor startup energy was bookended by the insightful learnings of a University of Cambridge RF MEMS spin out that Mike Beunder lead to a \$300m exit.

Concluding the day Bill Yost showed our startups how to find a path to the VC money and the strategy for working out how much money they will need.

The after event networking involved a small taste of Castello Redmond '23.

Then to thank our presenters for delivering such impactful semiconductor startup content packed learnings and to thank our partners for helping to deliver such a valuable ecosystem to our early stage semiconductor startups we treated them to a Burns night supper by piping in the haggis and flashing the kilt.

SiliconCatalyst.UK: Imagination Technologies



A big thank you to our Silicon Catalyst In-Kind Partner, Imagination Technologies, for hosting and partnering with us on Thursday March 30th, 2023 for a unique UK based event “Semiconductors Question Time”



We gathered approaching 100 UK Semiconductor executives in the splendid atrium of Imagination House, Kings Langley on the outskirts of London in the UK, to discuss and debate the importance of government semiconductor strategies around the world.

Sean Redmond, our UK Managing Partner for Silicon Catalyst, set the scene by asking the audience to imagine where the UK semiconductor design industry would be if the UK Government had not implemented its last semiconductor strategy in 1979. There would quite possibly have been no Inmos, which was supported by the UK government at that time. Inmos gave birth to one of the world’s first parallel processor architectures, the Transputer and a rich pool of processor design expertise. Inmos was subsequently acquired by SGS Thompson, which became ST. Hence with no Inmos, there would not have been a STMicroelectronics Bristol site. Some of our most successful fabless semiconductor startups were created by teams that cut their teeth in STMicroelectronics. Element 14, Icera and subsequently Graphcore for example may never have been created.



XMOS was also founded by an ex-Inmos genius, David May. Sir Hossein Yassaie was ex Inmos, so again there probably would have been no Imagination Technologies. Acorn’s transition to a chip design team, was fuelled by skills from Inmos, so without Inmos there may never have been an Arm.

We started the evening with a very warm welcome from Ray Bingham, Executive Chair of Imagination. He provided great insight into the accelerated progress they are making, which the strong investment backing his team has delivered. This was followed by Jim Wallace, strategic business development director from Imagination Technologies, projecting the value of their open access semiconductor startup program.

The effervescent semiconductor industry analyst Malcolm Penn blew our ears off with a rollercoaster ride through his semiconductor industry four horse men of the apocalypse forecast analysis. It certainly doesn’t look like any one of the horses will save the day in ‘23.

Silicon Catalyst UK Ltd has been commissioned by the UK government Department for Science, Innovation & Technology (DSIT) to undertake a study into infrastructure

SiliconCatalyst.UK: Imagination Technologies



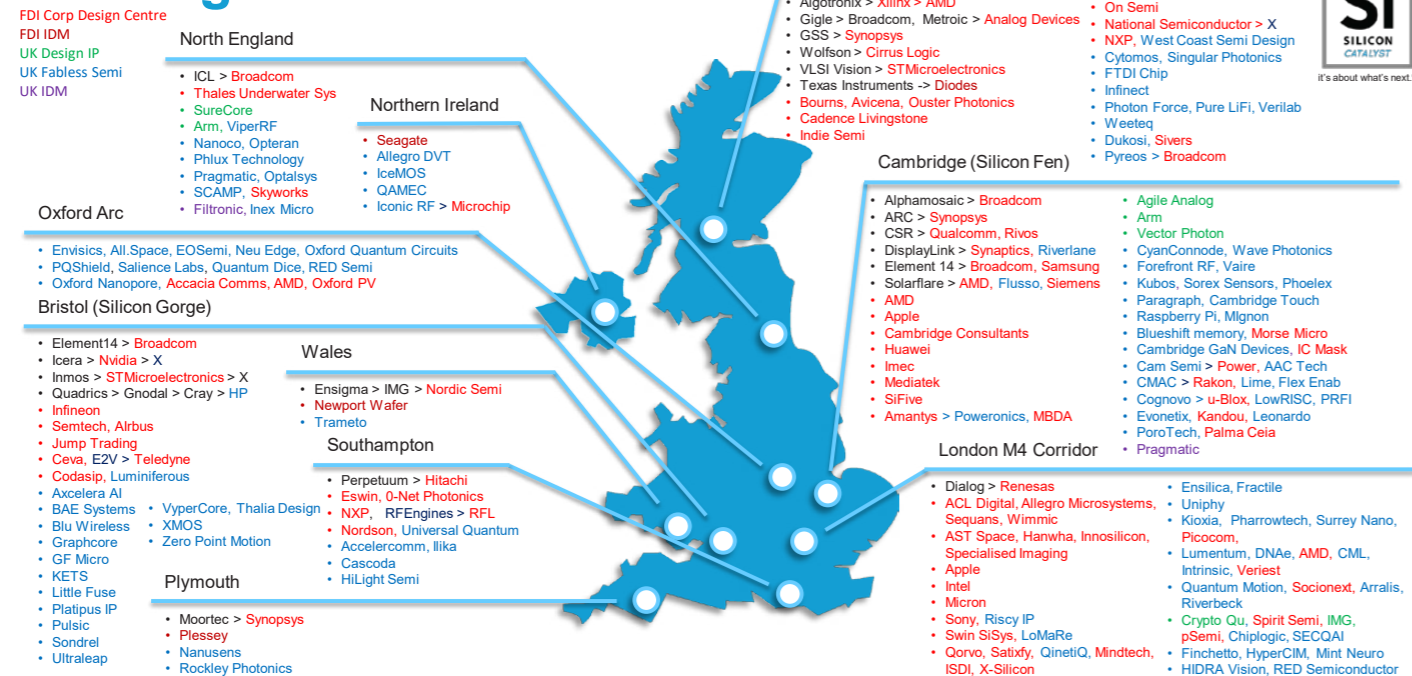
to grow the UK semiconductor industry and a new strategic coordination function for the sector. Sean Redmond, our UK Managing Partner, shared with the audience the vibrance of the UK IC design company landscape by presenting a cluster map of 193 unique companies shown across the UK, many with multiple sites.

The event then launched into the first panel discussion of the afternoon, chaired by Sean Redmond, by challenging the panel with debating the biggest elephant in the room, government semiconductor policy interventions. Starting with a deep dive on the EU CHIPS Act from Malcolm

followed by comparisons to the US CHIPS act from the extremely knowledgeable Dr John Goodenough. Then the wonderful Giorgia Longobardi, founder and CEO of Cambridge GaN Devices, projected out the opportunities for GaN semiconductor market growing at a staggering 57% CAGR to north of \$2Bn by '27. Firmly planting the flag for the need for an open compound semiconductor fab in the UK. Our most successful UK semiconductor CEO, Jalal Bagherli, then stressed the importance of international collaboration with all government semiconductor policy interventions to make sure they all complement one another.



IC design clusters in the UK



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Helen Duncan, Chief Marketing Officer, for BlueShift Memory said "The training and advice we have received from the Silicon Catalyst ecosystem has helped us sharpen our value proposition and go to market strategy. Putting us on the ChipStart UK stage has enabled us to attract the right investors at the right time, and we believe it has provided a springboard for our future success."

Tanya Mangoma, CEO and founder of HyperCIM said "to have a founder of Arm, Jamie Urquhart, as our ChipStart UK personal Mentor is gold dust. We are absolutely delighted to be one of the chosen few to be allowed to drink from the fire hydrant of global semiconductor opportunity that SiliconCatalyst.UK is pouring into us with this fabulous fully UK Government funded incubator."

Dorian Hacı, CEO and co-founder of MintNeuro (a spin-out from Imperial College, London) said, "access to multiple licenses of Electronic Design Automation tools at no cost and free prototype runs with TSMC, the leading foundry in the world, is accelerating our go to market plan. The training, advice and support from some of the best semiconductor experts in the world today is significantly mitigating our risks to deliver our high quality implantable medical devices for neural stimulation of the brain much faster than we thought possible. This fully funded UK Government ChipStart UK incubation, delivered by SiliconCatalyst.UK, is providing a clear path to our initial seed investment. It is providing demonstrable risk reduction in every aspect of our business plan."

James Lewis, CEO of RED Semiconductor, said "winning a coveted place on the ChipStart UK semiconductor startup incubator delivered by SiliconCatalyst.UK has been pivotal for our go to market strategy. The semiconductor industry specific deep dive training has refined our business plan. The global market leading customers and partner opportunities that Silicon Catalyst has delivered to us are game changing."

"The Silicon Catalyst ecosystem delivered through the superb ChipStart UK semiconductor startup incubator has been of immense support during our spin-out process from Edinburgh University," said CEO and co-founder of Singular Photonics, Shahida Imani. "Their In-Kind Partners have provided free EDA tools and access to advanced TSMC foundry runs. Their advisers have built mutual respect and trust up and down the supply chains that we need to build our business in, and their deep knowledge and advice has been seminal to attract our first pre-seed investment."

Vaire is the first chip company in the world to deliver on the promise of near zero energy AI compute. "We have made connections into the global semiconductor industry that would have been near impossible without the help of SiliconCatalyst.UK delivering this fantastic ChipStart UK incubation programme," said Rodolfo Rosini, CEO and co-founder.

The second panel session of the afternoon was chaired by our gregarious Silicon Catalyst Managing Partner from Israel, Moshe Zalcborg. Russell Haggart, one of our UK based Silicon Catalyst advisors, talked about the near extinction event of Silicon Valley Bank. The brilliant Vaysh Kewada, CEO of our UK portfolio company Saliency Labs, enthused about the help she received from Silicon Catalyst to help raise her very successful seed round. Followed by James Cannings, the CEO of one of newest UK portfolio Companies QPT, gave his insights into the very attractive tax benefits on offer in the UK from the

Seed Enterprise Investment Scheme. Before opening the floor for questions, Ian Lane from one of the UK leading semiconductor VC's, Cambridge Innovation Capital, gave a very clear explanation of how startups can use convertible loan notes.

The event was capped off with very productive networking over a splendid buffet dinner and enthusiastic sampling of Castello Redmond '22 made organically in the UK from Montepulciano grapes imported from Abruzzia in Italy by our Managing Partner, Sean.



SILICON CATALYST ADVISOR PROFILE PROFESSOR JOHN GOODENOUGH

Sean Redmond, Silicon Catalyst UK Partner, had an opportunity to speak with Professor Goodenough to discuss his current position at University of Sheffield, and his stellar career in the semiconductor industry

Professor John Goodenough is Chair in Microelectronics at Sheffield University. He was previously VP Research Collaboration at Arm and had been with the company for 20 years. He has held a number of executive technology management roles in engineering, design automation M&A and IT Services. Reporting to the CTO at Arm, John's focus was on the external research ecosystem working to both support their activities and accelerate the technology roadmaps at Arm. John has long been a champion of Design Enablement to drive best in class integration and interoperability of Arm's technology and has previously served as Board Director of various Design Automation standards groups. He was principle investigator for AISS, a major collaborative DARPA program which addresses several aspects of rapid turnaround design and deployment methodologies for the secure SoC Device. Dr Goodenough Holds a BSc from Durham University and a PhD in VLSI Architecture from the University of Sheffield.



JOHN GOODENOUGH, PH.D.
DEPARTMENT CHAIR IN
MICROELECTRONIC SYSTEMS,
ELECTRONIC AND
ELECTRICAL ENGINEERING,
SHEFFIELD UNIVERSITY
<https://www.sheffield.ac.uk/>

I started my engineering journey by solving puzzles. As a child, I dismantled radios and discovered their secrets. In university, my fascination grew as I explored the intricate system stack. I began programming microcontrollers, igniting my passion for the interplay between code and hardware. This drive eventually led me

to pursue a PhD in VLSI. The rest is as they say 'history'.

YOU SPENT MOST OF YOUR CAREER WORKING FOR OUR SILICON CATALYST STRATEGIC PARTNER, ARM. WHAT WOULD YOU SAY WERE THE TOP REASONS FOR THEIR GLOBAL SUCCESS?

Customer needs are the primary focus for Arm, an IP provider that thrives on the success of its customers. Arm's prowess as a business lies in its ability to understand and meet customer needs effectively. Another key strength is their collaborative approach, working harmoniously within the entire ecosystem to achieve mutual benefits. The company's relentless emphasis on its people and culture remains fundamental, even amidst organizational growth. Interestingly, Arm's technologies, though significant, take a backseat to the critical factors that truly shape its success.

YOU'RE ONE OF THE RARE SEMICONDUCTOR LEADERS THAT STARTED AS A UNIVERSITY LECTURER AND YOU TOOK ON THE CHALLENGE OF STARTING YOUR

Running a business is like solving a puzzle where technical obstacles are just the beginning.

SILICON CATALYST ADVISOR PROFILE PROFESSOR JOHN GOODENOUGH

Sean Redmond speaks with Professor John Goodenough

OWN BUSINESS, INFINITE DESIGNS. WHAT ADVICE WOULD YOU GIVE TO UNIVERSITY RESEARCHERS AND LECTURERS WHO ARE THINKING ABOUT STARTING THEIR OWN COMPANY?

Embrace the challenge! Running a business is like solving a puzzle where technical obstacles are just the beginning. You'll also navigate the intricate tasks of building your ecosystem, presenting products, and managing finances. Fearlessness comes from a curious and open mindset, welcoming every new challenge. Embrace the unpredictable journey, for it rarely unfolds as expected. Stay open to experiences, learn from them, and keep moving forward with unwavering determination.

WHAT IS IT THAT DREW YOU TO JOIN AS A SILICON CATALYST ADVISOR?

The essence lies in the power of the Silicon Catalyst ecosystem and network. Transitioning from the States to the UK, it becomes a gateway to tap into that very ecosystem. Within

it, you find a cohort of advisors embodying the entire spectrum of the semiconductor world. Accessing these networks is like discovering a remarkable shortcut. Picture yourself entering a room where someone can answer any question about the past 50 years of the semiconductor industry, encompassing all technologies, business ideas, models, and even learning from past mistakes. Personally, this is immensely valuable as I still harbor curiosity. Lately, I've been diving deep into silicon carbide and gallium nitride, engaging in conversations with experts in the UK's compound semiconductors realm. Regardless of your starting point, you gain access to individuals with lived experiences, comprehending all facets of the Silicon Catalyst ecosystem. This collective strength not only encompasses technologies but also encompasses insights on running startups, sales strategies, ecosystem-building, market share acquisition, and fostering collaborations. It's a network characterized by an open culture, where advisors are candid, allowing for fruitful challenges. Engaging with mentors who provide genuine insights

into reality is truly rewarding.

AFTER WORKING WITH ARM, THE WORLD'S LARGEST AND MOST INFLUENTIAL SILICON DESIGN IP COMPANY, WHAT DO YOU SEE AS THE MOST EXCITING THINGS COMING TO THE INDUSTRY?

While the demise of Moore's Law is not imminent, there's an intriguing prospect of how to adapt when Dennard scaling eventually fades away and feature sizes become uncertain in the next 5-10-15 years. It's not just about the speed in the traditional Intel sense; instead, we'll modify instructions to meet the performance demands of new applications, subsequently altering the process technology. The path we're heading towards involves integrating silicon with compound devices, each possessing unique characteristics like high-power switching or optical sensing capabilities. This era of heterogeneity presents a fresh canvas for exploration. Architecturally, we can ponder techniques to optimize device size, leveraging the diverse range of materials available to us today.



John Goodenough

Embrace the unpredictable journey, for it rarely unfolds as expected.



Blueshift Memory

New memory architecture accelerating compute and reducing energy consumption, overcoming the Von Neumann bottleneck

Company Overview

Blueshift Memory Limited is a fabless semiconductor IP company based in Cambridge, UK. It has developed a novel proprietary high-speed memory architecture that is capable of accelerating data-intensive applications like AI and Big Data, while significantly reducing energy consumption.

Blueshift Memory's award-winning Cambridge Architecture addresses the growing problem that data transfer between the core and the memory has become the limiting factor in computational speed. As computing workloads become more data-intensive and structured, our solution can typically speed up calculations 300-fold, reducing latency to zero and saving up to 90% of energy consumption.

Problem

The Von Neumann Bottleneck, or Memory Wall, is a well-known problem holding back the performance of digital systems, due to the evolution of memory hardware having been unable to keep up with advances in processor technology. This means that computer system throughput is limited in its ability to achieve top rates of data transfer due to the relative ability of memory compared with that of processors. The problem becomes even more pronounced when multicore CPUs are used.

Solution

Our self-optimising memory is aware of the data structure and can manage it actively. Reducing traffic across the data bus means that calculations can be performed up to a thousand times faster in certain applications. Because a huge amount of energy can be consumed by unnecessary data movement, the Cambridge Architecture also reduces energy consumption by up to 90%. A particular benefit is that by integrating our IP into legacy DDR3/4 devices, they can compete on speed with DDR6 at a lower cost, extending their product lifecycle.

Market Opportunity

The global DRAM market was valued at \$107.7 billion in 2023. Blueshift Memory is specifically addressing the IP market for Memory Controller IP for CPUs and Memory IP for DRAM and HBM, which together make up a SOM that is forecast to grow at 21.8% CAGR to reach \$1 billion in 2028.

Business Model

Beach Head Products:

- FPGA with CXL-ready CPU/chiplet-modified DIMM into data centre/cloud, running in-memory database software – subscription model
- IP to RISC-V vendors – licensing/royalties

Long Term:

- Memory controller IP to CPU and GPU manufacturers – licensing/royalties
- Memory IP to DRAM manufacturers – licensing/royalties



Blueshift Memory

Milestones

- Successful completion of £500k Innovate UK Smart Grant project, resulting in FPGA demonstrator module – June 2023
- Two US and EU regional patents
- Presented technology at Flash Memory Summit, awarded Most Innovative Memory Technology at Best in Show Awards – August 2023
- Established links in Taiwan via Innovate UK GBIP mission – September 2023
- Selected for ChipStart UK first cohort 2023-24
- Selected for Taiwan Tech Arena South incubator – Spring 2024

Team

- **Peter Marosan, Founder, CEO and CTO** - ELTE Scientific University; Budapest; Hungarian Academy of Science (ESA project); Econet; UGS
- **Dr. Theodore Omtzigt, Founder and Advisor** - Delft University of Technology; Yale University; Nvidia; Intel
- **Kitrick Sheets, Founder and Chief Systems Architect** - University of Illinois-Champaign; Purdue University; Bell Labs; Supercomputer Systems; Chen Systems/MCSB Technology; Cray Supercomputer Systems
- **Guillaume D'Eyssautier, Lead Board Advisor** - SEP, INSEAD; Matra Harris Semiconductors; GEC-Plessey Semiconductors; Rockwell Semiconductor; IBM Technology; Cadence; picoChip (now Intel); UltraSoC (now Siemens); ADD Semiconductor (now Microchip); Koble
- **Helen Duncan, Chief Marketing Officer** - University of Leeds; Plessey 3-5; ROHM Semiconductors; United Business Media
- **Dr. Sarmad Adeel, Senior Embedded Design Engineer** - Hamburg University of Technology (TUHH); NXP Semiconductors
- **Sarah Bayliss, Finance Manager** - University of Northampton; Harting UK Limited

Board Advisors:

- Dr. Ron Black
- Rupert Baines
- Dr. Audrey Stone
- Allan Cattle
- David Stewart (ChipStart advisor)

Ask

Seeking \$4 million seed round to develop a chiplet and SoC, and to take the technology to market.



Finchetto

Developing the world's first entirely passive, packet aware, network switch for telecoms, data centres, and high-performance compute users to significantly improve performance and lower energy consumption

Company Overview

Finchetto develops light-speed photonic processors and network switches that enable faster, more sustainable computation.

Finchetto has developed the world's first fully-optical network switch – i.e. there is no electronic control of the switching. This brings a step change in performance for data centres, high-performance compute & AI, quantum and telecommunications networks, sorely needed in the face of current/ future workloads and for future compute challenges.

Finchetto has demonstrated a prototype that reduces latency by 40x and energy by 26x vs. state-of-the-art and is working with Intel and British Telecom as design partners to deliver its vision.

Problem & Solution

Globally, data centres currently consume 3% of the world's energy. In 5 years' time, data centres are forecast to consume energy equivalent to the 5th largest energy-consuming country in the world. Within that, AI will account for the 23rd largest. AMD's CEO recently highlighted that the next generation of supercomputer would consume the energy of 21 nuclear power plants.

Network switches account for 30% of this energy consumption and this has grown 22x since 2010. With Germany passing the Energy Efficiency Act in September 2023, regulations mandating caps on data centre energy consumption are now real. Energy efficiency is a requirement. Furthermore, reducing network switch energy consumption by 10x would save over \$300bn in opex to global data centres.

Finchetto's switch delivers a 26x reduction in network switch energy consumption vs. state-of-the-art.

High-performance compute (HPC) & AI workloads require ultra-low latency networks to connect hundreds and thousands of processors at speeds of 100Gbps, and into the future, 400Gbps, 800Gbps and 1.6Tbps. State-of-the-art network switches have latencies of up to 2 microseconds. Removing the latency bottleneck in these systems will enable higher parallelisation of compute and faster response times for large-scale AI models that are unachievable today.

Finchetto's switch delivers a 40x reduction in latency vs. state-of-the-art.

Business Model

Finchetto is building first products for commercialisation in 2025 and will look to licence for scale.



Finchetto

Recent Achievements

- Demonstrated technology: 3-port prototype, 48-port due end March '24; ethernet protocol (layer 2 packet switching); <50ns latency (propagation delay); switching speed equal to speed of surrounding transceivers (reconfiguration time); 38W power (used for SNR amplification)
- Design partner work ongoing with Intel for extreme-scale compute. Network simulation and benchmarking of ultra-high port count.
- InnovateUK SBRI Future Telecommunications grant awarded £1m to develop telecoms-specific switch for British Telecom – project runs Mar '24-Mar '25
- Accelerator programmes: ChipStart UK (Silicon Catalyst); Intel Ignite; UK Quantum Business Incubator (STFC Harwell Campus).

Team

- **Mark Rushworth, CEO** - two-time founder, whose first DeepTech company, SageTech Medical sees its products used across the NHS, private sector hospitals and veterinary clinics. Mark holds certificates in integrated photonic chip design and is a member of the UK Government's Optical Communications and Photonics Expert Working Group.
- **Michael Pearcey, CTO** - inventor of the core IP, developed Finchetto's technical demonstrators, prototypes and software interfaces. Michael is a specialist in non-traditional computer systems architecture, programming network protocols and public key cryptography.
- **Nick Ray, Chair** - experienced CEO and Chair. 4x exits, two as founder CEO, two as turnaround CEO.



HyperCIM

HyperCIM

Enabling Enterprise software efficiency through unified compute and memory, delivered on a processor in-memory that is 100% compatible with enterprise software and infrastructure.

Company Overview

Established in 2023, HyperCIM's mission is to enhance power performance for petabyte-scale data processing via in-memory computing. Our technology significantly reduces software execution time and server power consumption, promising over 10x performance improvements, enabling cleaner, faster petascale data processing. Designed for seamless integration with existing server and database infrastructures, our accessible solution amplifies data handling capabilities in sectors such as financial services, banking, e-commerce, telecommunications, online gaming, and streaming services.

Problem

Backend developers and data engineers are increasingly challenged by managing data-intensive tasks due to growing data volumes and outdated computing architectures. The separation of memory and computation in current architectures leads to inefficiencies, with a significant portion of energy and time spent on moving data rather than processing it. This has resulted in performance bottlenecks, high energy consumption, and extended execution times. Our survey of over 300 application users and database management professionals overwhelmingly shows a critical need for a more efficient, seamlessly integrated database processing solution.

Our Technology Solution

At HyperCIM, we are developing a non-volatile computing in-memory chip that integrates with DDR DIMM architecture and is complemented by a software plug-in to ease customer integration. By processing computation closer to data storage, our technology significantly reduces unnecessary data movements, power consumption, and latency, while simultaneously freeing up CPU capacity. Our hardware architecture is agnostic to the in-memory logic programmed into the chip, with our initial product focusing on a subset of heavily memory-bottlenecked functions in open-source libraries that we have identified to be the most commercially relevant. Our strategic focus on a small number of critical functions enables us to target the most crippling bottlenecks customers face in computing, while the use of TSMC's developed non-volatility of the memory positions us as a kingpin in bringing sustainable compute technology to everyday enterprises, poised to scale with the growth of big data.

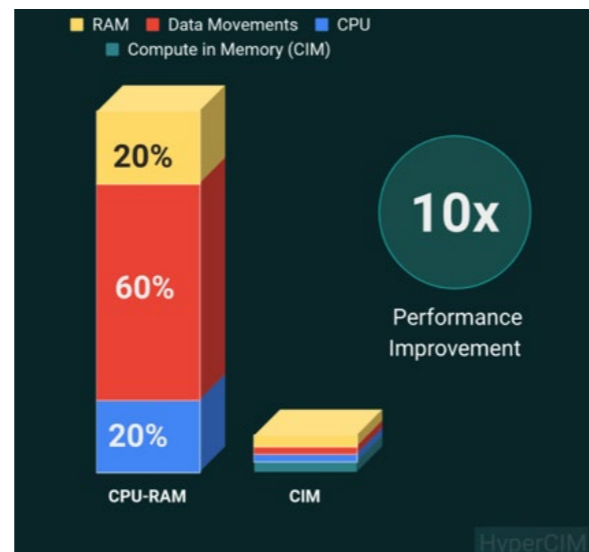
Market Opportunity/Size

The market for database management chips stands at an estimated \$90 billion. With HyperCIM's targeted solution for servers handling large volumes of data, the company sees a Serviceable Available Market (SAM) of \$55 billion. With strategic pricing and targeting, HyperCIM projects an attainable Serviceable Obtainable Market (SOM) of \$920 million within five years.

Business Model

Revenue model: HyperCIM aims to operate as a business-to-business (B2B) entity, focusing on direct product sales of compute-in-memory ICs built in standard CMOS with core logic and minimal adder for non-volatile ReRAM memory. Our primary targets are companies processing large volumes of data on-premise using open-source data management and analytics software, with our primary customers being server manufacturers (OEM and ODM).

Distribution method: In the initial phase, our sales will be handled by an in-house team that focuses on pre-identified target companies. After securing Series B funding, we plan to expand our distribution channels, while still engaging in direct sales for larger accounts. By the time we reach Series C, our goal is to form partnerships with cloud service providers like AWS, Google Cloud, and Azure to further expand our distribution reach beyond on-premise



HyperCIM

HyperCIM

Competition

Several solutions for data processing performance challenges include distributed computing platforms like Hadoop or Apache Spark, GPU acceleration, and cloud data warehouses. However, these involve high costs and complexities. Our technology offers easy integration and energy-efficient processing, emphasising server-based, digital solutions for centralised data centres. Unlike competitors, we focus on nonvolatile, application-specific solutions for efficiency and scalability, prioritising RAM for high-bandwidth tasks. Unlike companies focusing on machine learning, we address a broader range of data processing tasks without AI-centric limitations, offering a flexible solution for large data workloads. This highlights our capabilities for broad market adoption and sustainability.

Milestones

- Q4 2023: Validation and Market Need: Conducted surveys getting responses from over 300 algorithm end-users and database professionals, validating strong demand and identifying expansion sectors.
- Q4 2023: HyperCIM Incorporation: Officially established, setting the stage for technological innovation and growth.
- Q1 2024: Strategic Alliances: Partnered with TSMC and IMEC, enhancing product development and commitment to quality.
- Q2 2024: System Simulation: Achieved first pass system-wide simulations, proving software-hardware integration effectiveness.

Team

- **Dr. Tanya Mangoma, Founder** - Expert in Emerging Computing Hardware. Founder in Residence at Deep Science Ventures. 2x repeat founder. Ex-Dyson, University of Cambridge, University of Manchester.
- **Dr. Ashraf Lotfi, Director and Advisor** - 40+ years of experience in Semiconductor Technology. CEO and Founder of Enpirion, Inc. (acquired by Intel), ex-VP & CTO at Intel New Technology Ventures, with a background in strategy and M&A; ex AT&T and Bell Labs.
- **Dr. Brock Doiron, Advisor** - Ex-CEO and Founder of Xonai (a DSV portfolio company specialising in big data compilers), expert in tech markets, PhD in Device Physics from Imperial College London.
- **Jamie Urquhart, Advisor and Mentor** - Co-Founder and former COO of Arm Ltd, 40+ years in semiconductor tech, 16+ years in venture capital.

Ask

Fundraising: HyperCIM is in the process of closing its pre-seed funding round and is preparing for a seed funding round to accelerate product development and market penetration. In Q2 2024, we plan to launch our seed funding round, targeting approximately £3.3 million. We welcome discussions with interested investors who wish to be part of our journey.

Partnerships: We have partnered with leading chip manufacturers and are ready to forge new partnerships with hardware vendors, including OEMs and ODMs. As we aim for seamless integration of our technology, we want to ensure we are developing to scale within the existing ecosystems. We invite interested parties to connect with us and explore potential synergies.



Literal Labs

A new generation of energy efficient AI

Company Overview

Literal Labs is developing fast, low-energy AI algorithms using a new technique based on Tsetlin Machines. The company is the result of collaborative research between Newcastle University and the Center for AI Research at Agder University in Norway. Literal Labs was spun out from Newcastle University 2023.

Problem

AI today is mostly based on neural networks and although these have proven to be very powerful and flexible, they are also very compute-intensive. At the heart of a neural network is a complex algorithm requiring large amounts of multiplication. The industry started to repurpose graphics processors to process neural networks since GPUs are large arrays of multipliers. The problem is that GPUs are expensive in terms of silicon cost and energy consumption. Many companies and organisations have created optimisations and proposed new architectures to try and solve this problem with varying degrees of success. However, none have managed to stop the burgeoning power demand from AI. So-much-so that it is limiting the ability to further enhance AI and limiting its usage in everyday devices.

Technologies that optimise neural networks can achieve small incremental improvements but to fundamentally tackle the energy problem that AI is creating we have to look at the underlying algorithm.

Literal Labs is bringing to market a new approach that can deliver similar levels of AI at orders of magnitude less energy using a combination of propositional logic and Tsetlin Machines.

Our Technology

Literal Labs technology is as a result of a collaboration between Newcastle University and the Center for AI Research at the Agder University in Norway into the use of Tsetlin Machines combined with propositional logic.

Literal Labs have developed a novel approach to machine learning that reduces the computational effort to achieve accurate AI classification in edge devices. The technology promises to deliver better energy efficiency, lower device memory footprint requirements and faster classification than the traditional neural network approaches. Additionally, the technology is explainable something that the traditional neural network approaches struggle with. This will dramatically expand the markets, cost and performance points that can use machine learning and AI.

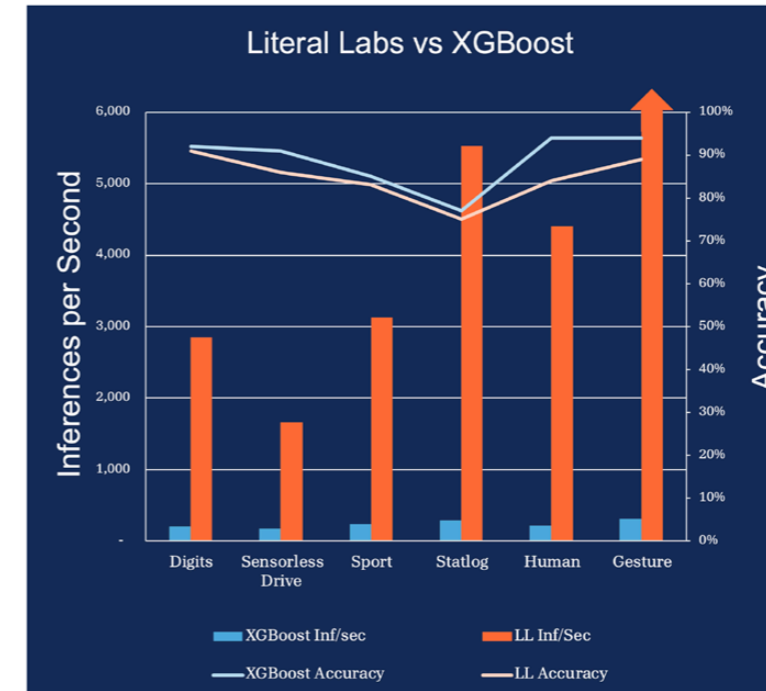
Literal Labs are developing tools to allow OEMs to deploy these techniques on existing silicon. Enabling the deployment of fast efficient AI without costly upgrades.

Initial Market

Literal Labs will initially target the EdgeAI market where compute resources are highly constrained. The edge AI market size was valued at USD 11.98 billion in 2021 and is expected to reach USD 107.47 billion by 2029, exhibiting a CAGR of 31.7% (source <https://www.fortunebusinessinsights.com/edge-ai-market-107023>)



Literal Labs



The graph compares the Tsetlin machine approach vs XGBoost and classic machine learning algorithm using the same hardware. The Literal Labs results show that it is able to achieve similar levels of accuracy but a speed up of up to 250x showing that this approach is computationally far more efficient.

(See for more details <https://cft.docsend.com/view/t6ucp2z4f62niskjf>)

Team

- **Noel Hurley, CEO** - Ex-ARM and processor exec of 30 years. Cofounder of XMOS semiconductors
- **Prof Alex Yakovlev, Co-founder** - Professor at Newcastle University, authority on low-power design, stemming back to his PhD in Mikhail Tsetlin's lab in St. Petersburg
- **Dr. Rishad Shafik, Co-founder** - Reader in Machine Learning Systems and Director of the Stephenson AI Lab at Newcastle University

Ask

Literal Labs is looking for partners and customers who can help it bring this potentially significant technical development to market so that the promise of ubiquitous AI can be delivered without costing us the planet.



MintNeuro

Empowering next-generation neural implants with advanced semiconductor technology

Company Overview

MintNeuro, founded with the mission to revolutionize the treatment of neurological conditions, is developing medical-grade, integrated devices aimed at making neural implants more compact, less invasive, and widely accessible. Positioned at the intersection of cutting-edge semiconductors and neural interface technology, MintNeuro seeks to address the critical challenges faced by medical device manufacturers and healthcare providers in managing neurological conditions.

The Problem

Despite the clinical successes achieved by current neural implants, they face significant limitations that have restricted broader adoption and hindered progress in addressing areas of unmet clinical need. Often characterised by their considerable size, these implants rely on outdated, power-intensive electronics that limit their functionality and performance. In addition, the extensive surgical procedures required for implantation not only present considerable risks to patients but also require a high degree of surgical expertise.

Compounding these issues, the path from concept to market for new neural implant devices is filled with inefficiencies that are difficult to justify. Development and validation phases are typically marked by prohibitive costs, frequently exceeding hundreds of millions of dollars, and timeframes that can extend beyond a decade before reaching the market.

The Solution

MintNeuro proposes a solution that harnesses the power of advanced semiconductor technology to overcome these obstacles. By focusing on the development of small, ultra-low-power, and integrated circuits and systems, MintNeuro aims to enhance the functionality, efficiency, and reliability of next-generation neural implants. These next-generation devices will be minimally invasive, enabling mass scalability and versatile application throughout the nervous system for a range of conditions. They promise not only to enhance functionality and performance, but also to offer wireless operation and real-time personalization of therapies, surpassing traditional treatments in convenience and compliance. Through a phased strategy that includes reconfigurable functional blocks for rapid custom circuit design, heterogeneous integration for system efficiency, and advanced chip-scale packaging for miniaturization, MintNeuro is poised to make neural implants more cost-effective, scalable, and accessible.

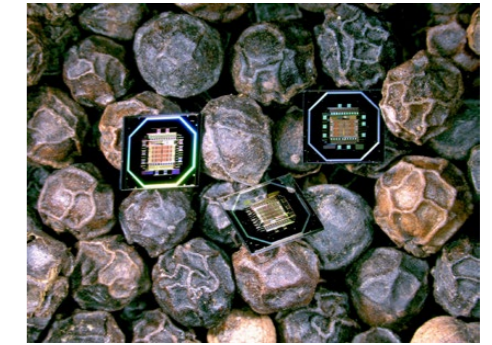
Technology

At the core of MintNeuro's innovation lies its sophisticated technology, which leverages semiconductor advancements to introduce new capabilities and performance enhancements to medical devices. The company's chipset offers bidirectional interfacing, scalability to larger channel count systems without the need to re-engineer silicon, and rapid customization through silicon-verified IP blocks.

MintNeuro's approach combines neural-optimised IC design with medical quality controls and innovative packaging methods to minimize risk and achieve the fastest industry turnaround, making possible a seamless transition from benchtop to clinical deployment. This efficiency is then translated to mass manufacture, leveraging the economies of scale inherent in the semiconductor industry. The performance of MintNeuro's silicon in terms of power consumption is best in class across all commercially available medical-grade integrated circuits. This excellence is further enhanced by a compact silicon footprint and a development roadmap that promises a 1000x reduction in implant size.

Market Opportunity

The global cost of neurological conditions exceeds \$3 trillion annually, representing a significant burden on healthcare services. The total cost of these disorders in Europe alone is on par with the combined costs of heart diseases, cancer, and diabetes. Currently, the neural implant market accounts for a modest fraction of these costs, but is on the verge of an exponential rise, with the potential to significantly offset both direct and indirect expenses related to neurological conditions. The demand for active integrated circuits and systems, which are essential in sensing and stimulation of neural signals, is contributing to this market growth. The serviceable available market (SAM) for electronic components in neural implants stands at \$1.5 billion, with the overall neural implant industry (neurology segment of the active implantable medical device industry) valued at a total addressable market (TAM) of \$12 billion. In addition, the market is projected to grow at a compound annual growth rate (CAGR) of 12%.



Intellectual Property

MintNeuro's existing IP portfolio includes exclusive rights to granted patents for advanced architectures for distributed wireless neural interfaces, methods for inserting electrode-based probes into biological tissue, and systems for real-time neural spike processing within implantable devices. Moreover, MintNeuro is currently protecting several new inventions in integrated circuits and systems for neural implants, showcasing its continuous innovation in chipset architecture and system-in-package solutions for neural implant electronics. These patents address key industry challenges such as design effort, cost, and space constraints, further solidifying MintNeuro's position at the forefront of implantable neurotechnology.

Traction

As a spinout from Imperial College London, MintNeuro benefits from a decade of research and development at Imperial, along with continued access to more than £10 million worth of facilities tailored for the design and prototyping of neurotechnology. Pre-formation, the company's academic achievements include securing over £4 million in research funding, contributing to the publication of more than 50 related papers and the filing of four patents. Additionally, MintNeuro received £300k in translational and enterprise funding from RAEng and UKRI, supporting the foundational stages of the company, including founder training, venture building, and the spinout process. Since 2023, MintNeuro has actively engaged with the venture ecosystem to accelerate its growth and market introduction. The company has secured over £900k in direct grants and subsidies, including funding from the NIHR and Innovate UK, and participation in programs such as the Biomedical Catalyst Neurotech Accelerator and ChipStart UK programme. This engagement has not only provided financial support but also valuable industry connections and resources.

Business Model

The revenue model is structured around direct device sales and customisation NRE fees, aiming for phased market penetration and revenue growth. Initial offerings focus on neural interface chipsets, progressing to more integrated system-in-package solutions, and eventually culminating in comprehensive neural implant platforms. This product evolution is geared towards increasing functionality and reliability while minimizing size, power requirements, and complexity. The pricing and customisation fees are set to reflect the value provided at each stage, reaching significant annual revenues as the product line matures and industry demand increases. At the core of MintNeuro's business model are medical device manufacturers, the primary customer segment for its range of products. Third-party developers, e.g. CDMOs and neurotechnology research institutes, play crucial roles in bridging the gap between MintNeuro's innovations and key customers.

Team

The team behind MintNeuro, comprising experts in microelectronics, neuroscience, and medical devices.

Leadership team:

- **Dr. Dorian Hacı, CEO** – PhD in Neural Implants, RAEng Enterprise Fellow, 8+ years in microelectronics for medical devices, 3+ years in venture building and enterprise programs.
- **Prof. Tim Constandinou, CTO** – Professor of Bioelectronics at Imperial, group leader at Dementia Research Institute, key opinion leader in next-gen neural interfaces, 20+ years in neurotechnology and implantable medical devices, early experience working for startups.
- **Prof. Andy Jackson, CSO** – Professor in Neural Interfaces at Newcastle Uni, managing a non-human primate (NHP) lab at Newcastle, 20+ years in researching Brain-Computer Interfaces, neural prosthetics, movement neuroscience, epilepsy, and sleep.
- **Prof. Tim Denison, Chair** – RAEng Chair in Emerging Technology and Professor of Engineering and Clinical Neurosciences at the University of Oxford, former VP of Core Technology at Medtronic, 20+ years' experience in the medical device and semiconductor industries.

R&D and translational team: Dr Ian Williams (R&D), Dr Peilong Feng (wireless tech), Jonathan Casey (product quality), Andrea Mifsud (IC design), Dr Adrien Rapeaux (neural engineering), Dr Katarzyna Szostak-Lipowicz (regulatory affairs), Dr Matthew Cavuto (mechanical engineering), Martin Lombard (design engineering).

Business Advisors: Carlo Guareschi, David Skellern, Chris Tomazou, Bob Enck.

Scientific and Clinical Advisors: Konstantin Nikolic, Will Muirhead, Antonio Valentin, Ioannis Stavropoulos.

Red Semiconductor

Solving global challenges in encryption, security & AI at the Edge

Company Overview

RED Semiconductor is a UK-based start-up developing ground-breaking microprocessor architectural improvements to meet the rapidly growing demands for algorithmic processing driven by tech megatrends like AI, Autonomous Systems, Metaverse, and Data Security/Privacy.

The company has been grant-funded to date enabling its technology to be developed to proof of concept through software simulation, and is now seeking equity investment to expand the team and complete the transition to hardware demonstration, and then to develop high performance test chips, enabling customers to evaluate and realise the benefits of RED's VISC technology.

The Problem

Incumbent microprocessor architectures have relied on Moore's Law for continued performance improvement through faster clock speeds enabled by smaller geometry silicon processes. Today the cost and resource requirement to move to latest process geometries is outside the scope of all but the largest companies, and even then the performance gains are diminishing. Coupled with this, the entire world of processing is changing rapidly, with the use of ever more complex mathematical algorithms in applications like Artificial Intelligence and Cryptography.

Clearly a whole new approach to microprocessor architecture is ideal.

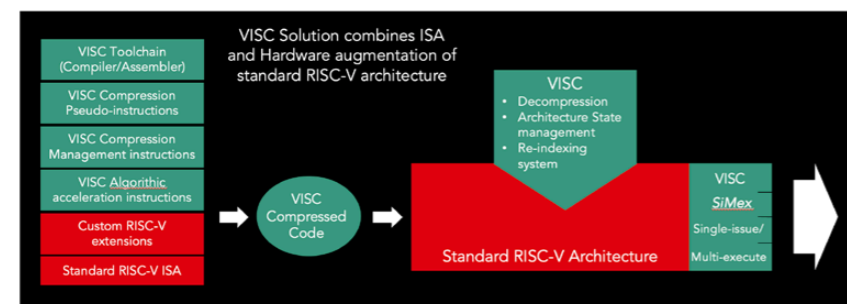
RED's Solution

RED Semiconductor has invented a new approach to algorithmic computing whereby software code is compressed using special vectorisation techniques in the instruction set, and corresponding decompression in the microprocessor hardware. This enables a holistic execution approach, enabling a single-issue instruction pipeline to simultaneously execute multiple vector elements in parallel. This delivers clear benefits in our customers' product development and deployment:

- Complex code is compressed by 10-100x
- Run-time performance of complex maths is boosted by 10-100x
- Silicon area increase is minimal and performance boost does not rely on latest silicon geometries, minimising the cost of the performance gains
- Power consumption is cut due to memory efficiency
- Design and development time for products is cut due to reduced size of code and complexity of debugging
- General purpose architecture means that heterogeneous compute requirements can be met with a unified instruction set and hardware architecture

Our Technology

RED Semiconductor is developing instruction set and hardware extensions for the globally popular RISC-V microprocessor architecture that deliver 10-100x performance improvements when processing complex mathematical algorithms. We call it VISC – Vector Instruction Set Computing. Algorithms like Matrix Multiply, Discrete Cosine Transform (DCT) and Fast Fourier Transform (FFT) are ubiquitous in software for AI/ML, Cryptography, AV Codecs and many other applications. Today's microprocessor implementations for Arm, x86 and RISC-V are typically coded in hundreds or even a thousand+ instructions for these algorithms, whereas with RED's VISC technology the instruction count is reduced to just 3 for a Matrix Multiply, 8 for DCT and 24 for FFT. The compressed code once decoded in VISC hardware is sequenced for



Red Semiconductor

Complex Mathematical Computation Function examples	RED Semiconductor VISC acceleration of RISC-V	RISC-V without VISC	x86, ARM, POWER...
Matrix Multiply Ubiquitous in algorithmic computation	3 instructions (Even for prime number size matrices)	100+ instructions (more for prime-number-sized matrices)	100+ instructions (more for prime-number-sized matrices)
DCT (Discrete Cosine Transform) Universally used in Codecs	8 instructions (Uses 1 line of L1 cache – no memory accesses)	2,000+ instructions (due to loop-unrolling of every instruction)	2,000+ instructions (due to loop-unrolling of every instruction)
FFT (Fast Fourier Transform) Used in AI, cryptography, AV Codecs...	24 instructions (Uses 2 lines of L1 cache – no memory accesses)	2,000+ instructions (due to loop-unrolling)	2,000+ instructions (due to loop-unrolling)
Position POPCOUNT Used in Statistical Analysis, AI...	10 instructions	500+ instructions	500+ instructions

efficient parallel execution by the VISC execution engines, enabling run-time performance to be boosted by up to 2 orders of magnitude, while reducing the power consumption caused by excessive memory accesses that are typical of traditional microprocessors. Security of data processing is also improved due to the elimination of the hack-attack surface of memory accesses.

RED's VISC architecture can deliver benefits to any existing or new microprocessor Instruction Set Architecture (ISA). RED is initially targeting the RISC-V architecture as its use in SoCs (System on Chip integrated circuits) is growing rapidly. VISC can be bolted on to any RISC-V core, making it a maths performance-enabler across the entire RISC-V customer base, and in the future RED plans to further develop VISC for use in other architectures like Arm and x86.

RED Semiconductor is in the process of protecting a range of its key differentiating IP through patent applications.

Business Model

RED Semiconductor plans to license its core IP, and generate revenue from license fees, royalties, and customer support. Target end customers are the global major users of semiconductors, who routinely implement complex functionality into SoCs specifically used in their own products. Our routes to market may direct licensing into such customers, or in partnership with incumbent vendors of IP functions or EDA tools, serving those customers today.

Market Size

Derived from widely available market reports and forecasts, the size of RED's opportunity relates to the estimated 6 billion chips that will integrate RISC-V microprocessor architecture by 2030. These will predominantly be used in Edge, IoT and other embedded computing applications where over 70% of all data will be generated and processed. Future developments of VISC to work with other microprocessors opens up a much wider market into operating system-based computing across a whole range of applications including smartphones, wearables and smart home products.

Team

- **James Lewis, CEO** - Serial founder of semiconductor and technology businesses – Oxford Semiconductor (now Kioxia); Redux (now Google)
- **David Calderwood, Director of R&D** - Chartered Engineer with background in data comms (Phillips) and tech team-building (Calderwood-Han)
- **David Harold, COO** - Formerly CMO at Imagination Technologies
- **Andrey Miroshnikov, Architect and Engineer** - Microprocessor architect with experience at Qualcomm and Dialog Semiconductor
- **Shriya Sharma, Embedded Systems Engineer** - Southampton University
- **Steve Evans, Adviser** - Microprocessor industry expert – Arm and Imagination Technologies

Investment

RED Semiconductor currently requires investment of £3million in order to build its team of engineers and business development in order to complete the hardware development of its first RISC-V processor solution and provide lead customers with hardware and software development environment within and 18 month timeframe. Subsequent investment will take the solution to a high-performance silicon implementation enabling developers to move rapidly into product development and deployment.

SECQAI

SECQAI

Securing computation and communication to protect you from the threats of today and tomorrow

Overview

SECQAI is building a secure System on Chip, with Post Quantum cryptography and Quantum Random Number Generation, enabling confidential compute from the edge to the data centre.

Problem

Cyber attackers cause \$8 trillion worth of business impact to the global economy. It's a big headline, and something all economies are worried about. When we delve down into what this means ensuring our businesses are secure and have the opportunity to grow, companies have articulated three key problems:

- **Businesses are not prepared for the Quantum Threat:** 'Steal now, decrypt later' attacks are already occurring (Deloitte)
- **Cybersecurity is hard:** Companies need to manage an average of 76 security tools across their organisation (Panaseer)
- **It's difficult and risky to compute at the edge:** 70% of existing attacks are from preventable memory injection methods (NSA, Microsoft)

Solution

We reassessed security from the hardware level up, developing the Q-Locked System on Chip for Post Quantum Cryptography. Our customer centric approach drives us towards being the 'Apple of Security'. We're solving these three key customer problems:

- **Post Quantum Cryptography:** Enables your systems to encrypt data to a Post Quantum level, in line with NIST standards
- **All your security tools, built in:** Choose and run key edge security apps on our SOC using our management interface
- **Confidential computing at the edge:** Safely and efficiently run your models and software at the edge in your IOT devices
- **Next generation of Quantum Entropy:** Take comfort in having the next generation security supported by SECQAI's proprietary Quantum Random Number Generation on board

Use cases

- **TPM/HSM:** Adopt our SOC in your connected device, or wherever it may be. We have the right product for the level of compute you need.
- **NIC:** Protect your infrastructure with our NIC to upgrade your existing infrastructure and simplify your security footprint

The Market

The global IOT market is significant (£5,500bn in 2024) and growing at 9.77% CAGR to 2028. We see the mandated push from the US Government to transition new tech purchases across to Post Quantum Standards for National Security Systems, which we expect to see emulated across its allied nations. At the same stage, Critical National Infrastructure providers are needing to take more responsibility for their connected infrastructure. This is the regulatory push that's about to take off. When paired with the complexity of the security landscape, SECQAI's approach to simplifying that for customers means an opportunity for a strong demand pull.

SECQAI

SECQAI

First, we'll be focusing on customers across the utility, government and healthcare verticals in our key markets of the US, UK and the EU to ride this initial wave. The vision: secure communications across all connected devices, globally. The market opportunity is huge.

Business Model

With the criticality of data security, and the growth in edge compute, we sell directly to manufacturers and integrators who build innovative connected devices, on a price per unit basis.

Why Work with SECQAI?

- **Don't worry about your security implementation:** Rely on an 'all-in-one' SOC from a NATO DIANA backed company, built for the harshest environments and toughest threats. Protect your devices, and your reputation.
- **Sell more units, grow market share:** Be first to market with Post Quantum Encryption crypto agility built into your IOT products, helping you sell more and deepening the moat you need to defend against the competition.
- **Build your Security brand:** Embed SECQAI's SOC to get next generation confidential computing technology with Post-Quantum Encryption to provide differentiated security and build your security brand.

Who We Are

We're innovative physicists, engineers and developers focused on creating the next generation of hardware & software:

- 1 of 12 Start-ups in Chipstart UK (first set of funding under UK Chips Strategy)
- NATO DIANA Challenge winners for Secure Information Sharing. One of only 44 startups chosen from 1300 applicants across NATO member states. We are the only Silicon Chip provider for PQC
- Members of UK Quantum and TechUK: we inform the Quantum Security Working Groups for the UK
- Alumni members of the Plexal Cyber Runway programme, which was funded by the DCMS

Team

- **Rahul Tyagi, CEO and founder** - Quantum patent holder, designed security for UK Healthcare Org
- **Graham Harris, CFO** - C-Level/Senior positions at Microsoft Xbox, Pearson, Lionhead studios
- **Angus Lockhart, COO** - former top management consultant
- **Andrew Nicol, Hardware Engineering Lead** - headed up the FPGA Design and Verification team for Project Taara at Google X, head of Embedded Systems at Red Leader Technologies (SOC)
- **Alaeddine Jendoubi, Photonics Hardware** - expert in quantum photonics devices
- **Pavlos Aidinidis, Analogue Hardware** - high performing electrical engine
- **Anas Alsakkal, Low-power Hardware** - PhD background focused on non-conventional sensing and computing architectures

Ask

We're looking for innovate partners who want to bring the next generation of secure compute and cryptography into their products. Come and have a chat!



Singular Photonics

Imaging Time: The Fourth Dimension

Company Overview

Singular Photonics Ltd, a company with deep roots in the world leading University of Edinburgh CMOS Sensors and Systems group, are developing the next generation 4D sensors that will be the enabling technology to help diagnose, prevent and solve global environmental and health problems.

Our technology is based on single photon avalanche diodes detectors (SPADs) which can detect and time single photons (light quanta) enabling simultaneous capture of depth and temporal dimensions generating next generation 4D images. These detectors have seen their transformation from a research curiosity to a mainstream semiconductor technology with billions of SPAD devices in consumer use in mobile phones for depth sensing, autofocus-assist and more recently into LiDAR. In the near future, next generation SPAD-based detectors can be expected to play a major societal role, from wearable health, microplastic detection to hydrogen sensing further dimensions to the phone camera in your pocket.

Problem

Legacy technology such as CCD variants (CCD, EMCCD etc) and sCMOS detectors have been the established technology in spectroscopy (a technique of how we study structure of atoms and molecules) for decades but they suffer from inherent weaknesses such as requiring cooling, inability to operate in low light conditions and characteristically noisy meaning they can only capture a fraction of the meaningful data. These limitations, along with a bulky footprint, have limited their capabilities and thus are not well positioned to focus on emerging market applications that require room temperature operation, high resolution, low noise and portability.

Next generation SPADs are now allowing for the development of advanced functionality of SPAD based sensors that will help serve a broader range of market applications and overcome the limitations of legacy technologies.

Our Technology

SPAD sensors are ubiquitous in their adoption in volume markets. CMOS compatibility makes it easier to manufacture in higher volumes than legacy analogue ICCD/EMCCD/sCMOS technologies.

We have developed fast and sensitive SPAD light sensors (in line and 2D array formats) with associated readout/processing circuitry in standard CMOS technology. These sensors offer benefits in the initial beachhead markets of scientific imaging applications such as Raman spectroscopy, Fluorescence Lifetime Imaging Microscopy (FLIM), Flow cytometry.

The architecture is such that it is highly configurable and can be optimised to meet the considerable challenges posed by this wide range of applications. The SPAD sensors are packaged with integrated electronics, firmware and hardware to produce camera modules capable of interfacing to third party software to control the camera and read out data.

This will allow for easy adoption in new applications without the need to redesign (or indeed manufacture) an entirely new sensor for each application.

Market Opportunity

Raman spectroscopic techniques can be deployed in a number market applications from the analysis of microplastics to the identification of chemical properties of raw materials in the production of lithium-ion batteries to improve battery manufacturing process, to hydrogen sensing right through to non-invasive glucose monitoring.



Singular Photonics

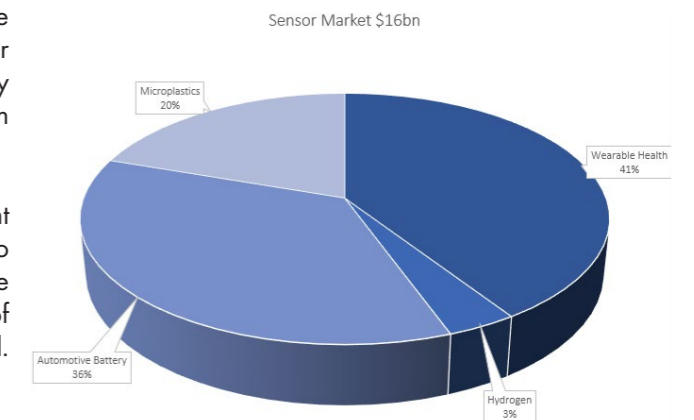
Collectively the sensor market for these applications alone are worth almost \$20Bn but is growing at an average of 13% CAGR and above to 20% in some markets. As this technology becomes more widely accessible emerging opportunities such as biomedical devices, industrial waste processing, Agritech etc., will provide further growth opportunities.

Business Model

We are fabless semiconductor company and entering the market with a portfolio of leading edge sensors.

Our initial beachhead is Scientific Instrumentation where we have already secured our initial two OEM customers. Our first sensor has been incorporated into a camera module allowing for early adoption in Raman Spectroscopy for the detection and identification of molecular fingerprints at a nanoscale.

For broader market adoption, we will accelerate the development of our next generation Megapixel 3D stacked sensor capabilities to support our vision to sell our sensors directly to the OEM in multiple markets that require state of the art capabilities for a wide range of applications such as portable and wearable health to environmental.



Milestones

- Incorporated in Feb 2024
- 3 Patents (licensed from the University of Edinburgh)
- Portfolio of 3 sensors
- Initial pre-seed funding in progress (due to close March 2024)
- Prototype product
- First 2 OEM customers secured

Team

- **Shahida Imani, CEO/CFO and Co-founder** - over 25 years in high growth start ups and exits.
- **Dr. Aravind Venugopalan Nair Jalajakumari, CTO and Co-founder** –Electronics Engineer and Chip Designer, previously ST Microelectronics
- **Pete Hutton, NXD** - Previously, President of Group Products, ARM
- **Prof. Robert Henderson, Chief Scientific Advisor and Co-founder** - University of Edinburgh CMOS labs.
- **Dr. Neil Finlayson, Applications Advisor and Co-founder**

Ask

OEM Partners looking to capitalise on emerging SPAD sensors for following applications:

- Wearable Health
- Microplastics Detection
- Hydrogen Sensing
- Process Control Equipment Manufacturers

We are seeking \$6m for our SEED funding to commercialise and deliver on our ambitious product roadmap.



Vaire Computing

Developing near-zero energy chips with reversible computing

Problem

Thermal dissipation puts a limit on semiconductor performance growth, and before the end of the decade existing architectures are not going to be able to deliver more compute per area without fundamentally changing how chips operate.

Most of the available technology choices are disruptive, require a realignment of supply chains, and ultimately just move the goalpost by a little without addressing the ultimate limit of compute presented by the Landauer's limit - meaning they can only buy limited roadmap time.

Solution

Vaire Computing is working on a new computer architecture, based on reversible computing, that can deliver near-zero energy chips operating at the ultimate physical efficiency of CMOS and deliver the next 50 years of exponential growth of computing power.

The initial use case is going to be AI inference for IoT and data centers.

Market Opportunity

Today's global computing capacity is roughly 0.01% of 2044's compute capacity. According to the IEEE semiconductor roadmap, by 2028 planar scaling is expected to end for classical computing.

Business Model

Vaire has not announced a business model nor a release date for their near-zero energy chips.

Progress to date

The company is in stealth.

Team

- **Rodolfo Rosini, CEO** - 7x founder, 5x VC-backed, 2x exited. Background in AI and defense tech.
- **Hannah Earley, CTO** - PhD from the University of Cambridge in reversible computing
- **Andrew Sloss, Senior Researcher** - founding engineer and 25-year veteran at Arm
- **Raj Singh, Board Advisor** - previously EVP at Marvell, Cavium, and 3DLabs

History

The founders of Vaire Computing met after independently researching reversible computing as a way to scale chips beyond the end of Moore's law. The company was founded in 2021, has raised multiple rounds of funding from leading US/UK VCs, and is based in London, Cambridge, Seattle, and Sunnyvale (SF), and is currently hiring.



Vaire Computing

THE FUTURE OF COMPUTING
DEPENDS ON MAKING IT REVERSIBLE

Reversible computing never received much attention.

That's because it's very hard to implement,
and there was little reason to pursue this great challenge
so long as conventional technology kept advancing.

But with the end now in sight, it's time for the world's best physics
and engineering minds to commence an all-out effort to bring
reversible computing to practical fruition

IEEE Spectrum

Enter Vaire Computing



Wave 2

Enabling rapid development for integrated photonic products

Company overview

Wave Photonics is building the platform to unleash the transformative potential of integrated photonics

Integrated photonics uses the same process used to make conventional semiconductor chips to make circuits for light. This makes it possible to take many light-based technologies from the lab and make them useful to humanity via the scalability of semiconductor processing. The first technology to exploit silicon photonics at scale is datacentre transceivers (Intel, Cisco, HPW, II-VI etc.) – this proves it can be done and paves the road for frontier technologies based on silicon photonics such as chip-scale lidar, diagnostic sensors, consumer healthcare sensors, quantum technologies, (particle accelerators!), eye scanners, inertial sensors, and a whole host of other technologies. We believe that these technologies will become much higher volume than transceivers and will be normal feature our everyday lives in the near future.

Problem

The journey from idea to product is difficult. To build a product, years of design work go into making the fundamental building-block components (waveguides, beam splitters, crossings, filters etc.) required to put together a circuit. The existing libraries of components are minimal, sensitive to process variation and poorly optimised, and those that do exist only work for a few (telecoms) wavelengths, and so are not suitable for many other applications.

Even once this hurdle has been crossed and a circuit has been designed and verified, to turn a photonic circuit into a product requires packaging, laser integration, QA and frequently, additional processing steps such as coating, the inclusion of hybrid materials or microfluidics. Currently the ecosystem is fragmented and these processes are slow and bespoke.

This comes together to mean that transformational technologies stay stuck in R&D.

Solution

Wave Photonics is building a platform based on its core computational design technology which will enable designers to take products from idea to volume using pre-designed, adaptable components and integrations with packagers and other service providers. This means they can immediately focus on their core differentiating technology.

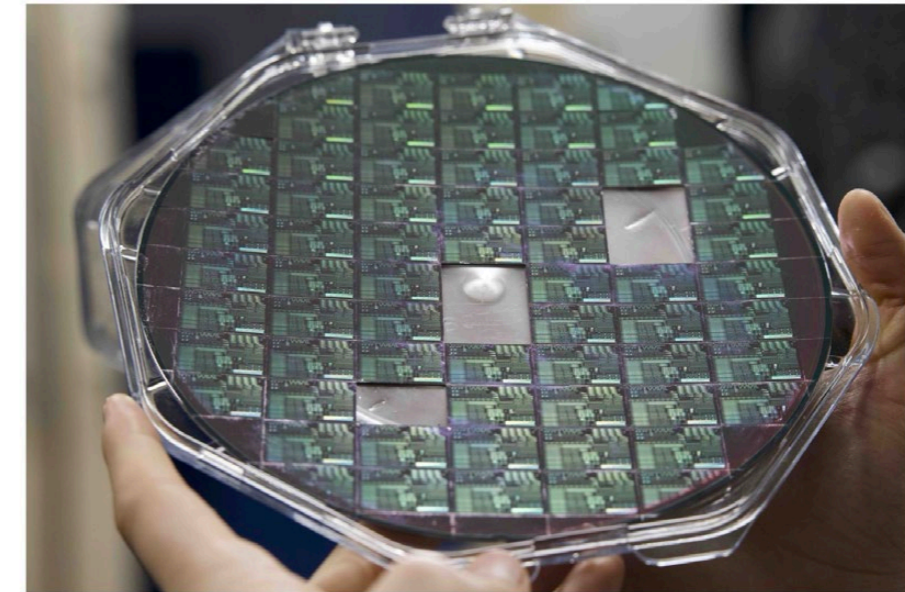
Business model

Phase 1: Licence a library of components to chip designers for a yearly annual fee, also charge fees to make small adaptations by rerunning the optimiser with different a different target. This stage will be enough to make the company profitable, but the primary purpose is to bring users onto the platform. Library is priced cheaply to encourage widespread adoption – important for phase 2.

Phase 2: Integrate with packagers, QA providers, and other service providers by including IP blocks/templates in the library to facilitate the services, then charge a portion of the transaction as a fee. This scales as silicon photonic products are produced at volume.



Wave 2



Milestones

- Technology de-risked - demonstrated and measured at a research foundry
- Awarded >£2.5M in non-dilutive Innovate UK and EIC funding
- Seed stage: building core technology into a product and market de-risking

Team

- **James Lee, CEO** - Cambridge quantum photonics PhD
- **Matthew Anderson, CSO** - Cambridge quantum photonics PhD
- **Mateusz Kubica, CTO** - former quant/quant dev, 10 years' experience
- **Jiangbo Zhu, Senior Photonics Engineer** - 10 years silicon photonics research, ~100 tape-outs
- **Friederike Jöhlinger, Photonics Engineer** - Bristol integrated photonics PhD
- **Giannis Chatzopoulos, Photonics Engineer** - Southampton integrated photonics PhD, former NPL
- **Bence Parti, Photonics Engineer** - Oxford Physics masters
- **Ming Zhang, Non-Exec Director** - Former founder, ex-Synopsys, ex-Intel, ex-Samsung, Advisor to America's Frontier Fund
- **Mark Miller, Advisor** - Repeat founder, ex-Mentor, ex-Cadence, ex-Xfab)

SiliconCatalyst.UK:
it all happens here®



Silicon Catalyst is Bringing Its Unique Startup Platform to the UK

By Mike Gianfagna | SemiWiki | From the archives

Silicon Catalyst is the world's only accelerator focused on semiconductor solutions. The organization has an extensive support infrastructure that includes preferred access to IP, design tools, business infrastructure and fab/assembly. They also provide a broad network of industry advisors and access to investment capital. In short, everything a silicon-based startup needs to get off the ground as quickly and efficiently as possible. We've covered many aspects of this special organization on SemiWiki. You can catch up on the buzz here. Read on for the details of how Silicon Catalyst is bringing its unique startup platform to the UK.

For those of us who live and work in Silicon Valley, it's easy to believe all silicon startups start here. In fact, there is ground-breaking work going on around the world. A recent press announcement detailing the newly admitted companies to the Silicon Catalyst accelerator drove home this point.



SEAN REDMOND
MANAGING PARTNER,
SILICONCATALYST.UK

Relevant questions include why the UK? And why now? Silicon Catalyst held a press briefing before the announcement that answered these, and many more questions. As for why the UK, some points were offered, below. I have added my own comments in parenthesis:

- Tremendous semiconductor talent recognized globally (remember Arm started in Cambridge)
- Top universities recognized globally (OK, we've all heard of Cambridge and Oxford)
- A history of innovation in semiconductor solutions (the UK leads the world in compound semiconductor development)
- An increasing number of UK

startups have found Silicon Catalyst and applied to the accelerator (Trameto/Wales, Saliience Labs/Oxford are currently in the program)

As for why now, I think the answer is clear. Moore's Law is slowing – migration to the next process node is still important but a lot more is needed to keep things moving at the typical exponential pace. Hyper-convergent design solutions are the way forward. The intersection of multiple technologies in a dense and highly advanced package. Fueling this kind of innovation means new technology and new architectures. This is where startups make significant contributions and the support

provided by Silicon Catalyst is making a big impact on the whole ecosystem – my opinion. To wrap up these questions, Silicon Catalyst explained that there are three new In-Kind Partners joining from the UK. These are the folks who provide all the support mentioned previously. They are: **Agile Analog**, **SemiWise** and **SureCore**.

Heading SiliconCatalyst.UK is **Sean z**, an experienced semiconductor executive with international experience and a strong connection to the United Kingdom.

Sean has the background and experience to build a strong Silicon Catalyst presence in the UK. I had the opportunity to chat with Sean a bit. Sean has experience working with the UK government and so understands what's needed to ignite a higher level of innovation in the region. Visibility, support and promotion of the UK's substantial innovation assets will be important in his view. Silicon Catalyst brings

the right resources and focus to help. He described a new funding program from the UK government to fuel innovation – this will fit well with the startup acceleration provided by Silicon Catalyst. There is a memorable comment from Sean: *“The bedrock of technology development is semiconductor”*. I couldn't agree more.

The press release announcing the UK expansion provides more background on the new operation. Noteworthy are the organizations that weigh in with supportive

comments; the list includes Arm, STMicroelectronics, Synopsys and Real Ventures. Silicon Catalyst has substantial support across the semiconductor ecosystem.

The SiliconCatalyst.UK organization will be hosting a webinar for start-ups, university staff, investors, and potential in-kind partners on Wednesday, June 23, 2021. The webinar will feature presentations by Vaysh Kewada, CEO of Saliience Labs in Cambridge and Huw Davies, CEO of Trameto in Wales, both UK companies in the Silicon Catalyst accelerator, as well as other

Silicon Catalyst partners and guest speakers. I encourage you to attend this webinar to learn more about how Silicon Catalyst is bringing its unique startup platform to the UK. Registration details will be available shortly, watch their website.

semiwiki.com

SiliconCatalyst.UK Launch NEWS COVERAGE



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SiliconCatalyst.UK:
it all happens here®



Silicon Catalyst Launches UK-based Accelerator

Santa Clara, California and Stewkley, England | From the archives

Silicon Catalyst is the world's only accelerator focused on semiconductor solutions, announced today SiliconCatalyst.UK, bringing Silicon Catalyst's platform locally to the UK and European start-up community. Heading SiliconCatalyst.UK is Sean Redmond, an experienced semiconductor executive with international experience and a strong connection to the United Kingdom.

Silicon Catalyst's mission is to help semiconductor hardware start-ups succeed. The ecosystem that Silicon Catalyst has created lowers the capital expenses associated with the design and fabrication of silicon-based integrated circuits (ICs), sensors, and microelectromechanical systems (MEMS) devices by providing advanced design tools and services from a comprehensive network of In-Kind Partners (IKPs). The Portfolio Companies in the Accelerator utilize IKP tools and services including design tools, simulation software, design services, foundry PDK access and MPW runs, test program development, tester access, and banking and legal services. The world-class Silicon Catalyst network of advisors and investors further facilitates their journey from idea through prototype toward volume production. See siliconcatalyst.uk for further background about the Accelerator.

"The UK has incredible innovation

through its world-class universities, already significant startup community, and support from the government," said Sean Redmond. "We look forward to working closely



Silicon Catalyst UK event participants at the Colossus Gallery, National Museum of Computing, www.tnmoc.org/colossus

with the U.K. start-up ecosystem, bringing a small part of Silicon Valley to further accelerate entrepreneurial teams to their full potential. We will be hosting a webinar on Wednesday, June 23, 2021 and invite members of the semiconductor value chain to attend and learn more about our comprehensive accelerator program." Registration details will be available shortly.

Nick Kepler, Chief Operating Officer of Silicon Catalyst, said "Silicon Catalyst exists to help start-ups, and we're excited for the opportunity to accelerate the technology innovation

happening in the United Kingdom. Over the last six years, Silicon Catalyst has made available to its Portfolio Companies over \$100 million dollars of in-kind services and helped them to raise more than \$250 million dollars in funding. In addition, many of our Portfolio Companies credit their success to the extensive network of nearly 200 advisors which saved them literally years by avoiding mistakes that most start-ups make."

"I am delighted to help launch Silicon Catalyst in the U.K. Having recently worked closely with the U.K. government, industry, and universities to guide their industrial digital strategy, this launch is a great opportunity to put that work into action for U.K. semiconductor start-ups," said Sean Redmond.

"Start-ups can capitalize on major growth opportunities in areas such as IoT and machine learning with fast, low cost and low risk access to best-in-class SoC design technology," said Phil Burr, senior director of strategic programmes, **Arm**. "Combining Silicon Catalyst's support with Arm Flexible Access for Startups, which provides free access to Arm IP and tools for prototyping silicon, will help startups get to working prototypes as quickly as possible, accelerating innovation in the UK."

"Silicon Catalyst has opened the doors to Silicon Valley for us," exclaimed Huw Davies, CEO of UK startup

Trameto. "In addition to affordable access to high-value In-Kind Partners like TSMC, Synopsys, and Advantest. Trameto has been strongly supported by experienced semiconductor industry veterans such as Mark Ross, ex-CTO of Cypress Semiconductor, as technology contributor and advisor, and John East, ex-CEO of Actel, as advisor."

"ST works with a large number of innovative tech start-ups across the world to help them develop and industrialize their products and get to market faster, targeting automotive, industrial, personal electronics and communication infrastructure applications," said Kirk Ouellette, Vice President Strategic Marketing and Strategy Development, **STMicroelectronics**. "Our engagement as a Silicon Catalyst Strategic and In-Kind Partner helps us find and engage with relevant start-ups, and surrounds them with the supportive Silicon Catalyst ecosystem that is critical to their success. We look forward with excitement to engage with many more start-ups and the various tech ecosystems in the U.K. with this additional Silicon Catalyst team."

"We are pleased to be working with SiliconCatalyst.UK to ignite the next generation of innovation," said Steve McDonald, **Synopsys** VP of Sales for Europe. "The strengthening economic pull from new market verticals for custom silicon is creating tremendous opportunity for chip design start-ups. With a distinguished track record enabling emerging businesses, Synopsys provides Silicon Catalyst portfolio companies with state-of-the-art tools and IP that reduce risk and accelerate time-to-market."

"It has been a pleasure for Real Ventures to partner with Silicon Catalyst over the past several years,"



Senior chip industry executives met at Bletchley Park to debate how to crack the code for U.K. semiconductor startup innovation and scaleup, appropriately in front of one of the code-breaking machines at the National Museum of Computing.

said Mark McDowell, Partner at **Real Ventures**. "Silicon Catalyst is incubating a fascinating collection of semiconductor hardware start-ups. As investors in SPARK Microsystems we have experienced how the Silicon Catalyst ecosystem surrounds each start-up with support that de-risks our investment."

"**Saliency Labs** joined Silicon Catalyst earlier this year and has already gained extensive value," said Vaysh Kewada, CEO of U.K. start-up Saliency Labs. "Silicon Catalyst provides start-ups with far more than in-kind services. It facilitates deep connections into the semiconductor industry through its advisors, who have spent time getting to know the company well, and then introduce and facilitate business-critical relationships. These relationships are already proving invaluable to Saliency Labs, and we look forward to continuing to work with Silicon Catalyst."

Agile Analog, based in Cambridge U.K., is Silicon Catalyst's newest In-Kind Partner. John Hartley, CCO said, "We look forward to helping the

Silicon Catalyst Portfolio Companies by quickly customizing their analog IP needs using our programmatic, systematic and repeatable methodology."

"As Silicon Catalyst has grown, we have been impressed that many of their start-ups are developing interesting technologies to address important problems in the world," commented Kirill Kuzmichev, Principal at **NanoDimension**. "In addition, the support of the Silicon Catalyst ecosystem, from partners providing tools and services to advisors providing expertise, increases the chance that each of these start-ups will succeed. Silicon Catalyst is one of the best places to look for good investments in semiconductor hardware."

More information is available at siliconcatalyst.com, siliconcatalyst.uk, siliconcatalystangels.com

Silicon Catalyst startup accelerator launches in UK

by Peter Clarke | eeNews Europe <https://www.eenewseurope.com/news/silicon-catalyst-incubator-comes-uk>

June 1, 2021 - Silicon Catalyst, the California-based accelerator focused on semiconductor startups, has announced the formation of a UK office.

Veteran EDA executive Sean Redmond is heading up [SiliconCatalystUK](#).

Silicon Catalyst was founded in Silicon Valley in 2014 as a mentoring and networking company, partly in response to a lack of venture capital funding. It provides startups with advice and lower-cost access to essential suppliers who in return get to engage with pre-evaluated startups.

More than 900 start-up companies have engaged with Silicon Catalyst since April 2015, with a total of 97 startup and early-stage companies being selected for admission to the accelerator.

The acceleration model has helped startups with the design and fabrication ICs, sensors and MEMS by providing advanced design tools and services from a network of "in-kind partners" and services that extend out to foundry PDK access, MPW runs and legal and banking services.

Startups start here.



it all happens here.®



Startups start here.®

APPLICATIONS NOW BEING ACCEPTED

- **In-Kind Partners** (TSMC, Synopsys, Arm, ST, MathWorks and over 50 more) – provide each startup several millions of dollars' worth of goods and services including EDA tools, IP, PDKs, prototypes, design and test services, packaging and business solutions. Our companies have received over \$150M in in-kind goods and services.
- **Strategic Partners** (including TI, ON Semi, Soitec, Bosch, Cirrus Logic, Arm, ST Micro, Sony, EMD Electronics, NXP, Mayfield and DuPont) – participate in the selection process and actively look for opportunities to partner with our startups.
- **Investors** – Our partnership with Mayfield and a large group of over 300 VCs, Angels, Angel groups, Corporate VCs, and Family Offices fund each journey. Silicon Catalyst Angels, created from our ecosystem, also funds our companies. Our companies have received over \$600M in venture investments.
- **Advisors** – A valuable network of over 300 industry experts that we match to the specific needs of each startup.
- **Universities, Industry Organizations, Accelerators and Government Agencies** – We nurture over 400 partner relationships for the benefit of our portfolio companies. Our companies have received over \$100M in grants.

THE GOAL: TO MAKE THE UK AN EPICENTER OF SEMICONDUCTOR START-UP INNOVATION



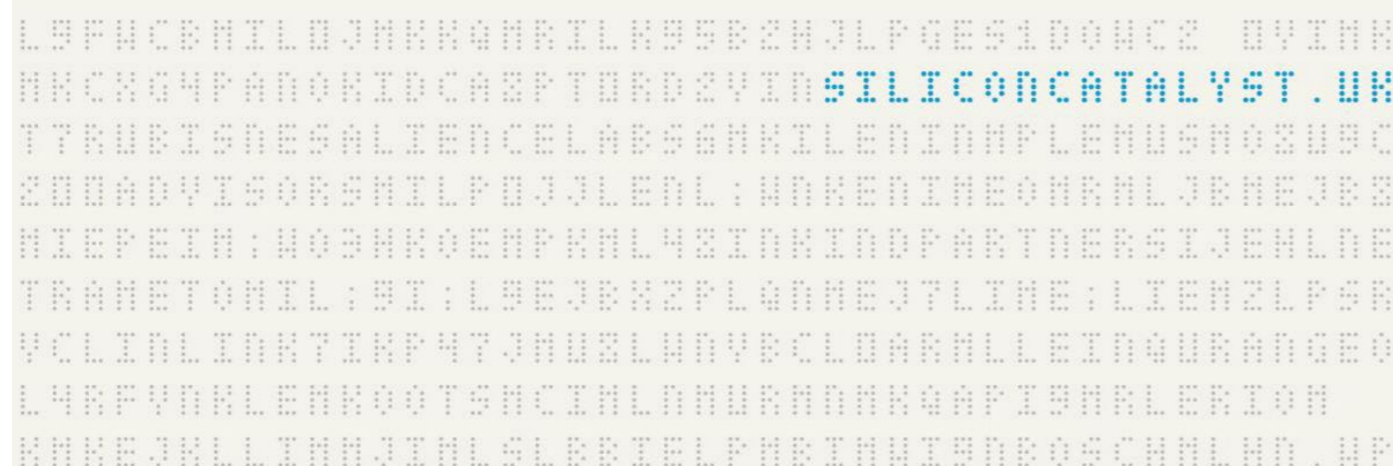
www.siliconcatalyst.uk



Cracking the Code to Startup Innovation in the UK



We look forward to seeing you on Tuesday, **12th October**, from **2 p.m. to 6 p.m.**, for a cracking good time at SiliconCatalyst.UK's semiconductor leadership event (physical attendance) jointly with the NMI.



Walk in the footsteps of Alan Turing with us at the birthplace of modern computing
BLETCHLEY PARK NATIONAL MUSEUM OF COMPUTING



SILICON CATALYST ADVISOR PROFILE DR. JALAL BAGHERLI

SiliconCatalyst.UK Advisor Dr. Jalal Bagherli shares some enlightening insights on his storied career.

We recently sat down with SiliconCatalyst.UK advisor Dr. Jalal Bagherli to discuss his journey in the semiconductor industry.

From an early age Dr. Bagherli has been fascinated with how things work, in particular with electronics and miniaturization. His curiosity as a boy had him wondering how a TV works and how a digital clock calculates time and how cameras function.

This curiosity and search for knowledge led him on a pioneering path to a PhD in chip design in the United Kingdom at a time when IC design firms became a force in the early 1980s, with fabless companies emerging. A true believer that the only constant in life is change, Jalal views every day as an exciting challenge and opportunity to see things differently and perhaps make a difference through the discovery of a better way. Delighted to have chosen a career in semiconductors, he is quick to offer, "I have never gotten bored in this industry."

The CEO of both the successful semiconductor startup Alphamosaic and the hugely successful global industry leader Dialog Semiconductors, he began his career with two Silicon Catalyst Strategic Partners, namely, Texas Instruments and Sony. Bagherli speaks very highly of his 9 years at TI or 'Training Institute' as he and many others have called it. He described his time there as having laid the foundation and appreciation of strong corporate governance and culture. It is with gratitude that he discusses what he learned about project management, customer engagement, and both industry ethics and ethos. His work in both

the UK and France exposed him to an international operating environment. He found the opportunity to engage with people from Europe, Asia and the US to be quite stimulating and unique to the semiconductor industry at the time.

He described his time at Sony to be less top down than TI and more entrepreneurial from a product creation point of view. At Sony he learned the discipline to handle hard-to-manage consumer electronics which have their own unique challenges, rhythm, and culture. A key takeaway was understanding the importance of budget in a consumer spending environment, namely what impact does a new innovation or approach have within the confines of an existing budget vis-a-vis what it is replacing. Whereas TI offered key B2B insights, his time at Sony enlightened him to the decision-making ramifications in a B2C environment. And, of course, he learned the importance of Christmas which put a capital C in Consumer electronics. Sony was management by consensus, management by teams, without having the power of 'hire and fire'. The understanding of soft power was essential. The collaborative culture was conducive to deploying indirect influences to persuade, inspire, and encourage outcomes. Dr. Bagherli described it as motivational management.

The lessons learned earlier in his career served him well as the first and last CEO of the successful startup Alphamosaic. Though not a founder, he sold the company to Broadcom after only three and a half years. The lessons learned from Alphamosaic included understanding the value of



DR. JALAL BAGHERLI
SILICONCATALYST.UK
ADVISOR



SILICON CATALYST ADVISOR PROFILE DR. JALAL BAGHERLI

A conversation with a SiliconCatalyst.UK Advisor

money. The constraints of money in a startup force one to prioritize what is most important at a given moment in time. One dollar in a startup is more valuable than 10 dollars in a big company because you have to be frugal and focus on what really matters. In addition, the Esprit de Corps within a team of startup entrepreneurs fosters an energy, enthusiasm, and dedication founded not only on the technology but on the sense of ownership and being a part of something special. When someone feels they can make a difference in a company, they are more empowered to do so.

My journey as a startup CEO afforded me observations and leadership skills that I brought to my next endeavor at Dialog which was a turnaround story. Dialog was a publicly listed company that was in trouble and had lost its way. My mission there was to find a way to right the ship. Borrowing from my startup experience, I tried to inject energy, inject ownership, and inject enthusiasm back into the company. My goal was to put a focus on what mattered. I looked to set ambitious yet achievable goals for my teams and the company. I made clear what my expectations were then got out of the way and left them to execute. Each team was left to define their own goals which gave them ownership of their outcomes. It was almost a scrum-like management style before scrum was even a thing. My objective was to only intervene when necessary. I didn't want to take the fun out of their jobs. I believe people should chart their own course by taking responsibility and ownership of a function, project or product. There were no assistant manager titles to make sure managers were more hands on with the function and make better decisions.

At Dialog, I insisted on regular company-wide communication, usually monthly or bi-monthly, worldwide. I would be on every one of those calls and accessible to everyone for any question, without a filter. I believe in full transparency. By being accessible and therefore accountable to anyone in the company, I was walking the walk I wanted the employees to walk. It turned out to

be a good motivator. I think that's the best way to carry people with you, especially if the company is in trouble. I had no tolerance for either Mañana (I'll do it later) or politics. I tried reducing layers in order to improve critical change communications to employees.

Something else I can share which may be helpful to those reading this is that early on at Dialog, I tended to overthink things. I went in with the idea that I'd be out in three to five years with everything fixed. Meanwhile, I was there for sixteen years. So clearly, I should have done a lot of things faster. I should have brought better people on faster. I didn't want to upset the ecosystem, my thought initially was to move gradually, when in fact I should have moved faster. Having said that, there truly are no easy answers.

I'm impressed with the Silicon Catalyst model and believe it was sorely needed in the UK. I am equally impressed with the companies that you are incubating. In fact, I have invested in Salience Labs and have joined their board. Some advice I can share with startup CEO's is to believe in your innovation but be humble. You must be willing to listen and seek knowledge and wisdom from those who can help you. You will make yourself a lot more attractive to investors and advisors if you follow this advice.



Dialog brings decades of experience to the rapid development of ICs while providing flexible and dynamic support, world-class innovation and the assurance of dealing with an established business partner.
www.dialog-semiconductor.com

SILICON CATALYST ADVISOR INTERVIEW



Jem Davies, Former VP of Technology at Arm

From the archives

Silicon Catalyst UK Managing Partner Sean Redmond had an opportunity to interview Jem Davies, a Silicon Catalyst Advisor. Jem is an experienced entrepreneurial senior leader, with a successful track record identifying technical trends, spotting commercial disruptions, setting strategy, and building/developing leadership teams to achieve real commercial business growth, acquiring startups to accelerate that growth, when appropriate. He has more than two decades' experience in the semiconductor and IP businesses working closely with the largest technology companies in Asia, US and Europe.

Originally an OS kernel hacker, Jem strayed across into hardware architecture and held various roles at Arm over a long career, including Fellow, VP of technology, setting technology strategy and roadmaps, finally as general manager of two startup businesses he founded/created inside Arm: media processing (producing the world's #1 shipping GPU) and AI/Machine Learning.

Based in Cambridge, UK, Jem holds four patents in the fields of CPU/GPU architecture, memory systems and compression and a degree from the University of Cambridge.

What follows is a brief sampling Sean's conversation with Dave. You can view or listen to the full interview from the Silicon Catalyst website, <https://siliconcatalyst.com/advisor-ecosystem>

SR: WHAT GOT YOU STARTED WITH THE SEMICONDUCTOR INDUSTRY, YOUR SCHOOLING AND FIRST JOB?

JD: I never intended actually from the start to get involved in semiconductors. I went to University to read maths. I changed and became a theoretical chemist, which was absolutely useless as a vocational qualification, and I thought I better get a job. And so I ended up in software, moving progressively further and further towards hardware until basically I was a hardware architect. I started working with semiconductors, running a small software consultancy and we were working with Arm. I then joined Arm and stepped into semiconductors full-

time. My job initially was to Port Linux to the first cache coherent multi-processor that Arm was producing and I thought that was a software job.

How little did I understand that actually it was all about fixing the hardware and making sure that the hardware understood that it was there to run software and not the other way around. In my career, I've gotten involved in a number of acquisitions and even more investigations of companies not to be acquired while I was working at Arm. We were looking at buying small startups. And that's actually kind of what I am. I'm a startup guy. I built two businesses inside Arm.

SR: WHAT ADVICE WOULD YOU HAVE FOR EARLY-STAGE SEMICONDUCTOR START-UPS?

JD: The advice I would give my younger self would be about communications, about persuading people. Particularly when you're young you think you've got all the answers and you're right and everyone else is wrong. And if they don't understand that you're right, then they're stupid. And actually no, it's standard communications theory, the responsibility is on the transmitter to ensure the message gets across - it's not the responsibility of the receiver and if they don't understand you or they do something stupid because they don't understand you - it's your fault!

And even if you want to be a technical leader, as opposed to a manager, you have to work on those skills. You have to work on understanding people, making sure those people understand you and the message you're trying to get across. Having a really clever invention isn't the same as having a really good business proposition.

One of the things I really enjoy working with Silicon Catalyst is taking these very, very technical startups and say that's really clever, but that's not that's not a business proposition. So what is the problem?

From the customer's perspective, what of their problems will be solved by your clever invention. I don't care whether you call it marketing or you call it technical communication, but you've got to be able to do that. The

very best startups combine that technical cleverness or invention with the ability to clearly communicate your value to the market.

I think that messaging is incredibly important and I'm convinced that communicating what it is you do is incredibly important. I understand that a lot of very technical people are allergic to the word marketing or brand or tagline, but actually the naming of things does matter.

SR: WHAT APPLICATION AREAS AND TECHNOLOGIES DO YOU SEE THAT WILL DRIVE THE NEXT BUSINESS GROWTH STAGE FOR THE SEMICONDUCTOR INDUSTRY?

JD: I wouldn't like to say I've got the exact prediction correct as to what the next big thing is, but I've got a framework within which I can see what sort of things are coming. With all due respect for my incredibly clever CPU architect colleagues, they're running out of road. You can only make your general-purpose CPUs so fast, so efficient, so low power, so high performance, you know, you can improve the memory interface. But you know, there's the end of the road is out there.

Today's computing workloads are not generic, they're not all the same thing. And so there are certain workloads, which we see have become worthwhile in building special purpose processes For graphics, obviously, you can't do 3D graphics on a CPU, it would go one frame per fortnight. You just can't do it.

What's interesting now is we're seeing other new workloads that are becoming so prominent, so prevalent that it is now worth getting special purpose processors, especially for machine learning. It's going to be huge and some people predict that you know, 50% of all compute cycles in a few years' time will be spent executing machine learning workloads. And so designing processors dedicated to those special purpose workloads will be key.

What's the next thing? There are some people I've talked to who think that data analytics and graph analytics of results from huge scale data collection activities is an important growth opportunity. The type of computation requires traversing these data structures that graph like data structures is sufficiently different than a general purpose CPU, which doesn't do it terribly well.

Watch Jem Davies speak about Arm Flexible Access (AFA) here on SiliconCatalyst.com.

JEM DAVIES

Jem is currently a non-executive director and advisor to several startup companies in the UK and US, looking for opportunities to use his expertise to achieve wider impact and success.

An experienced entrepreneurial senior leader, with successful track record identifying technical trends, spotting commercial disruptions, setting strategy, and building/developing leadership teams to achieve real commercial business growth, acquiring startups to accelerate that growth, when appropriate. More than two decades' experience in the semiconductor and IP businesses working closely with the largest technology companies in Asia, US and Europe.

Originally an OS kernel hacker, Jem strayed across into hardware architecture and held various roles at Arm over a long career, including Fellow, VP of technology, setting technology strategy and roadmaps, finally as general manager of two startup businesses he founded/created inside Arm: media processing (producing the world's #1 shipping GPU) and AI/Machine Learning.

Based in Cambridge, UK, Jem holds four patents in the fields of CPU/GPU architecture, memory systems and compression and a degree from the University of Cambridge. He enjoys gliding, diving and fireworks.



INDUSTRY NEWS

MOSHE GAVRIELOV: PREVIOUSLY CEO AT XILINX, VERISITY AND EVP AT CADENCE, CURRENTLY A MEMBER OF THE TSMC BOARD OF DIRECTORS

Sean Redmond's interview with Moshe Gavrielov

SEAN REDMOND

I'm delighted to introduce Moshe Gavrielov, the ex-CEO of Xilinx, current board director of TSMC, and a very good friend to the UK semiconductor industry. Tell us about your connection with the UK Moshe and why you like spending time here?

MOSHE GAVRIELOV

I was born in Israel, but I actually grew up in London and I spent several formative years here when I was a child in London. I just always loved going back and walking around London.

Then following that, I actually had an opportunity to run LSI logic's international business based out of the UK. The European headquarters was moved to Bracknell. So I spent two years managing the European business and then it expanded to all of the international business out of Bracknell. So I spent another two years of my life in the UK. So between the seven early years as a kid and two years, much, much later as an adult, I've always liked coming to the UK. I have a lot of friends in the UK. I have tremendous admiration for the engineering capabilities in the UK, which truthfully, I think have been underutilized and under exploited, over the years. So for me, there's just a very warm spot in my heart for everything from the UK.

SEAN: Moshe, you've been the CEO of a fabulously successful startup, Verisity, that was IPO of the year on Nasdaq in 2001. What advice would you give to new semiconductor startup CEOs that you wish you knew



SEAN REDMOND
MANAGING PARTNER,
SILICONCATALYST.UK

when you started taking on that role as the CEO of Verisity?

MOSHE: Well that was indeed a unique opportunity. It was first and foremost a great set of people. And I would say, you need to make sure in particular in a startup, that you have people you want to work with, right? Because startups tend to be so intense and they tend to have small teams where people perform several functions. There's no sort of infrastructure. I would say, first and foremost, make sure that you like the people you're working with, because you will spend a lot of time with them.

And then, you know, there's always a question. How do you drive the company? Do you drive it towards an exit, which is an acquisition, or do you try to build an independent company? And, I believe, that the proper approach is if you do things with the intention of it being a well-run significant company that can grow and remain independent, then you have more options.

And then if, and when, as most startups end up, they do get acquired. We were fortunate at Verisity. We went public in 2001, which is not an easy time to go public. And then we were public for four years before we were acquired by a much larger player. But I would say, try to think about the medium and the long-term and use that as the driver of what you're trying to do. And don't just do it based on short-term thinking, because I think that if you compromise and just try to get things done for the short term, you really are restricting your options going forward. And it's worth keeping that in mind when you're running even a small company to keep the medium and long-term in mind in terms of your goals and expectations.

SEAN: Excellent. Thank you, Moshe. Very few startup CEOs go on to run one of the largest semiconductor companies in the world. And you successfully made that transition. What's your view on taking risks when you're starting new projects? Clearly startups are by their very nature, new, innovative, quite often doing things that have never been done before. And so in making decisions about taking

“Keep your eye on the differentiation, make sure that you exploit it and you're very aggressive at driving it.”

technology risk or market risk to develop products for yet to be defined markets, what's your take on that very difficult decision in terms of risk-taking.

MOSHE: You know, as you point out very correctly, startups are risky and that's okay. They're also a lot of fun. There's a lot more freedom when you're running a startup because you don't have tremendously difficult, big company issues. You can make decisions very quickly and you can pivot quite quickly. I would say that with the issue of risk, I think the most important thing to do is to have a clear understanding of what your core differentiation is. And as long as you have a clear understanding of what you have, which is different, either in terms of the technology and the markets and relentlessly drive to exploit that, then you're more likely to be successful. And I would say that anything which really is not differentiated, or maybe is just focused on reaching a lower price point, but without a clear technology or market differentiation, it's very risky.

And the reason is that those price points are not defined by you. They are defined by what the competition is prepared to sort of accept, right? So you can sort of say, okay, you know, mine will cost half as much. Well, it could cost half as much as what your competitor is selling it for today, but if they want to protect their market, which they typically will, and you're a small player, then just sort of reducing the price, beyond what you believe they can do is not something you can control. And so keep your eye on the differentiation, make sure that you exploit it and you're very aggressive at driving it as profoundly as you can, because then I believe you'll be more successful in delivering success, going forward.

SEAN: Excellent advice Moshe for new CEOs out there. What's the hardest thing they're going to have to face as a CEO?

MOSHE: Well, this is a cliché, but it's actually true. The CEO role is a very lonely one and in the startup world it's even lonelier. Because there's so many things that you need to do as a CEO and there's not the broad support structure. My advice is to make sure that you have, and I don't know if mentor is the right word, but you have someone, who's not part of your team, but who you can be open with and who will listen to you and hopefully has the experience. Who will be able to share their thoughts based on what you're presenting to them. It's something I actually am trying to do now, since I'm retired, and I'm not in any active operational roles. I like to do board roles and primarily make myself available to the CEOs and actually to some of the staff. Sharing my thoughts with them without trying to run the companies for them, which I have no interest in doing, I think is one of the biggest benefits that I provide. And I personally had that option where there was someone who was outside our industry. I could always call and he was always happy to hear what my challenges were and to share his opinions. That neutral person who's really there as a sounding board and is a constructive sounding board is invaluable. And I would say that for CEO startups, if you can find someone like that, normally they don't have to be friends, but normally there's sort of a respect that you have to that person and that person has towards you, is very helpful and was very helpful to me.

www.tsmc.com



MOSHE GAVRIELOV

MEMBER BOARD OF DIRECTORS TSMC

MEMBER BOARD OF DIRECTORS NXP SEMICONDUCTORS

FORMER PRESIDENT AND CEO XILINX

Mr. Gavrielov served as President and CEO of Xilinx, Inc. from January 2008 to January 2018 and as a director of Xilinx, Inc. from February 2008 to January 2018. Prior to that, he served at Cadence Design Systems, Inc. as Executive Vice President and General Manager of the Verification Division from April 2005 to November 2007, and CEO of Verisity, Ltd. from March 1998 to April 2005. He also served at a variety of executive management positions in LSI Logic Corp. for nearly 10 years, and engineering and engineering management positions in National Semiconductor Corporation and Digital Equipment Corporation. Currently, Mr. Gavrielov is the Executive Chairman of Wind River Systems, Inc. in U.S. (a nonpublic company) and a director of Foretellix in Israel (a nonpublic company), Mr. Gavrielov holds a bachelor degree in electrical engineering and a master degree in computer science from Technion—Israel Institute of Technology.

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Fabless Companies Can Expect to Regain Leverage as Capacity Grows

At Silicon Catalyst semiconductor startup event at Williams Advanced Engineering, ex-Dialog CEO says good times ahead for fabless companies.

Nitin Dahad | Editor-in-Chief | Correspondent | EE Times, EE Times Europe

The next few years could be a good period for fabless semiconductor companies, especially with the expected growth in fab capacity meaning fabs will need to fill their production lines. That's the view of seasoned electronics industry executive Jalal Bagherli, speaking at this week's Silicon Catalyst semiconductor startup event at Williams Advanced Engineering in the U.K.

Bagherli, previously CEO of Dialog Semiconductor and now investor and board member at various companies, outlined the trends impacting the semiconductor industry, which center around four key areas: geopolitics, Covid-19, climate change, and the semiconductor down cycle. He said the various chips acts around the world are likely to result in over-capacity in the near future. As a result of this and the coming down cycle, he commented, "This means the fabless business model regains leverage. They [the fabs] will be desperate for your business, and silicon cost will go down."

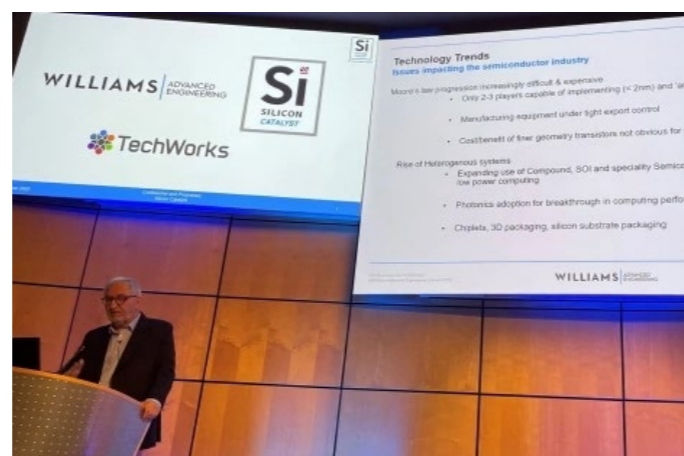
Since selling Dialog Semiconductor, Bagherli has been a prolific 'commentator' on key events and trends in the semiconductor industry. In addition to the geopolitical aspect of how the industry is being impacted, in his talk he offered his perspectives about changing technology trends and business models.

JALAL TECH TRENDS

Jalal Bagherli highlights some of the key technology trends impacting the semiconductor industry. (Image: Nitin Dahad)

Since the focus of the event was on startups, he also offered his advice to startups:

- If you are fundraising, close as soon as possible and raise as much as you can – at least for a runway of 18 months before next funding round



Jalal Bagherli highlights some of the key technology trends impacting the semiconductor industry. (Images: Nitin Dahad)

- Stay away from 'bleeding edge' digital products – differentiate away from this to have a higher chance of success with less funding
- Focus on customer design-wins that will help create a demand pipeline for the next upturn which could be at least nine months away
- Look at opportunities created by strategic insourcing by system houses – as companies bring chip design in house, they may not have all the expertise needed which creates custom opportunities for niche and mixed signal products to complement their own processors.

Bagherli is currently co-chair at Williams Advanced Engineering (WAE), an adviser to Silicon Catalyst in the U.K., chair of ATE test hardware firm PTSL (who just this week acquired Dallas, Texas-based ThinkMEMS and also last month closed a \$30 million investment from Tikehau Capital), and an investor in Saliency Labs. The WAE grounds, with its Formula 1 racing history, provided the backdrop to this latest in Silicon Catalyst's

series of "Forming, storming, norming & performing of semiconductor startups" events (the last one was held at Arm headquarters in Cambridge, U.K.).

IT TAKES TEAMWORK TO GET A NEW CHIP TO MARKET

The Silicon Catalyst event included some fascinating insight into Williams Advanced Engineering's work on electrification and battery management, followed by presentations from startups Oxford RF Solutions, Saliency Labs, and QPT.

OXFORD RF SOLUTIONS

Kashiff Siddiq, founder & CEO of Oxford RF Solutions, talked about his startup's next generation ADAS sensors, which could potentially reduce the number of sensors in the car.

SALIENCY LABS

Vaysh Kewada, co-founder & CEO of Saliency Labs, gives an update on the company's photonic solution for AI inference.

We also heard the journey of PTSL, from kitchen worktop with no debt or equity and just £4k of founders' capital, to finally raising external \$30 million of funding this year for next phase growth.

PTSL

Jordan Mackellar, founder & CEO of Probe Test Solutions (PTSL), talked about his startup journey, including the use of a vacuum cleaner providing suction for the wafer on the kitchen top for its first test rig.

In addition, the fund manager for WAE's technology investment group, Foresight, also highlighted its work with deep tech startups, with which it gets involved at seed funding stage.

JOE JONES - WILLIAMS ADVANCED ENGINEERING

Joe Jones, product manager for battery technologies at Williams Advanced Engineering, delivered a fascinating



Kashiff Siddiq, founder & CEO of Oxford RF Solutions

insight to the work on battery management, battery intelligence and battery digital twins that is helping the path to electrification in many industries.

The event also presented the importance of the ecosystem and teamwork in getting a chip to market. Raspberry Pi's chief operating officer, James Adams, talked about the work involved in developing its own microcontroller (MCU), the RP2040. He said, "Making chips is hard," as he described how it took teamwork together with Arm and imec and three years to get from design to end product.

RASPBERRY PI MAKING CHIPS IS HARD

James Adams of Raspberry Pi talked about their journey to getting their own MCU to market, from design to production volume.

He said, "We had a great bootstrap with Arm flexible access and imec. It's been a team effort." Presenting for Arm's involvement in the development, Gabriella Giuffrida, Arm's senior business manager for the flexible access program, said that doing the technology is "incredibly expensive" for a startup, so minimizing risk and providing access to the huge Arm ecosystem was important.

ARM'S FLEXIBLE ACCESS OVERVIEW

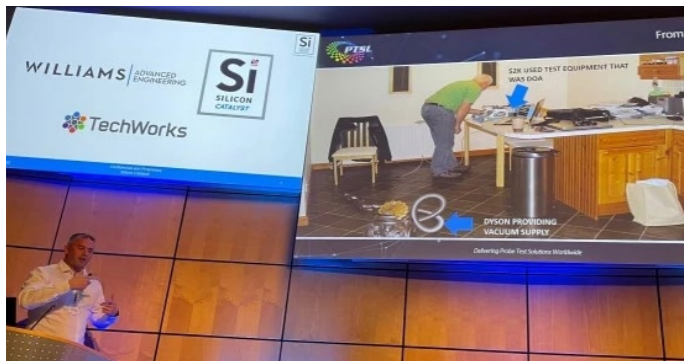
Arm's flexible access program starts free, and fees are introduced gradually as a startup goes through its funding stages.

Imec's ASIC design manager, Paul Ovington, talked about its role in helping Raspberry Pi get its MCU to market through its Imec.IC-Link unit. He said, "We help fabless semiconductor companies get their product to market." For Raspberry Pi, they helped with the project management, packaging, test and qualification, tape-out support, and rapid production ramp.



Vaysh Kewada, co-founder & CEO of Saliency Labs

Si SILICON CATALYST STARTUP SOLUTIONS



Jordan Mackellar, founder & CEO of Probe Test Solutions (PTSL) (Images: Nitin Dahad)



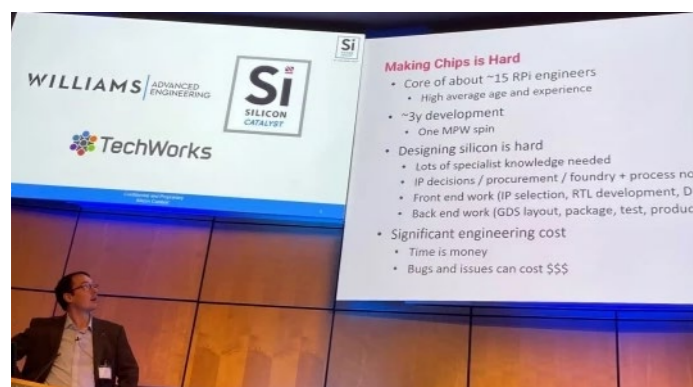
Joe Jones, Williams Advanced Engineering

JAMES ADAMS HIGHLIGHTED THE KEY LEARNINGS FROM THEIR EXPERIENCE IN GETTING THE RP2040 OUT. HE SUMMARIZED IT AS FOLLOWS:

- Hiring in the right experience is important – both internal and external
- Leverage external experience, especially in navigating chip design complexities
- Leverage proven external IP, making sure not to reinvent the wheel but focus on your own unique selling point
- Build the virtual team that you need

SERVING THE SILICON RENAISSANCE

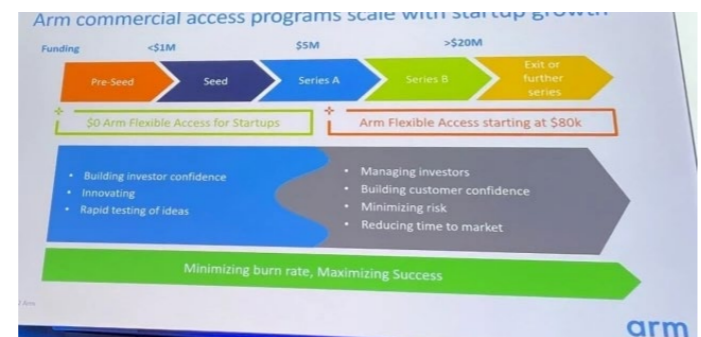
Established first in 2015 in the U.S. by Rick Lazansky, Mike Noonan, Dan Armbrust, and Tarun Verma, Silicon Catalyst



James Adams Raspberry Pi

says it is the world's only accelerator focused exclusively on accelerating semiconductor startups – including photonics, IP, MEMS, sensors, materials, and life science. Its model is providing support to startups through a network of in-kind and strategic partners to help dramatically reduce the cost and complexity of development. Silicon Catalyst supplies startups with a path to design tools, silicon devices, networking, access to funding, banking and marketing acumen to successfully launch and grow their companies' novel technology solutions.

As Richard Curtin, managing partner at Silicon Catalyst in the U.S., reminded me on a call this week, "There is a silicon renaissance", and he added that we should remind ourselves that semiconductors are the oxygen that allows software to breathe: a good reason for an accelerator focused on silicon. The U.K. Silicon Catalyst chapter was launched last year with Sean Redmond as its managing partner.



Arm's Flexible Access Program (Image: Nitin Dahad Data source: Arm presentation at Silicon Catalyst)

NITIN DAHAD

Nitin Dahad is a Editor-in-Chief of embedded.com, and a correspondent for EE Times, and EE Times Europe. Since starting his career in the electronics industry in 1985, he's had many different roles: from engineer to journalist, and from entrepreneur to startup mentor and government advisor. He was part of the startup team that launched 32-bit microprocessor company ARC International in the US in the late 1990s and took it public, and co-founder of The Chilli, which influenced much of the tech startup scene in the early 2000s. He's also worked with many of the big names - including National Semiconductor, GEC Plessey Semiconductors, Dialog Semiconductor and Marconi Instruments.

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U.K. Should Emulate Israel for Semiconductor Startups to Succeed

Senior executives from the U.K. semiconductor industry met at Bletchley Park to discuss how to nurture and grow the country's semiconductor startups.

Reprinted from EETimes Europe / Nitin Dahad | From the archives

This week, some of the most successful senior executives from the U.K. semiconductor industry gathered at the birthplace of modern computing, the Bletchley Park National Museum of Computing, to discuss how to crack the code to chip startup innovation in the country.

It was rather like a re-run of Captain Ridley's shooting party [see my note at the end of this story], quipped Sean Redmond, managing partner of the accelerator Silicon Catalyst, co-host of the gathering this week with the National Microelectronics Institute (NMI). The two organizations announced a collaboration just a couple of weeks ago to work on creating the right environment for more U.K. semiconductor startups to be more successful globally.

The gathering this week was aimed at bringing together in a room those who can potentially help make that happen, discuss what are the challenges and the possible solutions. There were successful chip and EDA industry veterans like Jalal Bagherli, Simon Davidmann, and Stan Boland, as well as other influencers in the ecosystem such as John Goodacre and Neil Dickens, plus of course various startup founders, as well as government representation on semiconductor industry policy.

The debates on challenges are for semiconductor startups in the country

threw up some common themes, as we heard from two startups, Saliency Labs and Cascoda, as well as the panel discussion that followed.

It won't be anything new for those familiar with the U.K. scene over the last 20-25 years as it's the same old story: lack of long-term capital for scaling up, access to talent, and the right kind of support from government programs. On the latter point, one panelist said many U.K. startups have to apply for DARPA funding in the U.S. or look for European Union grants, as there's no real program for them in the U.K.

The CEO and co-founder of Saliency Labs, Vaysh Kewada, talked about her experience as a new startup established in 2020, and how as part of the Silicon Catalyst program the company already raised its first funding in March 2021, and is about to close its second round of funding to build the company's prototype chip. She highlighted the top three needs of a semiconductor startup as supply chain, customer integration, and hiring at speed. On the supply chain, she said being part of Silicon Catalyst helps, especially since their SoC is multi-platform. Customer integration is also essential as, she said, "We need to be able to show traction and demonstrate integration with a customer's requirement, hence the need to work closely with customers."

Saliency Labs is developing a

high-speed photonics chip for AI acceleration. The company has shown that photonic processors can process information much more rapidly and in parallel, something electronic chips are incapable of doing. Their work on this was published in the Nature journal earlier this year. Kewada said, "The market needs a new compute platform as a result of the end of Moore's Law and with AI compute requirements doubling every three months. With the rise of silicon photonics, we have been able to come together as a team to create hybrid photonic in-memory compute. Photonics can enable us to get up to 50x improvement in inferences per second per watt compared to electronics."

Meanwhile, Bruno Johnson, CEO of Cascoda, explained how his company played the long game having established the company in 2007 and without having the support of a dedicated chip industry support network as provided by Silicon Catalyst now. He talked about how Cascoda worked over many years to realize their vision of enabling standards-based IoT to address the huge lack of interoperability in the industry. It invented a new type of radio demodulator which offers a significant increase in range by improving receiver sensitivity, without sacrificing power consumption and with no need for a power amplifier. Johnson's approach to growth is to work on



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Nitin Dahad is a Editor-in-Chief of embedded.com, and a correspondent for EE Times, and EE Times Europe. Since starting his career in the electronics industry in 1985, he's had many different roles: from engineer to journalist, and from entrepreneur to startup mentor and government advisor. He was part of the startup team that launched 32-bit microprocessor company ARC International in the US in the late 1990s and took it public, and co-founder of The Chilli, which influenced much of the tech startup scene in the early 2000s. He's also worked with many of the big names - including National Semiconductor, GEC Plessey Semiconductors, Dialog Semiconductor and Marconi Instruments.

developing a scalable technology that integrates into existing infrastructure, and work with or be part of standards bodies (he's involved with the Thread Group as well as the Open Connectivity Foundation).

THE PANEL: WHERE ARE WE NOW, WHERE DO WE WANT TO GO?

Having heard from the two startups, the panel dissected where is the U.K. semiconductor industry right now as regards nurturing startups, and where could the industry learn from.

Tim Ramsdale, CEO of Agile Analog, a four-year old startup who recently closed a \$19 million funding round, highlighted that the semiconductor industry is a long-term play, in the range of 20-30 years. "But in the U.K., the appetite for investing in semiconductors wasn't really there, say five years ago. We also need larger ecosystem players here," he commented, the latter point referring to the ability to get a wider skills and talent pool to enable hiring locally.

John Reilly, the sales director for silicon partners in EMEA, India and Russia for Arm, illustrated how Israel has managed to succeed with nurturing its chip startup ecosystem and how this could be a model for the U.K. "Our business in Israel is almost exclusively with startups. So what lessons can we learn? Well, if you look at the Israeli military, it churns out a pool of experienced resources [who then go on and do their own tech startups when they leave]." In addition, he said success breeds success. "This is when successful entrepreneurs go and help other startups and also become role models themselves."

Reilly certainly has a key point. Two of Israel's military units, unit 81 and unit 8200, have alumni who have launched many successful technology startups. Since they are elite units looking at things like security and intelligence, and whose remit is to use technology to develop solutions that keep Israel safe, they have excellent skills and experience of using technology to solve real world problems.

When they come out of the units, they already have teams that have worked together successfully so often come together to form their own startups - an example of a recent one is NeuroBlade, who just raised \$83 million for its compute-in-memory chip. Hailo is another example. According to one report earlier this year, soldiers and officers who served in Unit 81 between 2003 and 2010 have since then founded many startups - in fact around 100 veterans from the unit at the time founded 50 companies and have raised over \$4 billion, with valuations over \$10 billion.

Coming back to the panel, Alec Vogt, director northern Europe for Synopsys, talked about the importance of an accelerator like Silicon Catalyst for startups. "In the U.K., there is no lack of creative ideas. However, what happens next is not so great. Because there isn't an appetite for longer term investment in semiconductors in the U.K., the ecosystem supporting semiconductor investments is weak, and there are no real government funding programs." He then said that there was a danger of the country closing in on itself. "We need to be open, create a pool of talent, bring

expertise and funding here so that the great ideas can have more chance of becoming a success."

The Silicon Catalyst and NMI collaboration is meant to address some of the issues around access to various aspects of support, including tools and in-kind benefits from key partners of the network, plus access to funding sources.

Redmond said, "The UK has world class research universities and a track record for semiconductor innovation. It also has fifteen semiconductor fabs specializing in advanced processes for photonics, power and mixed-signal RF applications. This manufacturing base has been extended with a strong MEMS, PICs and ASIC ecosystem. Combining these local assets with international partners and entrepreneurial drive creates a springboard for semiconductor startup success." Hence, his vision was to help create a better support network for semiconductor startups to help them grow.

Meanwhile, the legal entity behind NMI, called TechWorks, was keen to work with Silicon Catalyst to 'de-risk' the path to growth for chip startups in the country. The CEO of TechWorks, Alan Banks, said, "By cultivating collaboration and ensuring government recognition of the semiconductor sector in areas such as automotive, IoT, communications, AI and edge computing, we have ambitions to facilitate the next generation of semiconductor companies building on the legacy of companies such as Arm, Wolfson, Icera and, more recently, Graphcore."

Note: "Captain Ridley's shooting party" was the cover name used by secret service agents from MI6 and intelligence experts who headed out to Bletchley Park in 1938 to activate the secret base that became the home of the code breaking center, where Alan Turing and many others broke a number of German codes, including that of the Enigma machine.



STRATEGIC PARTNER

Silicon Startups Contest by Arm and Silicon Catalyst



How Arm is helping the world's silicon startups succeed

More IP, a new contest and some startup success stories from Arm Flexible Access.

Four years ago, we launched [Arm Flexible Access](#) as a new way for our partners to access Arm's industry-leading chip designs quicker, easier and, well, more flexibly.

A significant audience we are engaging is the global silicon startup community through [Arm Flexible Access for Startups](#). This provides access to a broad portfolio of Arm's extensively verified IP, tools and training on the easiest and simplest ever business terms from Arm, with clear, predictable pricing upfront and a zero cost license fee for startups to develop their silicon prototypes.

This commitment to early-stage silicon startups is important to Arm. The continued growth of the semiconductor industry will be heavily influenced by the entrepreneurial drive and innovation of early-stage startups who are providing the next wave of innovative products and technology solutions that, like Arm's, will change the world.

The startup "game changer"

Our approach to support startups is working. Since its introduction, Arm Flexible Access for Startups has managed to help around 100 startups and the results have been impressive.

Sohail Syed, CEO and President of [DreamBig Semiconductor Inc.](#), refers to Arm Flexible Access for Startups as "a game-changer" for the company. It allowed the silicon startup to prototype its Deimos Chiplet Hub for



next-generation datacenter solutions quickly and cost effectively, while helping to mitigate any wider technical and business challenges.

[Cambridge Touch Technologies](#), a startup developing an AI engine that runs signal processing for touch technology, is another success story. The 'design first, pay later' model of Arm Flexible Access for Startups was vital when the company signed up in 2020, as it was still in the very early stages of the funding process. The CEO and Co-founder Corbin Church says: "Within two years of signing up, we already have a second product in the pipeline and are planning to tape out our first commercial chip later this year."

We understand startups

From our 30 years of experience, we understand that designing silicon is

complex, expensive, and risky. Since the program launched in 2019, we've had many different discussions with early-stage startups, understanding what they need and want to design silicon effectively and efficiently. What we heard is that there are three key considerations that are front of mind for them:

- Experimenting with ease and having the ability to pivot their design as much as they need before production;
- Moving quickly and confidently with minimal disruptions; and
- Effectively controlling their cash flow to give their investors confidence.

Access to more Arm IP

These considerations are what guide Arm's offering through Flexible Access for Startups. We are now adding [Arm Cortex-A55 CPU](#), one of Arm's most



popular IP designs for consumer tech markets, to the broad portfolio of Arm IP and tools that we offer through Arm Flexible Access for Startups. This means silicon startups can access Cortex-A55 free of charge as part of their initial prototype development process.

[Hailo](#), a startup that has gone from strength-to-strength since joining Arm Flexible Access, commented on the importance of Arm's proven IP technology as the company started its first silicon prototype.

Hailo's co-founder and chief technologist Avi Baum says: "Our technology needs to work first time and the technology contributed by the ecosystem has to be just as trustworthy."

The proven range of IP and tools allows startups to move with confidence and manage any risks during the silicon prototype process, with this being important to Eray Erdogan, Co-Founder of [HEX Microchip](#). He says: "Arm's proven IP, tools and support have helped us manage risk and start on a solid foundation, which has been a bastion of confidence leading us to success."

Comprehensive ecosystem and technical support

And it's not just Arm's IP and tools that we offer. Through the program, Arm's own technical network and our vast ecosystem become a free extension for small startup teams. With access to thousands of technology companies spanning hardware and software and millions of developers all building on Arm, there is a wealth of knowledge and insights to support the development of silicon prototypes.

We also offer a comprehensive package of support and training from Arm's skilled engineers. This helps

startups quickly address any technical or commercial challenges faced during the design process, speeding their time-to-market and saving costs in the long-run.

The Arm ecosystem is a key benefit valued by our startup customers.

Yannick Thepaut, CEO, [EASii IC](#), says: "We can rely on the Arm ecosystem



to secure projects and give the necessary level of confidence to reduce development costs and accelerate the time-to-market."

Meanwhile, Manu Nair, Founder and CEO of [Synthara AI](#), notes the quick and responsive feedback from Arm's Account team to the company's requests and how it benefited the development of its prototype. He says: "The clear and actionable support enabled us to close our design quickly and efficiently."



Sparking fresh innovation with a new startup contest

We are making continuous efforts to provide the benefits of the program to more silicon startups globally. [Silicon Catalyst](#) is running a "[Silicon Startups Contest](#)" in partnership with Arm for early-stage startups who are designing their next system-on-chip (SoC) with Arm processor IP.

This is a great opportunity for startups to access Arm's leading IP and save costs during the design development process, with the most innovative system-on-chip (SoC) design winning \$150,000 of Arm Technology credit towards an Arm Flexible Access tape-out. This could cover IP fees for a small embedded system, or significantly contribute to the cost of higher

performance applications. The contest winner, alongside two runners-up, will also receive a free Arm design check-in, a ticket to Arm's invite-only ecosystem event, and an investor pitch review and preparation support by Silicon Catalyst, with an opportunity to present to the Silicon Catalyst Angels group and its investment syndication network.

Business guidance to help startups thrive

Silicon Catalyst is one of the expert organizations that Arm Flexible Access startups can lean on for wider business support. Arm's partnership with Silicon Catalyst brings wide-ranging guidance to startups on how to reduce costs and complexity during the design development process. Another organization offering expert guidance is Sand Hill Angels, a group of 160 Silicon Valley angel investors and advisors offering business knowledge on how to scale startups effectively.

Like Arm, Silicon Catalyst and [Sand Hill Angels](#) are passionate about helping startups succeed and scale. They are part of a global Arm network of startup-specific support, including incubators, funders, advisors, research institutes and government agencies.

Create life-changing products on Arm Through Arm Flexible Access for Startups, we are giving silicon startups the tools and support to create the very best products as efficiently and effectively as possible. Whether that's through zero cost access to our industry-proven technology, access to millions of global innovators in Arm's vast ecosystem or access to world-class technical support, we are committed to enabling the startup community to move fast, experiment with ease and design with confidence.

If you're an early-stage silicon start-up, then take a look at what [Arm Flexible Access for Startups](#) can offer you on your first step towards changing the world with your products that are built on Arm.

STRATEGIC PARTNER
NXP



NXP: Helping to make the future bright, safe, and secure

Semiconductor technologies are a crucial component empowering today's consumer and industrial applications. Whether it's tapping your phone to pay or controlling appliances with your voice, semiconductors are what make it possible for the world around us to be connected, aware, secure, and more sustainable.

As a world leader in secure connectivity solutions for embedded applications, NXP® Semiconductors is pushing the boundaries of technology across the automotive, industrial & IoT, mobile, and communication infrastructure markets. As one of the accelerator's newest strategic partners, we look forward to continuing our long history



LARS REGER
EXECUTIVE VICE PRESIDENT
AND CHIEF TECHNOLOGY
OFFICER

of innovation through collaborations with those in the Silicon Catalyst ecosystem across AI and machine learning, wireless, power and connectivity, among others.

WHO WE WERE AND WHO WE ARE NOW

NXP, headquartered in Eindhoven, Netherlands, designs and manufactures a variety of devices used to sense, think, connect, and act intelligently to improve people's daily lives.

Formed in 2006 when Philips spun off its semiconductor operations, NXP Semiconductors went public in 2010. Since then, we have grown organically

and through acquisitions; our most significant transaction was our merger with Freescale Semiconductor in 2015.

Though NXP was founded relatively recently, our semiconductor heritage stretches back to the earliest days of the industry. Philips began exploring semiconductor materials in the 1930s and established a manufacturing facility in 1955. Freescale, meanwhile, was a spinout of Motorola, which established its semiconductor development group in 1949.

Today, NXP is a world leader in secure connectivity solutions for embedded applications. We employ approximately 31,000 people in more than 30 countries, and in 2021 reported revenue of \$11 billion. The company is led by President and CEO Kurt Sievers, who started with Philips in 1995.

We do much of our own manufacturing, with wafer fabs in



the Netherlands, the United States, and Singapore, complemented by several test and assembly plants in Southeast Asia.

A SMARTER WORLD STARTS WITH NXP

NXP has one of the most diverse and sophisticated product portfolios in the

semiconductor industry, spanning embedded controllers and processors, advanced sensors, power ICs, connectivity devices, and more. Our products are designed to be reliable, safe, and secure.

Because of the breadth of our product portfolio, we are one of the few semiconductor manufacturers able to offer full system solutions. NXP focuses on four key growth markets:

Automotive, where we provide solutions to complex autonomy, connectivity, and electrification challenges for today's safe and secure vehicles. NXP products are integral in power trains, advanced driver assist systems (ADAS), infotainment systems, vehicle-to-X communications, and more.

Communication Infrastructure, where we support 5G-connected, edge computing technologies that support

NXP SECURE CONNECTIONS FOR A SMARTER WORLD

- 1949**: Motorola semiconductor development group founded in Phoenix, Arizona
- 1953**: Philips enters semiconductor industry with manufacturing and development in Nijmegen, Netherlands and Hanburg, Germany
- 1955**: Motorola introduces germanium transistor for car radios—the world's first commercial high-power transistor
- 1958**: Motorola teams up with the U.S. space program, virtually every manned and unmanned space flight since then has used Motorola/Freescale technology
- 1969**: First words from the Moon to the Earth relayed by a Motorola transistor
- 1974**: Motorola introduces its first microprocessor—the MC6800 8-bit model
- 1980**: Motorola and its automotive customers develop the world's first microprocessor-based engine control, the EEC III module, designed to reduce fuel consumption and emissions
- 1983**: Philips Semiconductor's TDA7000 FM radio receiver is the first complete radio on a chip and is listed by EEC as "One of the 25 Microchips that Shook the World"
- 1984**: Motorola launches the MC6801—the world's first true 32-bit microprocessor
- 1989**: Motorola pioneers communications processors with industry's first multi-protocol microprocessor
- 1991**: Philips develops the first CAN/LIN microcontroller for in-vehicle automotive standards
- 1992**: First design of Philips' One-Chip MP—one of the first "Microchips that Shook the World"
- 1993**: Philips Semiconductor founded
- 1995**: Motorola technology powers Octavo—one of the first Internet of Things applications
- 1995**: Philips launches the Dinos car audio DSP, which would lead Philips/NXP to become market leader in car audio a few years later
- 1996**: Philips introduces DMOS technology for RF power amplifiers, setting a new industry benchmark in cellular base stations
- 1996**: Motorola is one of first to deliver microelectromechanical systems (MEMS) inertial sensors for automotive airbags, addressing automotive safety issues
- 1997**: Philips launches the GreenChip power supply chip, which significantly improves energy efficiency of TVs, notebooks and desktops
- 1999**: The e-switch product family creation is the first dual-die power package
- 2000**: Philips releases the first angular sensor as a system-in-package (SiP)
- 2002**: Philips Semiconductor and Sony invent Near Field Communication (NFC)
- 2002**: World's first tubing-free wireless insulin pump for diabetes patients uses Motorola microprocessors
- 2002**: Motorola releases first pressure sensor to address U.S. TREAD act requirement for tire pressure monitoring
- 2003**: Motorola releases first pressure sensor to address U.S. TREAD act requirement for tire pressure monitoring
- 2004**: Motorola Semiconductor Products Sector becomes Freescale Semiconductor, Inc.
- 2004**: Philips releases the first angular sensor as a system-in-package (SiP)
- 2006**: NXP established
- 2009**: NXP creates the first micro hybrid power chip for start and stop
- 2009**: NXP launches PNX8500—the world's first fully integrated digital TV processing/monitoring around 350 million transistors
- 2010**: NXP listed on the NASDAQ Stock Exchange in New York City
- 2011**: NXP ships world's fastest Armv7 Cortex-M3 and Cortex-M0 microcontrollers
- 2011**: Freescale launches industry's first magnetometer combining a magnetic sensor, accelerometer and pressure sensor, designed for location tracking in smart mobile devices
- 2011**: NXP launches the SoftAccess/ID program
- 2012**: NXP launches AN516x wireless microcontroller family for the Internet of Things
- 2012**: Freescale launches industry's first MIFARE Ultralight F1T—the smart paper, inkjetting IC
- 2012**: Freescale launches industry's first MCU built on the Arm Cortex-M0+ processor
- 2013**: NXP Semiconductors N.K. joins NASDAQ-100 Index
- 2013**: NXP launches the first 77 GHz radar IC for advanced driver assistance systems (ADAS)
- 2013**: Freescale introduces industry's first multimode wireless base station processors, scaling from small to large cells
- 2013**: First power management IC integrating functional safety in the SoftAccess portfolio
- 2013**: Ships one billionth GreenChip IC
- 2014**: During NXP Semiconductors established, becoming China's first true automotive semiconductor business
- 2015**: Freescale and Motorola merge into the world's 4th largest semiconductor company and largest automotive supplier
- 2015**: NXP engineers win the distinguished "European Investor Award for MNC"
- 2015**: NXP launches battery management portfolio with battery cell controllers for Li-ion batteries
- 2015**: NXP provides V2X and RFID technology for the U.S. Department of Transportation Smart City Challenge
- 2015**: NXP creates the first integrated solution for microwave heating/cooking
- 2016**: NXP launches battery management portfolio with battery cell controllers for Li-ion batteries
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- 2016**: Thomson Reuters Foundation honors NXP with the prestigious "Step Slavery Award"
- 2016**: NXP introduces the S32 automotive platform, with fully-scalable computing architecture to bring future vehicles to market faster
- 2017**: Launch of UC06E 8 the industry's most power efficient global KAM RFID chip for consumer retail data
- 2017**: NXP introduces the S32 automotive platform, with fully-scalable computing architecture to bring future vehicles to market faster
- 2017**: #1 supplier of microcontrollers with 31% market share, according to IC Insights
- 2017**: Industry's first 65 V LDMOS technology, enabling ultra rugged products up to 1.8 kW in power
- 2017**: NXP presents the world's first one-chip solution for global radio broadcast standards
- 2017**: NXP enables secure ultra-wideband ranging technology for automotive and IoT
- 2017**: NXP premier EdgeVerse™ brand platform to support the fast-growing edge computing portfolio
- 2018**: NXP, Mastercard and Visa transform mobile payments for billions of IoT devices (launch of midsize 200)
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- 2018**: NXP delivers new security and connectivity to 2018 FIA World Cup Russia™ F1 with Smart Student Experience
- 2018**: NXP powered by top 100 Global Innovator
- 2018**: Dutch innovation award for ultra-compact RF CMOS radio transceiver TEF610X
- 2019**: NXP enables secure ultra-wideband ranging technology for automotive and IoT
- 2019**: NXP premier EdgeVerse™ brand platform to support the fast-growing edge computing portfolio
- 2019**: NXP debuts L1K applications processor with dedicated neural processing unit for advanced machine learning at the edge
- 2019**: L1K ET processor processor for voice and face recognition—the world's fastest sub-dollar MCU
- 2019**: K55 13 and MIFARE power innovative smart city use cases
- 2019**: NXP acquires Marvell's Wi-Fi 6 Connectivity Business
- 2020**: NXP selects TSMC 5nm process for next-generation high-performance automotive platform
- 2020**: NXP introduces S32G networking processor unlocking the value of vehicle data
- 2020**: NXP Advances 5G with New Gallium Nitride Fab in Arizona

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STRATEGIC PARTNER
NXP

scalable communication networks.

Industrial and IoT. For industrial and IoT applications, NXP supplies simplified machine learning solutions that automate better decision-making at the device level for Industry 4.0 applications. Our portfolio of connectivity devices supports every major wireless communications protocol.

Mobile, covering both mobile devices and wearable technology, we provide solutions for connected lifestyles that involve data moving more freely and transactions that are easy, safe, and secure.

Our products are also increasingly relied on for smart home and smart city applications. We support smart home applications with solutions that listen, learn, and adapt into the places we call home for more comfort, safety, and convenience. Our smart city solutions simplify how people access and interact with local services to achieve new standards of sustainability, efficiency, mobility, and economic growth.



THE ROAD AHEAD

NXP is poised to address what will surely be some of the biggest technological growth markets for years to come. Smart devices will become more pervasive because they help make our world richer, more fulfilling, safer and more secure, as well as more environmentally responsible. As electronics proliferate in our lives, the world will become more connected, and smarter because of it. We see that happening now with electric vehicles with ADAS features, mobile wallets, smart factories, and so much more. We

look forward to working with Silicon Catalyst and its ecosystem of startups and young companies to imagine and help create what comes next.

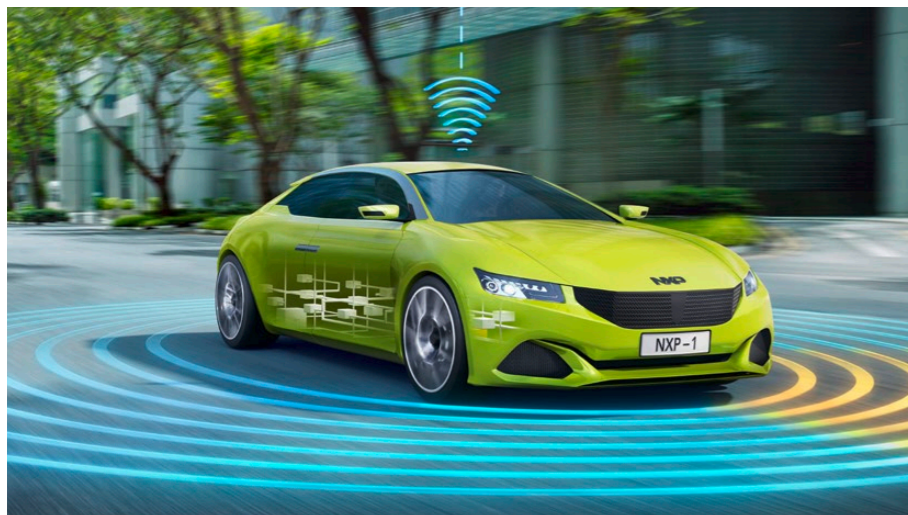
<https://siliconcatalyst.com/silicon-catalyst-welcomes-nxp-electronics-as-newest-strategic-partner>

EXPERIENCE

Lars Reger is executive vice president and chief technology officer for NXP Semiconductors. As CTO, Lars is responsible for managing new business activities and R&D in the automotive, industry 4.0, internet of things (IoT), mobile, connectivity and infrastructure focus markets.

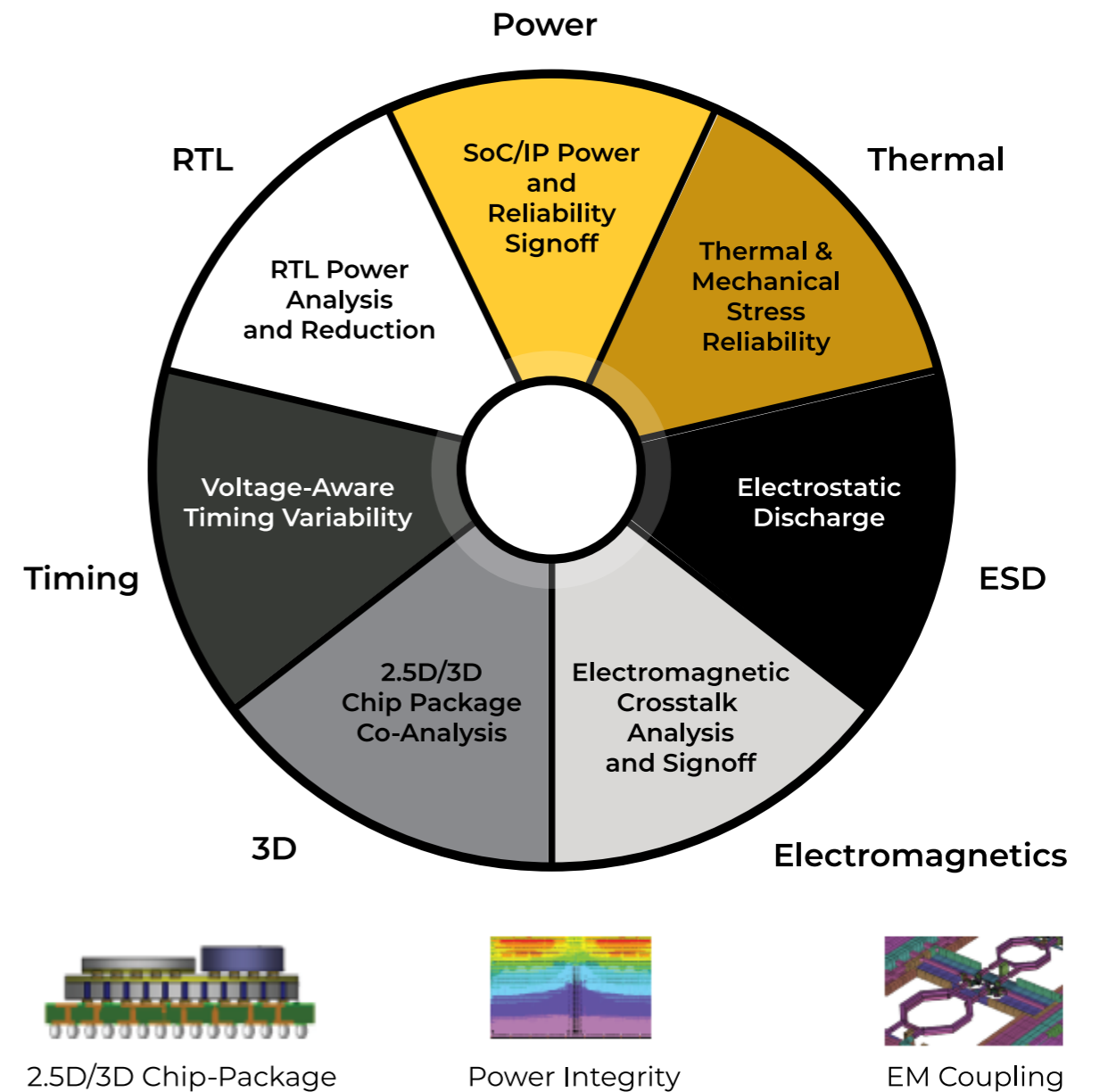
Before joining NXP as head of automotive strategy in 2008, Lars gained deep insight into the microelectronics industry with a focus on the automotive sector. He began his career with Siemens Semiconductors as a product engineer in 1997. His past roles at Infineon included head of the process and product engineering departments, project manager for mobile system chips and director of IP management. At Continental, Lars was responsible for business development and product management within the connectivity business unit.

In 2012, Lars was appointed CTO of Automotive at NXP and in December 2018, he was appointed NXP's CTO with responsibility for the overall technology portfolio.



Full-System Multiphysics Analysis

- Chip – Package – Board – System
- TSMC Certified Down to 3nm



Silicon Catalyst Partners with Sony Semiconductor Solutions to Accelerate Semiconductor Startups

Silicon Valley, CA | From the archives

Partnership will focus on innovations beyond image sensors

Silicon Catalyst, the world's only accelerator focused exclusively on accelerating solutions in silicon, announces that Sony Semiconductor Solutions Corporation ("Sony"), the global leader in image sensors, has become its ninth Strategic Partner. The partnership will expand Sony's access to new innovations in sensing solutions development and facilitate Sony's ability to create strategic relationships with pioneering young companies that are developing technologies complementary to Sony's internal innovation. In addition, the partnership further strengthens Silicon Catalyst's leading role in helping new semiconductor companies address the challenges in moving from idea to realization.

"Sony is always open to collaborating with outstanding entrepreneurs, young technology companies and industry experts. This partnership is another example of our approach," said Yasuhiro Kono, Corporate Executive, CFO of Sony Semiconductor Solutions Corporation. "We look forward to working with Silicon Catalyst's community, and through this partnership establishing better and more open strategies in the design and development of next generation sensing platforms."

Silicon Catalyst has created a unique ecosystem

Device business by the Sony Semiconductor Solutions Group is focused on image sensors, and includes a variety of other parts including microdisplays, LSIs, and laser diodes. In image sensors, where we command the top share of the global market, mobile applications are central, with growth expected in new areas such as automotive cameras, security cameras, and factory automation. One use of image sensors is in viewing applications for conventional digital cameras or mobile devices, where they make devices more convenient or enjoyable for individual users. Another use is in recognition, where they bring greater convenience, safety, and security to society. We have positioned this use in sensing as our next pillar of growth, and our long-term vision calls on us to fulfill essential roles in society as a leader in this field. To date, the Sony Semiconductor Solutions Group has created new markets for image sensors through innovation, and looking ahead, we will continue to take on challenges for further growth. www.sony-semicon.co.jp/e/

to provide critical support to semiconductor hardware startups as they move from idea through prototype to initial product. In its seventh year of operation, Silicon Catalyst has reviewed over 400 early-stage companies and has admitted 48 startups into the accelerator. These Portfolio Companies have access to tools and services from a comprehensive network of In-Kind Partners (IKPs) -- including design tools, simulation software, design services, foundry PDK access and MPW runs, test program development and tester access -- that dramatically reduce the cost of chip development. Additionally, the startups tap into the world-class Silicon Catalyst network of advisors and investors.

"Sony Semiconductor Solutions is the world's leading image sensor company, and we are delighted to have them join the Silicon Catalyst ecosystem as our first Asian Strategic Partner," said Nick Kepler, COO of Silicon Catalyst. "Sony has developed and deployed many generations of technical invention in image sensors, and we are excited to explore the next generations with them as image sensors evolve to include memory and AI while supporting always-on systems that bring greater convenience and possibilities to our world. Our partnership connects Sony with Silicon Catalyst's curated portfolio of some of the most interesting semiconductor hardware startups; it also makes Sony more accessible to these startups, which reap tremendous benefits from deep, long-term engagements with industry leaders like Sony who can provide guidance and relationships with experts."

Sony Semiconductor Solutions

In November 2021 Sony Semiconductor Solutions (SSS) joined the Silicon Catalyst ecosystem as a Strategic Partner. Today, we would like to explain our business environment and strategic direction within this journal. Also, we are sharing our corporate slogan that we have established this year to help our stakeholders understand the SSS Group's goals and business activities. We hope to deliver our message to partners whom cooperate and co-create our goals.

OUR MARKET POSITION AND DIRECTION

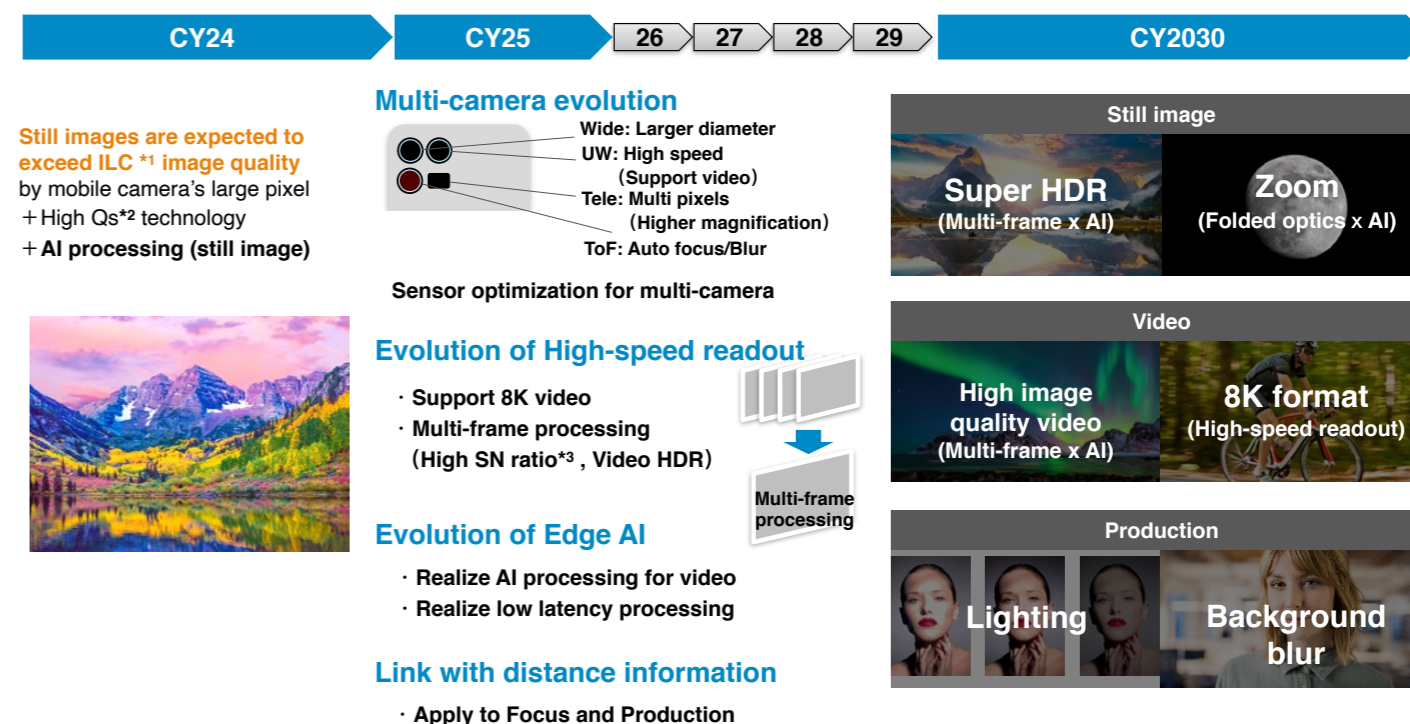
Sony Semiconductor Solutions Corporation is a wholly owned subsidiary of Sony Group Corporation and the

global leader in image sensors. In FY21, SSS had image sensor sales of 947.3 billion yen and 43%* value share of the market. We divide our business domain into three areas, "Mobile Imaging", "Sensing", and "AV". As to mobile imaging, we believe that it will continue to account for the majority even in 2030. In terms of sensing, the ADAS area in automotive is expected to expand. The market for industrial applications is growing due to continued labor savings and automation needs. On top of these areas, we expect market growth within our solution business, which we are currently working on.

We strive to continue to maintain our No.1 position in

*Source Sony

DIRECTION OF MOBILE IMAGING TECHNOLOGICAL EVOLUTION



*1:LC: Interchangeable Lens Camera *2: Quantum saturation *3: SN Ratio: Signal-to-Noise Ratio

the share for the worldwide CMOS image sensor market and provide advanced imaging technologies that bring greater convenience and joy to people's lives. We also work to develop and bring to market new kinds of sensing technologies with the aim of offering various solutions that will take the visual and recognition capabilities of both human and machines to greater heights.

MOBILE IMAGING INITIATIVES

In mobile imaging, image sensors for high-end smartphones are expected to grow significantly through 2030. When it comes to high-end models, smartphone makers continue to position cameras as an important differentiating factor and are pursuing high-performance camera systems. Smartphone makers who have their own Application Processors are doing this, so too are makers who utilize general-purpose Application Processors. They are trying to realize a new imaging experience by developing their own Image Signal Processors. What is required here is large pixels and large-sized image sensors. We will continue to focus the most on high-end models and develop high-value-added image

sensors that contribute to high image quality and multi-functionality. As one of the technological developments for high added value, we announced the world's first pixel structure called stacked CMOS image sensor technology with 2-Layer Transistor Pixel.

<https://www.sony-semicon.co.jp/e/news/2021/2021121601.html>

Based on the technological development we have underway and looking to 2030, we think that technological evolution will progress on the axes of still images, videos, and production. In the still images space, super HDR and zoom functions can be realized, and for video, high image quality and high-speed reading at 8K can be realized. Furthermore, it is expected that production functionality, like getting directions on how to take a good picture, will evolve.

Evolution of multi-camera systems, evolution of high-speed readout, evolution of Edge AI, and coordination of distance information with production are all possibilities. As such, mobile imaging remains a technology driver and an area with great room for technological evolution.

STRATEGIC ECOSYSTEM PARTNER

PROFILE

Sony Semiconductor Solutions

SENSING INITIATIVES

Next is the sensing area. In the future, we believe that the era of the "Sensing Society" will come with sensing technology and become an important foundation of society as a whole. The potential of the image sensor, which captures a lot of information, is particularly large. Here we would like to explain more on the automotive, industry, and solutions areas.

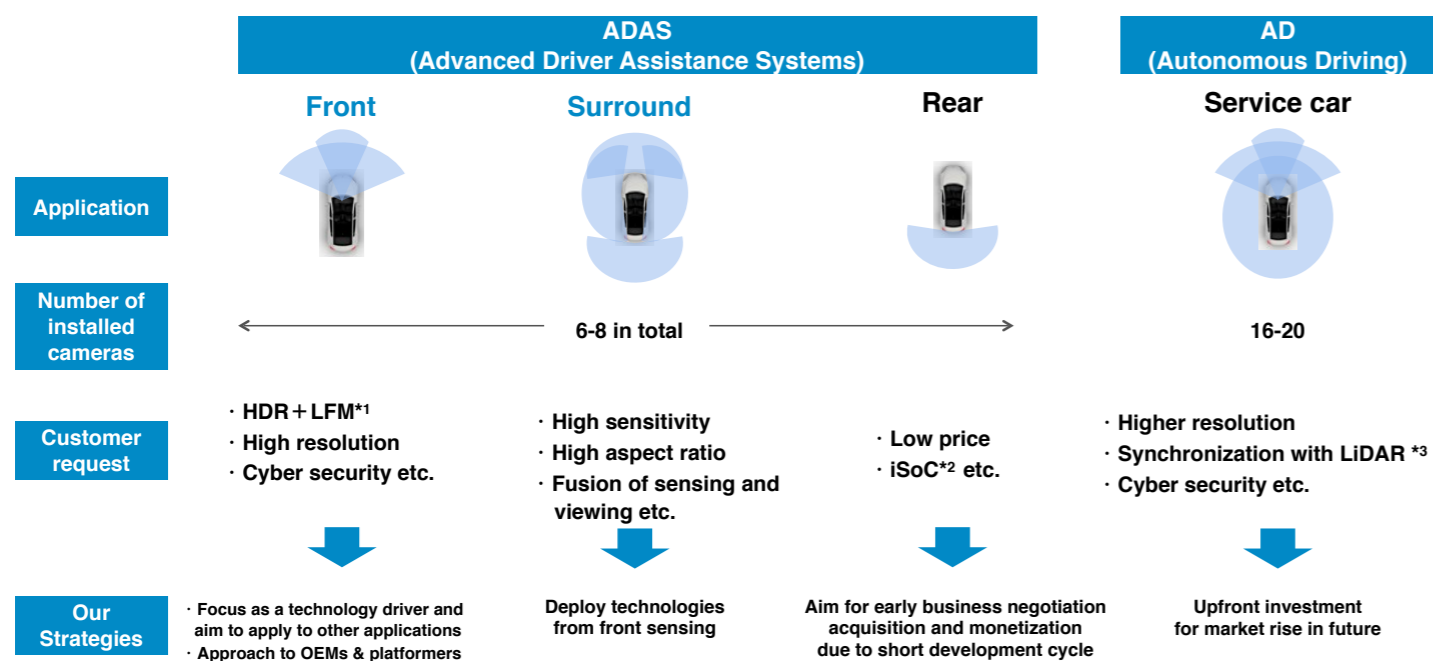
AUTOMOTIVE AREA

First is the automotive area. In automotive cameras, there are two major areas, ADAS and Autonomous Driving. The ADAS area is further divided into three areas: front, surround, and rear. By focusing on

the front, we will build a competitive advantage and leverage that advantage in other applications. Surround is also an important area where we aim to win business in this area by leveraging the technology we will develop in the frontal area. In terms of product other than the CMOS image sensor, we have developed and announced a stacked single-photon avalanche diode (SPAD) depth sensor for automotive LiDAR. By employing SPAD pixels as the detector in a direct Time-of-Flight (dToF) sensor, it is possible to accomplish long-distance, high-precision distance measuring.

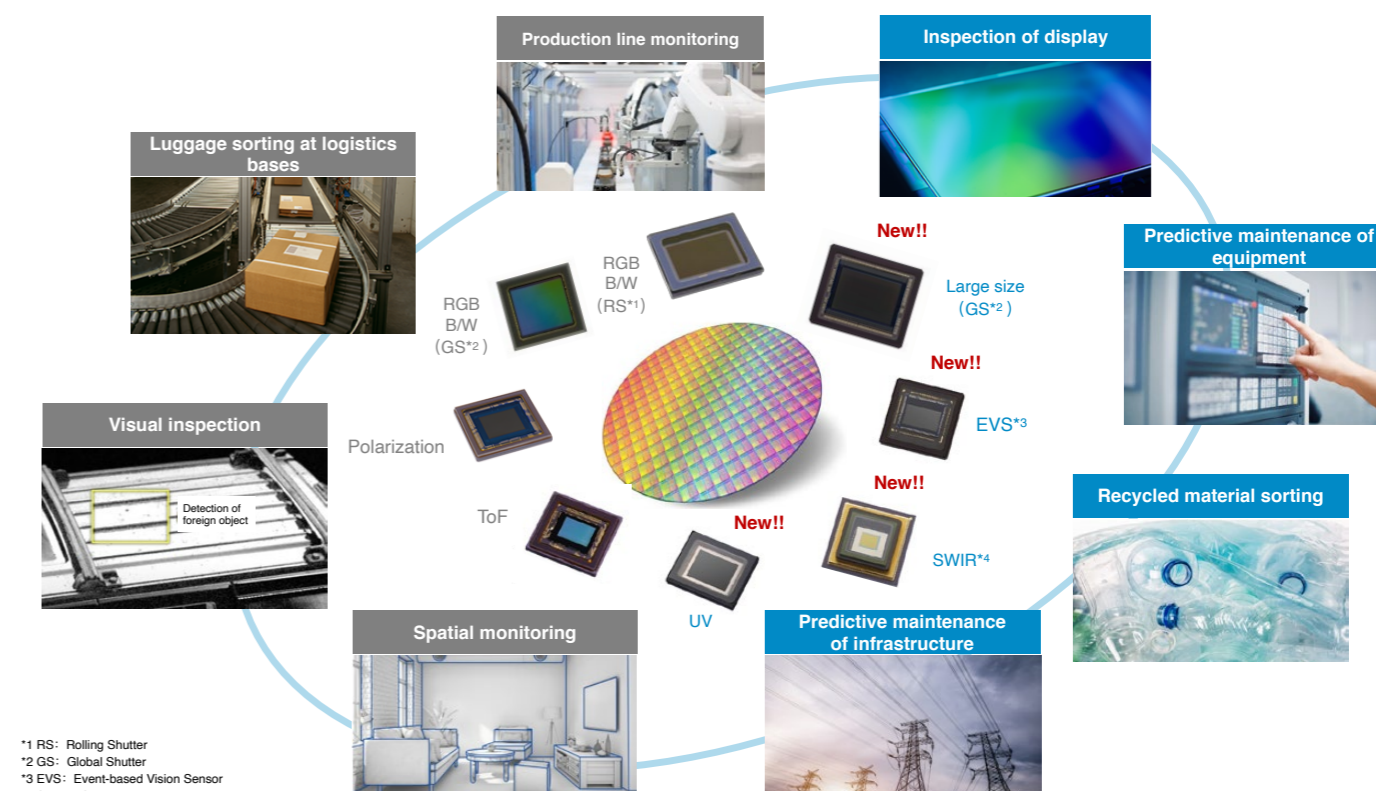
<https://www.sony-semicon.co.jp/e/products/IS/automotive/technology.html>

DIRECTION OF AUTOMOTIVE AREA



*1 LFM: LED flicker mitigation *2 iSoC: Image sensor with ISP *3 LiDAR: Light Detection And Ranging

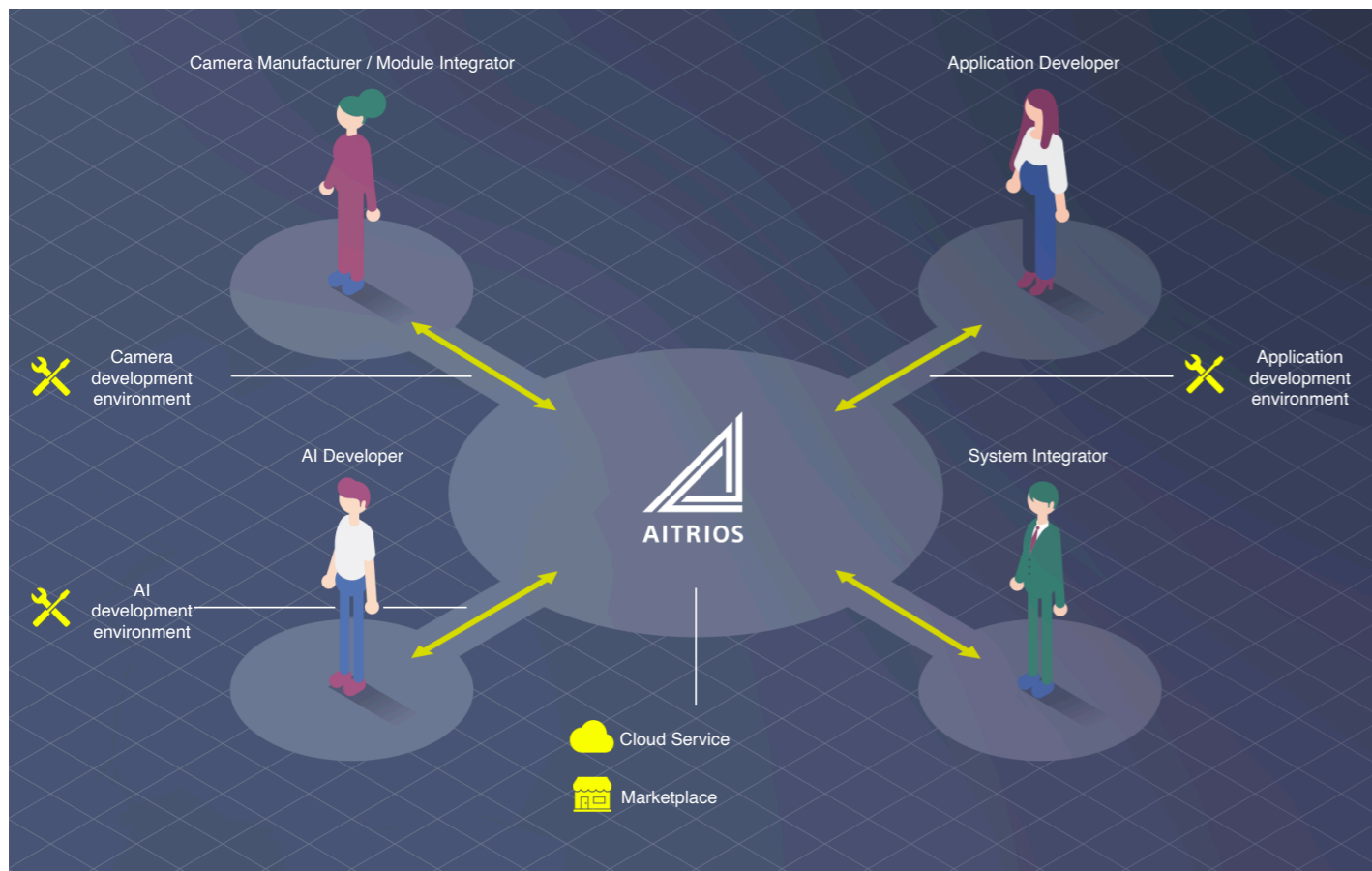
INDUSTRIAL APPLICATIONS



*1 RS: Rolling Shutter
*2 GS: Global Shutter
*3 EVS: Event-based Vision Sensor
*4 SWIR: Short Wavelength Infra-Red



SOLUTION BUSINESS



INDUSTRY AREA

In the industry area, in addition to global shutters, polarization, and Time-of-Flight, mainly for factory automation, we have released many sensors, such as large format image sensors with global shutter, event-based vision sensors, SWIR sensors, and UV sensors. We believe that these diverse sensor models are our greatest strength.

<https://www.sony-semicon.co.jp/e/products/IS/industry/>

SOLUTION BUSINESS

In the solutions business which we are continuing to pursue, we announced the edge AI sensing platform "AITRIOS™" last October for further expansion of our solutions business. With AITRIOS, we also aim to take on the challenge of our recurring business in addition to our sensor business.

<https://www.aitrios.sony-semicon.co.jp/en>

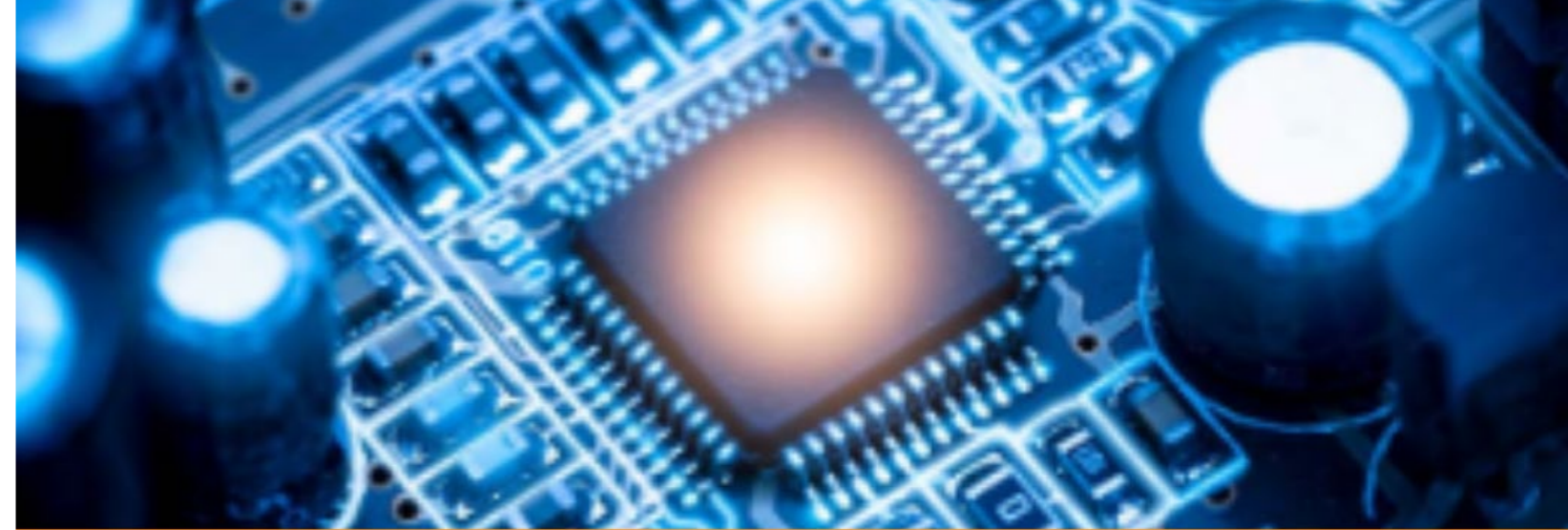
"SENSE THE WONDER"

"Sense the Wonder" is a corporate message from us to encourage society to "feel more curiosity" and "make the world more full of surprises and excitement." We believe that new encounters with people who respond favorably to the idea contained in this slogan will lead to creation of new value.

<https://www.sony-semicon.co.jp/e/company/vision/>

Visit us at: <https://www.sony-semicon.co.jp/e/>

AITRIOS is the registered trademark or trademark of Sony Group Corporation or its affiliated companies.



MathWorks Partnership

MathWorks is proud to support more than 20 Silicon Catalyst startups. The startups have leveraged over 130 licenses and hundreds of hours of technical support across the globe.

Silicon Catalyst startups bring some of the most interesting challenges that MathWorks engineers love to solve.

We look forward to our continued support of Silicon Catalyst as the program expands in Europe, India, and other parts of the world.



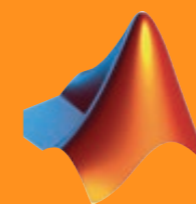
Analog Mixed-Signal - SerDes - RF IC and System Design



5G - Phased Array - WLAN - Antenna



Code Gen for Embedded - FPGA - GPU's



MathWorks®

MathWorks.com/startups



STRATEGIC PARTNER EMD ELECTRONICS



Collaborating with Startups to Accelerate Semiconductor Product Disruption in a Materials World

by Dr. Jacob Woodruff, Head of Technology Scouting and Partnerships

The number of different materials used in next-generation technologies and products is increasing dramatically, and startups, in particular, are exploring many variations for their new products.

EMD Electronics and Silicon Catalyst have partnered to encourage emerging companies in the semiconductor materials, process, and device space to join Silicon Catalyst, where selected companies

will get access to resources for various stages of product development and commercialization. Collaboration with EMD Electronics can provide valuable opportunities, including proof of concept, joint development agreements, materials and expertise support, early customer validation, and introduction to its strategic investment arm, MVentures.

In addition, Silicon Catalyst is partnering with Intermolecular, the

Silicon Valley science hub of Merck KGaA, Darmstadt, Germany and its electronics business which operates as EMD Electronics in the U.S. and Canada. Through their Startup Accelerator program, Intermolecular engages the start-up ecosystem to offer R&D services and explore potential new applications. These can be in areas ranging from neuromorphic computing and architectures, quantum computing to sustainability, and semiconductors



DR. JACOB WOODRUFF
HEAD OF
TECHNOLOGY SCOUTING
AND PARTNERSHIPS

Dr. Jacob Woodruff is Head of Technology Scouting and Partnerships, NA and EU, with EMD Electronics, where he works to find and advance external early stage and disruptive technologies. Dr. Woodruff is an experienced technologist, having managed global R&D groups developing semiconductor deposition materials at EMD Electronics. Previously, he lead ALD process technology development teams at ASM, and at SunPower and Nanosolar, managed R&D labs and developed processes for solar cell manufacturing. He holds a Masters in Materials Science and Engineering and a PhD in Physical Chemistry from Stanford University.



- any application where materials play a key role in product development.

“As our science hub in the Silicon Valley, Intermolecular acts as a valuable toolbox of integral research, testing, and development capabilities that allow us to continuously advance material innovation,” said Jacob Woodruff, Head of Technology Scouting & Partnerships, EMD Electronics

“Intermolecular’s custom-built tools, test vehicles, and rigorous analytics, coupled with tailored methodologies enable IP-protected, high-quality data generation for accelerating materials, processes, and device learnings,” added Ganesh Panaman, Head of Intermolecular.

Intermolecular is the trusted partner in materials innovation and can work with startups to help accelerate the speed of learning and generate datasets for AI/ML through its full suite of innovation services. These include screening materials to identify which ones will work best for the startup’s goals, exploring multiple materials for

a given application, studying materials companies are most interested in, and delivering solutions to customers’ specifications.

Additionally, Intermolecular’s proven workflows and simplified test vehicles can be deployed to physically, optically, and electrically characterize individual films and film stacks and understand their impact on device performance. The result is demonstrated high-quality and comprehensive data sets that customers leverage to make confident material decisions that lead to smarter product development.

Whether it is achieving a proof-of-principle, a first prototype, or a small series production, Intermolecular tailors solutions to meet a startup’s unique needs.

ABOUT EMD ELECTRONICS

EMD Electronics is the U.S. and Canada electronics business of Merck KGaA, Darmstadt, Germany. EMD Electronics’ portfolio covers a broad range of products and solutions, including high-tech materials and solutions for the semiconductor

industry as well as liquid crystals and OLED materials for displays and effect pigments for coatings and cosmetics. Today, EMD Electronics has approximately 2,000 employees around the country, with regional offices in Tempe (AZ) and Philadelphia (PA). For more information, please visit www.emd-electronics.com.

ABOUT INTERMOLECULAR

Intermolecular is a trusted partner for materials innovation and the Silicon Valley science hub of Merck KGaA, Darmstadt, Germany and its electronics business. Intermolecular explores, tests and develops advanced materials that are revolutionizing the next generation of electronics that make lives easier, entertaining and more productive. For more than 15 years, the team, methodologies and quality data have driven impactful outcomes, market opportunities and innovative product designs for customers.

Reach out to us at jacob.woodruff@emdgroup.com to learn how we can accelerate the discovery and development of your products.

STRATEGIC INVESTMENT PARTNER *Mayfield*
MAYFIELD

The Golden Age of Semiconductors Continues

by Navin Chaddha

As a venture capital firm with a 50+ year history of investing, we have witnessed many technology inflection points. Iconic semiconductor companies, which gave Silicon Valley its name, grew by taking advantage of Moore's Law, doubling processing speeds every 24 months by packing more transistors on chips. About five years ago we, along with others, observed a plateauing of Moore's Law, giving rise to a need for architectural innovation & workload-optimized silicon. I shared how the Renaissance of Silicon would create new industry giants, and wrote about opportunities for startups.

In 2023 the golden age for semiconductor innovation continues, enabling the rise of startups to serve emerging market needs. This is driven by governmental policy and four industry shifts.

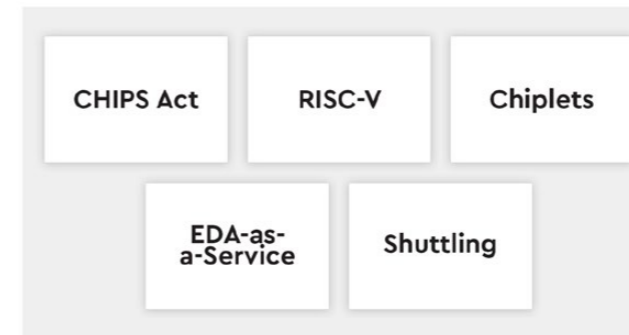
CHIPS Act: The recently signed CHIPS Act, through which the government will provide incentives for companies to manufacture semiconductors within the US, is a major development. These incentives extend to the supply chain and companies operating in mature nodes. In addition, there are R&D provisions that intend to improve access to prototyping which can encourage startups that need to leverage fab process changes to innovate. There are also expectations for a \$500M fund for chip startups.

RISC-V: We have seen the increasing momentum of the RISC-V movement, an open source architecture which has the potential to create exponential opportunities, similar to how Linux impacted software. Startups who are freed from using the closed X86 system or paying the prohibitive licensing fees imposed by ARM, are inventing new processors for new applications.

Current & Milestone Semiconductor Investments



Mayfield People First.



Chiplets: The emergence of chiplets – tiny integrated circuits that contain a well-defined subset of functionality and which can be implemented in a mix-and-match “LEGO-like” assembly – is another trend powering innovation.

EDA-as-a-Service: Cloudification has come to semis with the emergence of EDA-as-a-service, providing vendors access to design tools in a pay-per-use model.

Shuttling: And the prevalence of *shuttling* – the ability to utilize partial capacity in fabs – similar to renting space in shipping containers, has greatly reduced the cost of getting to the tape out stage.

EIGHT MARKET OPPORTUNITIES WILL BENEFIT FROM THE AVAILABILITY OF SPECIALIZED SILICON:

- **IoT** – The 100 billion devices that are touching all aspects of our lives – smart thermostats, doorbells and more – need to have intelligent processors with cellular internet connectivity.
- **Autonomous** – This is a complicated problem, as self-driving and ADAS (advanced driver assistance systems), are augmenting humans for the first time. A car is bigger than a data center with hundreds of interconnects. There has to be breakthrough processing at the edge, through inference chips as an example, as a bandwidth heavy solution like sending data back into the cloud for AI processing will not work.

• **Cooling** – Climate change is coming to data centers which are already moving to liquid emergent cooling, but that is not enough. Phones have 10x the power of desktops 10 years ago—when they overheat, they have to throttle the CPU, leading to poor performance. Miniature devices struggle to fit fans. There will be a new wave of solid state cooling startups addressing this need.

• **Biology** – Breakthrough health devices such as next generation sequencers, needle-free glucose monitoring sensors, new diagnostics systems and the like are creating the need for new kinds of special purpose chips.

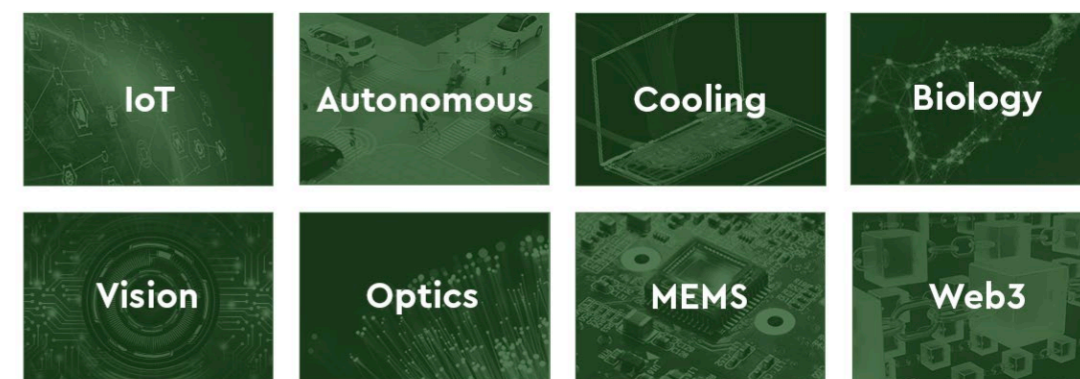
• **Vision** – Most devices now have eyes (phones, doorbells, cars) and as their resolution goes higher, we need their processing power to catch up.

• **Optics** – Copper wires have limited capacity leading to the need for optical interconnects to handle 400-800 gigabits/second. What used to happen in telecom with undersea fiber will now happen in commercial offices and data centers for connectivity.

• **MEMS** – There will be a lot of new innovation in sensors for various applications.

• **Web3** – Similar to how Cisco, Sun Microsystems, Palo Alto Networks or Juniper Networks served as the gateway to the Internet in Web 1.0, we believe that new equipment giants for Web3 will be created.

The semiconductor industry has a 70+ year history of innovating at inflection points to create new categories of products and maintain the US competitive advantage. I believe we are at another such inflection point, one in which governmental support and the driving force of new markets are coinciding to help entrepreneurs put silicon back into Silicon Valley.



PORTFOLIO COMPANY ALUMNI AYAR LABS 

Leveraging optical chip-to-chip connectivity to unleash the complete potential of AI – An interview with Ayar Labs

www.yolegroup.com | From the archives

Co-packaged optics (CPO) has gained attention recently due to its power efficiency in datacenters. While most leading proponents of CPO targeting networking applications have discontinued CPO programs due to macroeconomic headwinds, the situation of CPO for artificial Intelligence (AI) and machine learning (ML) systems is different. AI models have an insatiable demand for computing power, storage, and data movement, and traditional architectures are becoming the main bottleneck for scaling ML. As a result, new optical interconnects have emerged for HPC and new disaggregated system architectures, which Yole Intelligence, part of Yole Group reviews in its new report, Co-packaged Optics for Datacenter. In-package optical I/O technology for xPUs, memory, and storage can help achieve the necessary bandwidths. Moreover, the potential for billions of optical interconnects in the future is driving big foundries to prepare for mass production (including silicon photonics process flows) of any PIC architecture from design houses. CPO revenue was about US\$38 million in 2022 and is expected to reach US\$2.6 billion in 2033, at a 46% CAGR for 2022 – 2033, driven by accelerated data movement in AI/ML gear.

The combination of TeraPHY™ optical I/O chipllets and SuperNova™ light sources from Ayar Labs delivers dramatically increased bandwidth, at lower latency, over longer distances and at a fraction of the power of existing electrical I/O solutions. Its in-package optical I/O solution is disrupting the traditional performance, cost, and efficiency curves of the semiconductor and computing industries. Martin Vallo, Senior Analyst at Yole Intelligence, had the pleasure of interviewing Terry Thorn, Vice President of Commercial Operations at Ayar Labs, and discussing the current trends in optical interconnects for datacenter applications.

MARTIN VALLO (MV): We had our last interview in 2021 when you presented your breakthrough optical I/O solution enabling optical communication between computing chips. What is new in the life of Ayar Labs?

TERRY THORN (TT): Over the past 18 months, we have



TERRY THORN
VICE PRESIDENT
OF COMMERCIAL
OPERATIONS

Terry Thorn is Vice President of Commercial Operations. He joined Ayar Labs after 24 years at Intel Corporation where he held a variety of leadership positions in product line management, marketing, global cloud strategy, new business development and sales. Most recently, Terry was the GM of Global Accounts in the Cloud & Enterprise Sales Group with direct ownership of some of Intel's largest customers. He has a Bachelor of Science in Mechanical Engineering and an MBA from the University of Alabama.



MARTIN VALLO
SENIOR ANALYST
PHOTONICS AND
LIGHTING

With 12 years' experience within semiconductor technology, Martin is involved today in the development of technology & market reports as well as the production of custom consulting projects at Yole. Prior to his mission at Yole, he worked at CEA (Grenoble, France), with a mission focused on the epitaxial growth of InGaN/GaN core-shell nanowire LEDs by MOCVD and their characterization for highly flexible photonic devices. Martin graduated from Academy of Sciences, Institute of Electrical Engineering (Slovakia) with an engineering degree in III-nitride semiconductors.

kicked off several high-profile strategic partnerships while also building key relationships with high-volume foundry, laser and supply chain partners. We started 2022 by celebrating a strategic partnership with Hewlett Packard Enterprise. Shortly thereafter, GlobalFoundries announced its new Fotonix manufacturing process that we used to demonstrate our first working silicon in June 2021 at OFC.

Other key milestones included our \$130 Million Series C Funding, as well as partnerships with GPU and

PORTFOLIO COMPANY ALUMNI AYAR LABS CONT. 

AI powerhouse NVIDIA and leading aerospace and defense contractor Lockheed Martin to develop optical interconnects. We closed out 2022 with the \$15 million multi-year award of Project KANAGAWA with the Department of Defense that will promote the next-level development of Ayar Labs' optical interconnects to lead its transition into the DoD's advanced packaging ecosystem.

Most recently, we held a live demonstration of our optical I/O solution successfully showing 4 terabits per second (bidirectional) data transfer. We also featured our technologies in our ecosystem partners' booths, including GlobalFoundries, Quantifi Photonics and Sivers Photonics. The unveiling of a prototype of our solution with Intel's detachable optical connector at the package edge also generated a lot of interest at OFC this year. In a conventional edge-coupled method, the fiber ribbons are permanently attached into the V-grooves with epoxy. The detachable optical connector provides a means to replace the fiber ribbons. Still under development, the detachable optical connector holds promise for higher package yield and ease of field replacement.

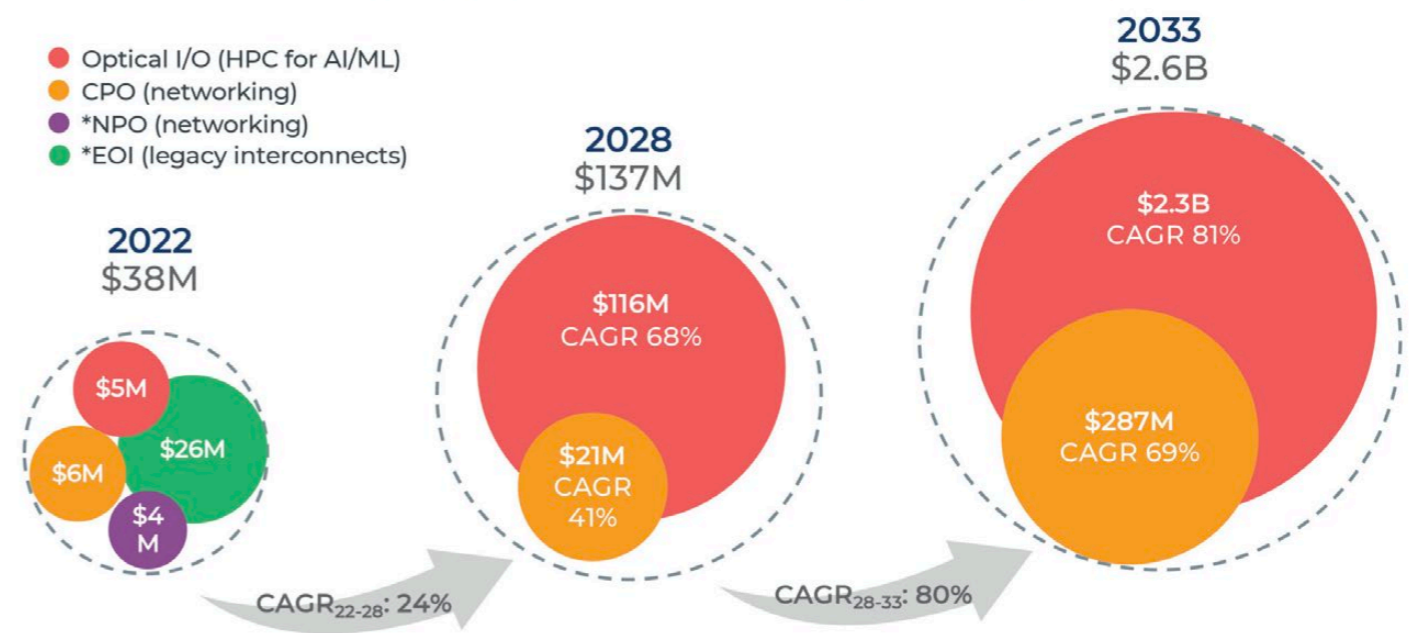
We have also seen a growing trend towards using chipllets and a robust standardization effort to enable an open chipllet ecosystem. This is an important development that is aligned with our vision of delivering optical I/O solutions in the form of chipllets.

MV: WE OBSERVE THERE IS LESS INTEREST IN CPO, PARTICULARLY FOR SWITCH APPLICATIONS. HOWEVER, THE DEMAND FOR OPTICAL I/O FOR HIGH-PERFORMANCE COMPUTING CONTINUES. WHAT ARE THE UNDERLYING REASONS FOR THIS?

TT: Optical I/O is better suited for high-performance computing (HPC) and artificial intelligence (AI) / machine learning (ML) applications, where you need distributed computing and shared memory capacity to meet demands for performance, power and bandwidth without increasing latency. Optical I/O with wavelength division multiplexing (WDM) and simple modulation requires far less power and allows much greater density – as low as a few pJ/bit and a bandwidth density of up to 1 Tbps/mm – resulting in just a few nanoseconds of latency, versus

2022-2033 DATACOM OPTICS REVENUE FORECAST

Source: Co-packaged Optics for Datacenter 2023 report, Yole Intelligence, 2023



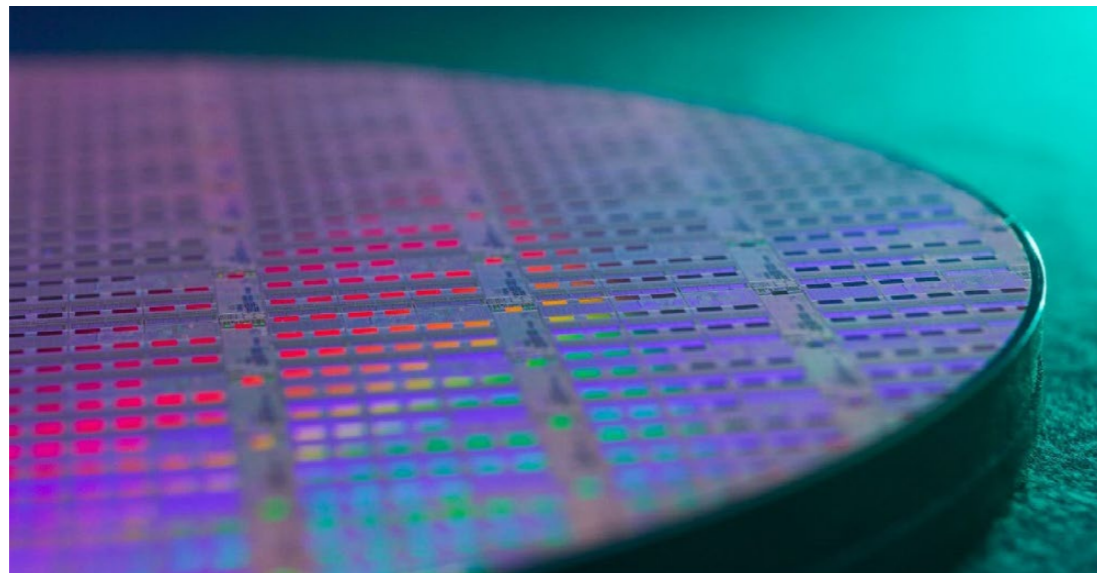
*In 2027 EOI and NPO will be replaced by CPO



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PORTFOLIO COMPANY ALUMNI AYAR LABS CONT.

Ayar Labs TeraPHY™ optical I/O wafer from GlobalFoundries Fotonix™ monolithic RF-CMOS platform.
Courtesy of Ayar Labs, 2023



hundreds of nanoseconds with CPO that tends to use complex modulation schemes.

In addition, as an electro-optical transceiver, optical I/O uses a microring modulator structure, requiring a much smaller chip area that results in a lower cost. For example, our microring modulator is approximately one hundredth the size of a Mach-Zehnder modulator. Lastly, optical I/O uses WDM, which allows multiple data streams to be packed into a single fiber to achieve very high throughput.

MV: WHAT WILL BE THE FIRST ACTUAL APPLICATION FOR OPTICAL I/O, AND WHEN CAN WE EXPECT AN ANNOUNCEMENT? WHAT ARE THE CHALLENGES TO OVERCOME BEFORE WE SEE THE FIRST OPTICAL I/O IN AI/ML SYSTEMS?

TT: We see many different applications that are all running into the same power, performance, and latency challenges, and each has a strong need for optical I/O:

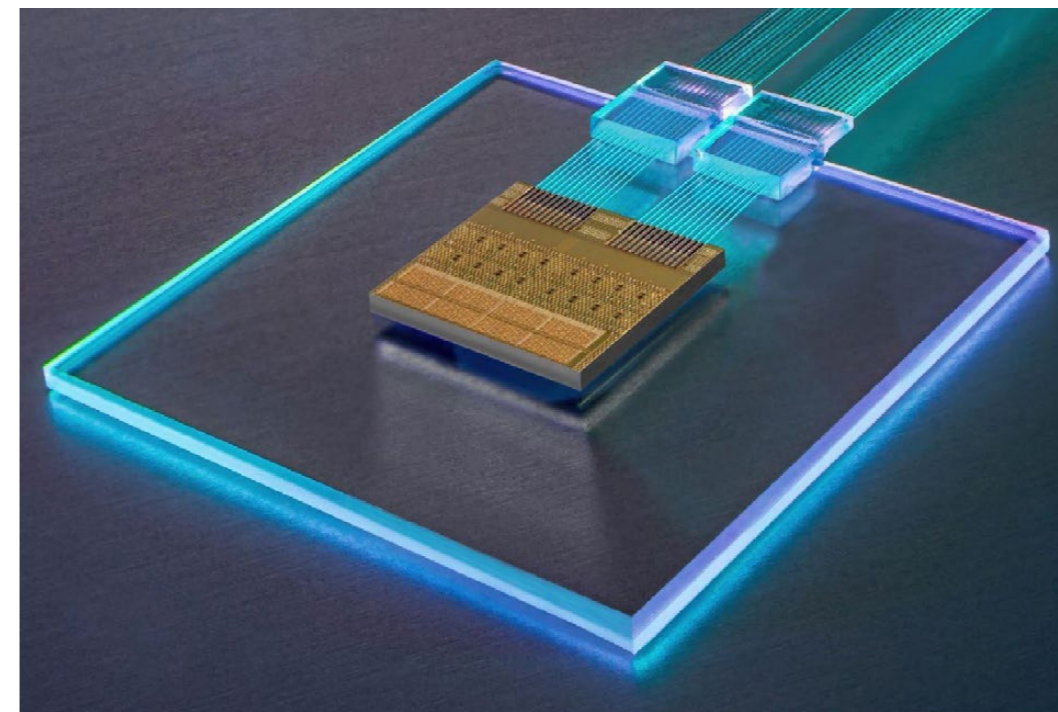
Artificial Intelligence and HPC. AI/ML and HPC applications require a distributed network of accelerators to disperse the computations and share memory capacity. With respect to memory capacity, an AI/ML model with hundreds of billions of parameters may require up to 2 terabytes of memory capacity to store intermediate computation results. When you connect hundreds of GPUs in a cluster such that every GPU can talk to the others, the data throughput required out of each GPU multiplies quickly. This puts enormous pressure on

bandwidth density – a measure of data throughput that can be realized per package edge or area. Optical I/O is critical to achieve the required bandwidth density, power, and latency performance metrics to enable larger clusters.

High-Bandwidth Memory (HBM) Expanders. A GPU is typically surrounded by two to four local memory HBM stacks, each having about 64 GBytes of memory capacity. For HPC and AI/ML applications, this capacity is not sufficient. An HBM memory expander can be used to increase memory capacity to hundreds of GBytes and more. Since memory applications are very latency sensitive, using optical I/O links to connect the GPUs to the expander memory modules is necessary. Pluggable optics or CPO optics are not suitable due to the latency issue alone.

Memory Pooling and Composable Infrastructure. As cloud infrastructure deals with dynamically changing workloads, flexibility to pool and share memory is becoming critical. The vision of composing workload-based clusters with desired CPUs, GPU, memory and storage resources that are interconnected with high performance and low latency. Optical I/O interconnect is coming into focus with adoption of the CXL™ standard.

Sensory Systems for Aerospace and Defense. In this example, one that reflects our recently announced strategic collaboration with Lockheed Martin, optical I/O is used to capture, digitize, transport and process spectral information. Multi-chip package solutions that place high-density, high-efficiency optical I/O chiplets in the same package as the RF



Ayar Labs TeraPHY™ optical I/O chiplet with 4 Tbps bi-directional bandwidth, at less than 5pJ/b, latency of 5ns per chiplet + TOF, and a reach of millimeters to kilometers.
Courtesy of Ayar Labs, 2023

processing devices will be used in phased-array apertures to connect systems to make smarter and faster decisions. Currently, the primary challenge for optical I/O is ecosystem development, which requires the coordination of many companies. We are working with a wide range of partners to foster the development of that ecosystem. As for the first announcements of these applications, we expect those to come sooner rather than later given the existing market need, perhaps within the next year or so.

MV: OPTICAL I/O PERFORMANCE ENABLES XPUS TO COMMUNICATE WITH EACH OTHER ACROSS A WIDE RANGE OF DISTANCES, FROM MILLIMETERS UP TO TWO KILOMETERS. THEREFORE, INTENSE COMPETITION IS EXPECTED BETWEEN AOC (ETHERNET) AND OPTICAL I/O (CXL, UCIE). HOW WILL THE BATTLE BETWEEN THESE TWO TECHNOLOGIES PLAY OUT?

TT: There is a clear distinction between Ethernet applications and compute or memory-centric applications, so we do not view AOC as a direct competitor. Within the compute or memory-centric interconnect protocols, Compute Express Link™ (CXL) and Universal Chiplet Interconnect Express™ (UCIe™) are complementary. CXL is a higher-layer protocol that traditionally runs on a PCIe physical layer. Recently, CXL has been expanded to also work with a UCIe physical layer. For off-chip connectivity within racks or across racks, UCIe optical retimers built using optical I/O technology can deliver low power, low latency, and high bandwidth density metrics that cannot be met with AOC.

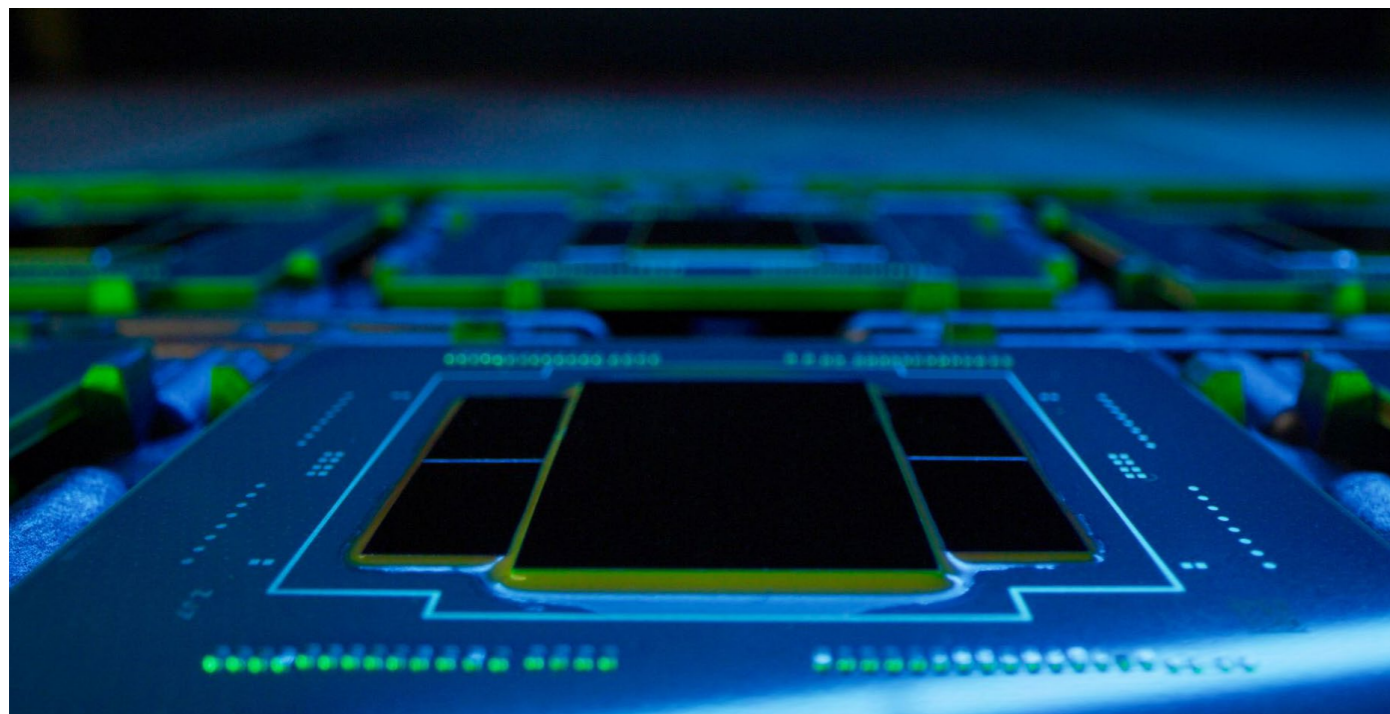
With optical interconnects, we can achieve greater reach with lower power consumption and latency. There will still be non-latency-sensitive applications that can accommodate higher power requirements, and Ethernet will be the preferred choice, including system-to-system communications. In these instances, AOC could be used. But once you start considering deep learning and HPC application – where, again, you are connecting many compute nodes together – AOC may not meet all the performance metrics.

MV: HOW DO YOU SEE THE EVOLUTION OF OPTICAL I/O IN TERMS OF TECHNOLOGY?

TT: First and foremost, optical I/O is highly scalable and there are several ways the technology will evolve. One is in the number of lambdas per fiber. We are currently using eight lambdas per fiber, but the CW-WDM MSA (Continuous-Wave Wavelength Division Multiplexing Multi-Source Agreement) roadmap already has specifications for 16 and 32 lambdas per fiber. Every time you double the number of lambdas per fiber – keeping everything else the same – you automatically double the amount of bandwidth. We can also scale up the number of optical ports (we are currently using eight) and increase the modulation rates (we are currently using a modulation rate of 32 Gbps).

Within optical I/O, we expect to see a divergence in the use of internal or external lasers. We continue to prefer the external laser approach given the compact form factor, flexibility, and field replaceability. We also believe UCIe is

PORTFOLIO COMPANY ALUMNI
AYAR LABS CONT. 



Four Ayar Labs TeraPHY™ optical I/O chipslets and a customer's ASIC in a multi-chip package.

Courtesy of Ayar Labs, 2023

the best-suited standard for die-to-die connectivity, which fosters the chiplet approach of implementing optical I/O.

MV: WHAT ARE THE KEY SPECIFICATIONS AROUND LASER SOURCES? WILL WE SEE WIDELY INTEGRATED LASERS IN OPTICAL CHIPLETS IN THE FUTURE?

TT: The current trend in the industry, and one we believe will continue, is the use of external laser sources. In optical I/O, the laser is the most sensitive component and needs to operate in a cooler temperature environment. Keeping it external and separate from the compute silicon allows you to better and more efficiently control the temperature. If you were to put the laser module next to the compute silicon, the heat coming from the GPUs and CPUs inside the compute node could impact the laser performance.

We do expect to see the use of comb lasers but they are still in the early research stage of development. It is something we could take a look at when the technology becomes commercially available. But, ultimately, we believe remaining 'external laser agnostic' makes the most sense in terms of manufacturing and deployment.

MV: THERE HAVE BEEN MANY DISCUSSIONS ON DISAGGREGATED RACK ARCHITECTURE, CURRENTLY THE MAIN DRIVER OF OPTICAL I/O TECHNOLOGY. COULD YOU SHARE HOW DISAGGREGATION WILL EVOLVE?

TT: Disaggregated infrastructure needs optical I/O to scale to the rack level and beyond. Disaggregated architectures that decouple memory from processors and accelerators allow for more flexible and cost-effective node designs that can meet the demands of next-generation HPC and AI workloads. For disaggregation to be possible, an interconnect that can deliver high throughput at low power and low latency over distances ranging from a few meters to hundreds of meters is critical. CXL, an emerging unified protocol for disaggregated systems, uses PCIe electrical signaling for I/O interconnect which has limited reach. To extend the reach and fanout, there is strong interest for a "CXL over optical" I/O interconnect.

For example, it is easy to envision a composability scenario in which several CPUs are contained in one chassis, and the GPUs are in a separate chassis while memory occupies another. As workloads scale up, you can compose two CPUs,

one GPU, several SSDs and pool some amount of memory to create one node. CXL brings cache coherent interconnect to memory disaggregation, which is why so many companies are working towards solutions that leverage CXL – and we believe optical I/O is a key ingredient to enable that vision.

Another important angle here is distributed computing, which goes back to the fact that AI/ML and deep learning all require a massive amount of training parameters — now in the trillions. Sharing the computation and memory between various compute nodes will be increasingly necessary. The only reliable way to connect these nodes and scale efficiently is through optical I/O.

MV: BRINGING ELECTRO/OPTICAL INTERFACES NEXT TO THE CHIP WILL SIGNIFICANTLY IMPACT THE INDUSTRY. COULD YOU EXPLAIN HOW THE SUPPLY CHAIN WILL BE AFFECTED?

TT: The industry is currently facing significant connectivity bottlenecks, and this is forcing the various players to explore new approaches. One trend we are seeing is the breaking up of SoC monolithic dies into chiplets. Incorporating electro-optical chiplets inside the package, right next to the SoC core die, is a continuation of this trend. This in-package approach will require changes in the supply chain.

In addition to packaging with chiplets, fiber attach and test methodologies need to evolve. We are also seeing strong progress and commitment from the foundries – namely

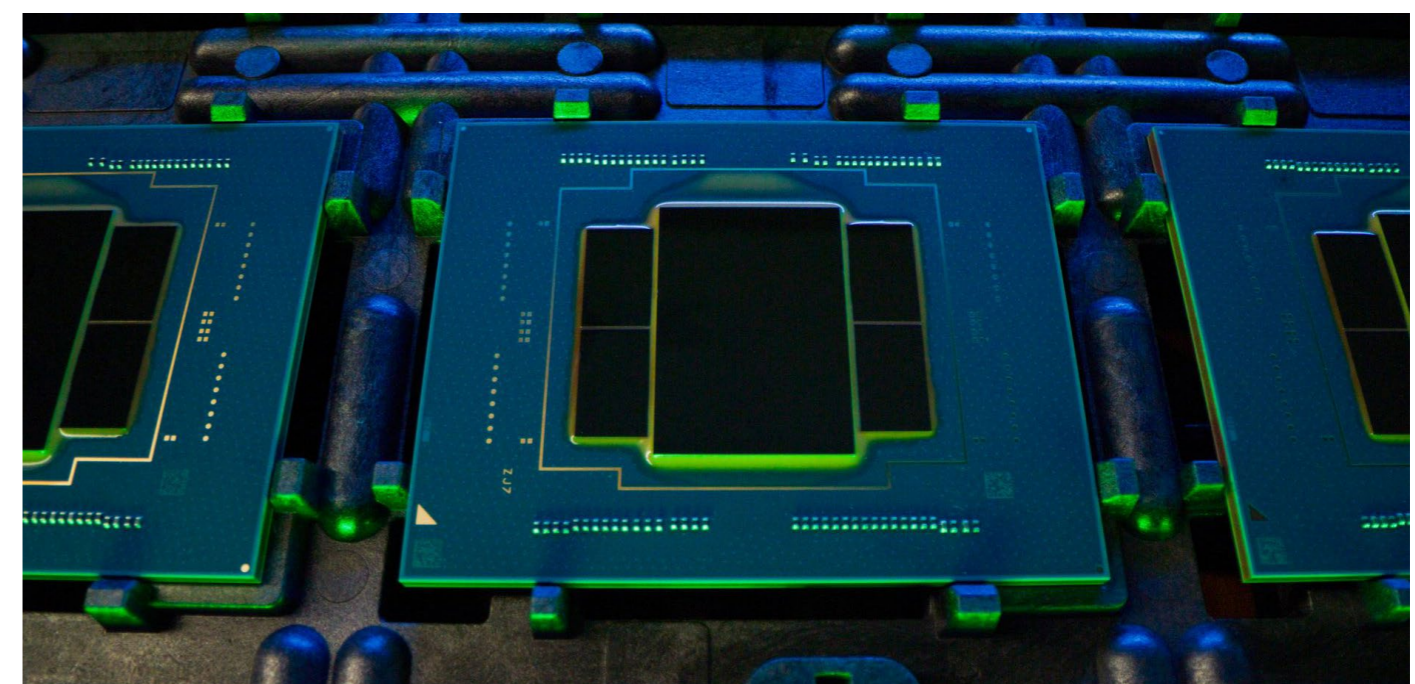
GlobalFoundries, Intel, and most recently, TSMC – in supporting integrated electro/optical components. Lastly, choosing to keep the lasers external is one way we are able to alleviate these supply chain complexities.

Standardization will also play a key role in addressing supply chain challenges and scaling this technology. Both UCle and CXL are looking to address interconnects over optical fiber and are exploring the formulation of optical I/O specifications. Further, the CW-WDM MSA is a critical industry initiative that is defining and promoting new standards and specifications for optical laser sources. There is a tremendous need to develop and nurture this full ecosystem because optical I/O is such a revolutionary technology impacting so many areas of the industry.

MV: HOW WILL OPTICAL I/O TECHNOLOGY AFFECT OTHER APPLICATIONS?

TT: That is a great question. We have talked a lot about HPC and AI/ML already, but we also expect to see its use grow in other areas that require the rapid transfer of data such as in the cloud and datacenter, telecommunications, aerospace and defense, autonomous driving, AR/VR and more. As optical I/O matures and becomes even more cost-effective, we see the potential for it to meet the growing bandwidth, power and latency requirements of a wide range of applications.

<https://ayarlabs.com/>



A multi-chip package with four Ayar Labs TeraPHY™ optical I/O chipslets and a customer's ASIC.

Courtesy of Ayar Labs, 2023

PORTFOLIO COMPANY NEWS SALIENCE LABS



CEO Interview: Vaysh Kewada

Daniel Nenni - SemiWiki.com | From the archives

Vaysh Kewada is cofounder and CEO at Salience Labs, a company developing an ultra high-speed multi-chip processor that packages a photonics chip together with standard electronics to enable exascale AI. Salience is funded by Oxford Sciences Enterprise, Cambridge Innovation Capital, Arm-backed Deeptech Labs, former Dialog Semiconductor CEO Jalal Bagherli and former Temasek board member Yew Lin Goh. Prior to launching Salience Labs, Vaysh worked at Oxford Sciences Enterprises, a \$745M VC fund focused on deep-tech investments. Prior to that, she was a management consultant at McKinsey & Company. Vaysh holds an undergraduate and Masters degree in Physics from Imperial College London, where her thesis focussed on genetic algorithms.



Multi-chip processors – ones that package together several platform technologies – is that step-change, allowing us to package electronics together with silicon photonics, and to move compute from electronics to the realm of light. By using light to execute operations, it's possible to achieve massively parallel performance and deliver high throughput, low latency matrix maths – at the root of almost all AI applications. And it's possible to do this with clocking speeds in the 10s of GHz – where currently the limitation of even the most cutting-edge chips is just 2-3 GHz.

WHY WAS SALIENCE LABS FOUNDED?

Salience was founded with the vision of creating an exa-scale processor, by packaging a photonics chip together with standard electronics. The technology is based on decades of research at University of Oxford and Münster University in Germany.

The key inventors and researchers of the technology: Professor Wolfram Pernice, Professor Harish Bhaskaran and Dr. Johannes Feldmann, are co-founders in the company, giving Salience Labs significant depth of knowledge in this field.

WHAT MAKES SALIENCE LABS TECHNOLOGY UNIQUE?

While other photonic chip companies execute operations in the phase of light, we use a proprietary amplitude-based approach to photonics, resulting in modular, dense computing chips clocking at 10's of GHz. It also allows for high levels of parallelization, by using different wavelengths of light to send many calculations through the chip. Salience uses a multi-chip design, with the photonic processing mapping directly on top of the Static Random Access Memory (SRAM). This novel 'on-memory compute' architecture allows for the fast compute in the photonic domain to be fully utilized, delivering an

TELL US ABOUT SALIENCE LABS?

Salience Labs was spun out of Oxford and Münster universities in 2021 to commercialise an ultra-high-speed multi-chip processor that packages a photonics chip together with standard electronics. By using light to execute operations, we can deliver massively parallel processing performance – bringing ultra-high speed compute to a wide array of new and existing AI processes and applications.

The compute requirements of AI double every 3-4 months, as the world needs ever-faster chips to grow AI capability. The current semiconductor industry can't keep pace with this demand. What's required now is not further incremental innovations on transistor technology. If we are to realise the tremendous potential of AI, nothing short of a paradigm shift in the way we compute will do. One that delivers an immediate step change in performance and speed, while also offering a long-term future roadmap of scaling improvements.

exceedingly dense computing chip without having to scale the photonics chip to large sizes. This architecture can be adapted to the application-specific requirements of different market verticals, making it ideal for realising AI inference use-cases in communications, robotics, vision systems, healthcare and other data workloads.

HOW HAS THE COMPANY EVOLVED SINCE YOU FOUNDED IT?

We originally spun-out of the University of Oxford and the University of Münster in 2021 and have just closed our seed round of \$11.5 million from a number of leading VCs including Cambridge Innovation Capital, Oxford Science Enterprises and Arm-backed Deeptech Labs participating, plus some leading names in the semiconductor industry including former CEO of Dialog Semiconductor Jalal Bagherli and Yew Lin Goh. Since closing our seed round, our focus has been on the tape out of our next test chip, developing our software models and packaging solutions. We are also building relationships with customers across a range of market verticals.

YOU ARE PARTICIPATING IN THE SILICON CATALYST ACCELERATOR PROGRAMME. WHAT HAS BEEN THE IMPACT ON THE BUSINESS?

We joined the Silicon Catalyst programme in 2021, right after spinning out from Münster and Oxford Universities. The greatest benefit is the access it gives us to advisors

– individuals who have made a significant impact on the global semiconductor industry. In fact, we met our chairman Dan Armbrust through the programme, who is a Silicon Catalyst Co-founder and Board Director. Through those advisors, we gained highly valuable commercial introductions to foundries, IP providers, and EDA providers at a very early-stage of the company. It has given Salience Labs' a commercial jump start. For example, we've just closed our seed round but we're already working with production level foundries on the fabrication of our next test chip. Silicon Catalyst has been a tremendous accelerator for our business.

WHAT CAN WE HOPE TO SEE FROM SALIENCE LABS IN THE FUTURE?

We're at a very interesting point in time where the industry is recognising the potential of multi-chip processors to solve the tremendous processing bottleneck currently hampering AI growth. Salience Labs' technology has the potential for breakthrough performance and power capability beyond what the established CMOS roadmap offers. We're talking to customers across a range of market verticals who are excited about the performance improvements silicon photonics will offer and the new AI processes and applications this will enable. We welcome any additional approaches from potential customers who are interested in understanding the capabilities of silicon photonics.

