

Driving tomorrow's technologies

From digits to quantum: the technology behind the click

BCS South Wales, 11 March 2021



"There are ten types of people in the world: those who understand binary and those who don't."

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Nothing new under the sun?

- Thomas Seebeck discovers the semiconductor properties of PbS
- Michael Faraday reports on conductivity temperature dependence for "semi-conductors"
- Light sensitive properties in Se discovered by W Smith
- Werner von Siemens invents selenium photometer



Nothing new under the sun?

- Samuel Morse sends first telegraph message
- Transatlantic Telegraph cable laid UK-USA
- Alexander Graham Bell demonstrates first telephone





"One day, every town in America will have a telephone"

American small town mayor, 1888



"New Technology" adoption rates (time to 50 million users)



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"We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run"

Amara's Law (American Futurist Roy Amara)





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Semiconductor revolution (transistors per chip)



- **1971** 2,300 (Intel 4004, 12mm²)
- **1979** 29,000 (Intel 8088, 33mm²)
- **1989** 310,000 (ARM 3, 87mm²)
- **1995** 5,500,000 (Intel Pentium Pro, 307mm²)
- **2008** 47,000,000 (Intel Atom, 24mm²)
- **2013** 1,000,000,000 (Apple A7, 102mm²)
- **2018** 10,000,000,000 (Apple A12X/ARM64, 122mm²)
- 2018 23,600,000,000 (Graphcore GC2, 825mm²)

In 1978, a commercial flight between London and New York cost \$900 and took seven

hours

If the principles of Moore's Law worked in the airline industry, that flight would now cost about a penny and take less than one second

Technology revolution







Materials revolution

Evolution defined by importance of materials



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Atomic Engineering



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VCSELs The new era of Laser Technology



QFoundry



Project title: QFoundry (Quantum Foundry) **Project value:** £5,777,425 **Duration:** 36 months

Project partners:





Quantum Key Distribution (QKD)

- Encryption: Quantum Key Distribution (QKD)
- Single photon point t point links
- Entangled photons
- Quantum teleportation





Atomic clocks to sensors

- Improved accuracy for navigation
- Gravity & magnetic field sensors
- Determination and measurement of SI units
- In-process battery cell sensing
- MWIR see through clouds, smoke, snow, smog
- Single photon imaging



Global semiconductor clusters - silicon











Birth of the CSconnected identity

2016

Concept of a common brand agreed between partners

2018

Collective activities established on voluntary basis

2020

Establishment of base for common marketing and skills activities

2017

CSconnected brand concept launched at CS-International conference, Brussels Establishment of Csconnected Ltd

2019

Submission of SIPF proposal under CSconnected brand

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The nucleus of the Global CS Cluster in CCR

Leveraged investment pipeline of >£600m





Collaborative Research & Development Packages

3.1: Next generation optical comms and sensing

Package includes high capacity data-centres and LIDAR sensing for autonomous vehicles.



NWF, Cardiff Uni, Swansea Uni, CSC, IQE, SPTS, CSA Catapult, Microsemi, Rockley Photonics 3.2: Large Scale GaAs-based wafer manufacturing

Development scalable compound semiconductor solutions for photonic, wireless and flexible photovoltaic applications.

IQE, NWF, Microsemi, Swansea, Microlink devices

3.3: Novel and efficient CS Wafer Fabrication Tools

This activity will address the development of next generation processing equipment and associated processes required to scale up CS wafer and device fabrication.



SPTS, Cardiff Uni, CSC, IQE, NWF, CSACatapult.

3.4: Advanced processes for5G and EAV systems

Demonstration of an advanced volume assembly capability for high value CS based electronic modules for 5G components and miniaturised electric vehicle motor drives.



MicroChip, CSA Catapult, Cardiff Uni, Swansea Uni, SPTS, NWF, IQE, CSC

THANK YOU

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