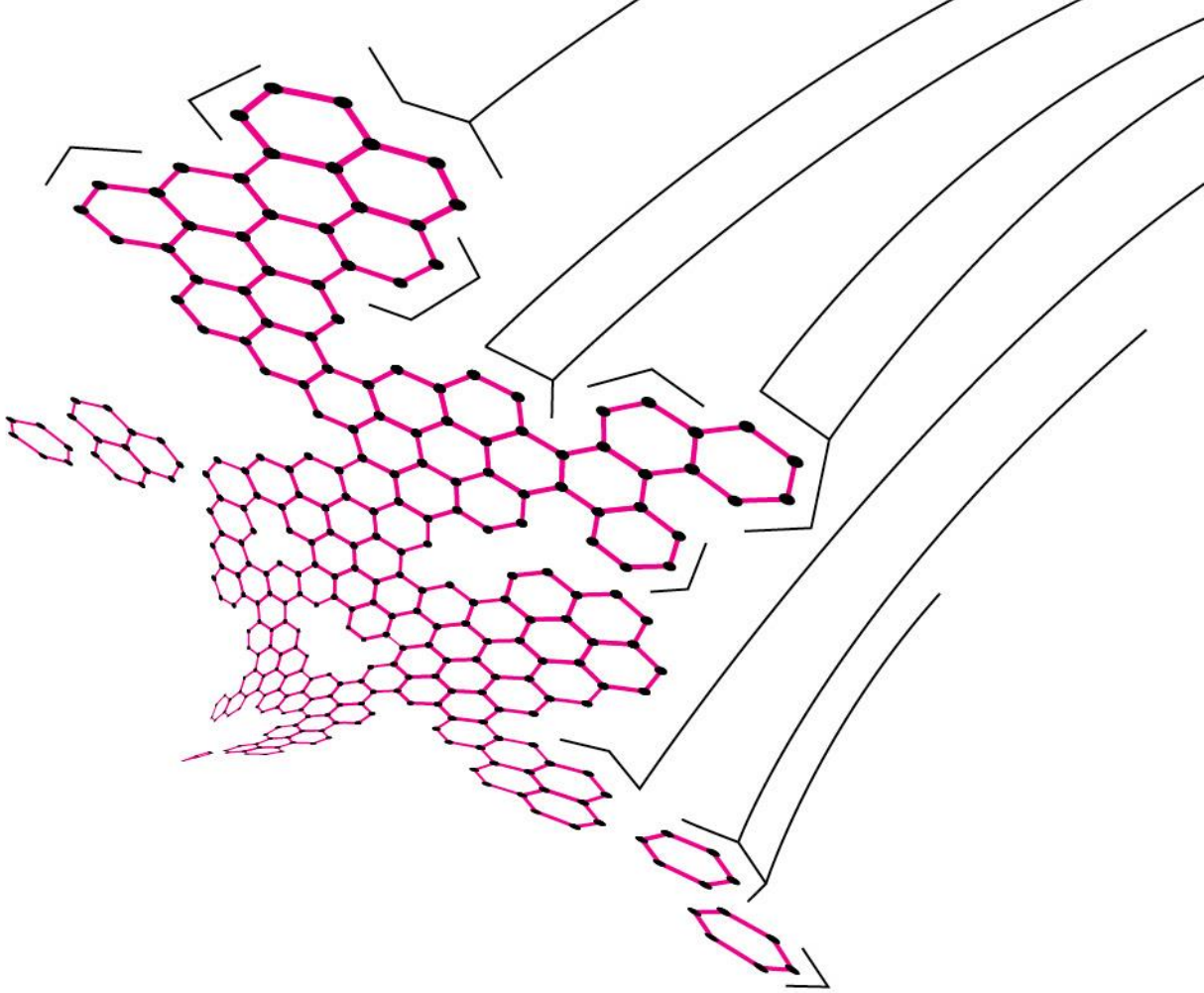
# TKI HTSM STRATEGIC PROGRAMME

# MICROELECTRONICS



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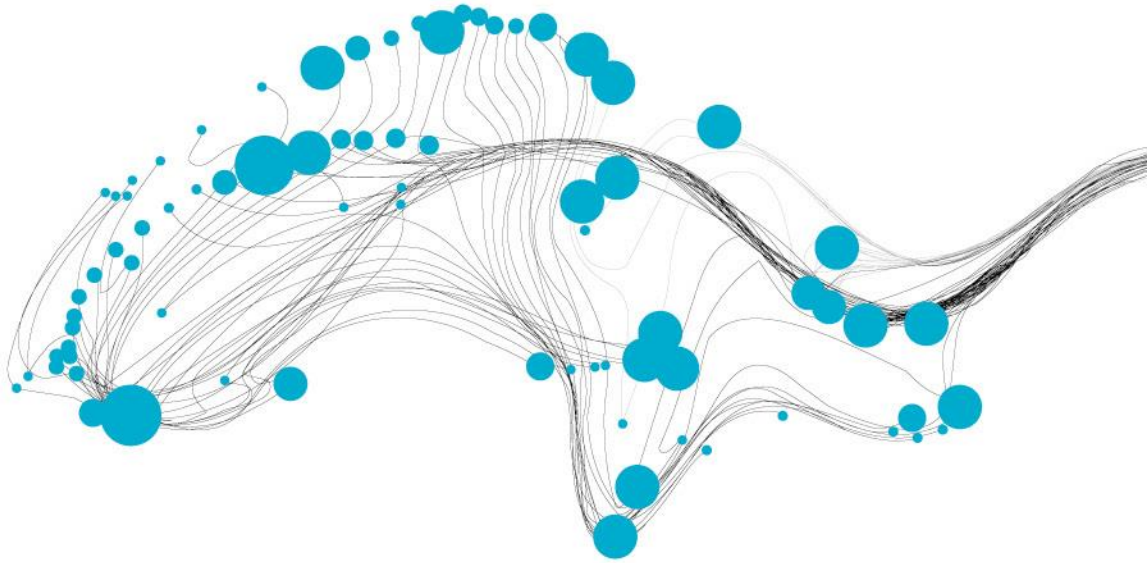
# OUTLINE

1) Background
   a) The ‘new’ PPSI scheme of MinEZK
   b) Launch of the TKI HTSM strategic programmes
2) Topics covered
3) How to apply?
4) Strengthening the microelectronics ecosystem

Strategic Business Development
University of Twente

# BACKGROUND

# THE ‘NEW’ PPSI SCHEME OF MINEZK & THE LAUNCH OF THE HTSM STRATEGIC PROGRAMMES



# DUTCH TOPSECTOR FUNDING VIA PPSI-SUBSIDY

- The MinEZK PPS-scheme has been updated (per 1-1-2024).
- MinEZK wants to steer more via the “PPSI-subsidy”.

- Reasons for updating the PPS instrument:
  - Geopolitical developments: China, supply lines, control points, ….
  - More focus on national transitions:
    - more mission-driven and KIA-based,
    - focusing on the transitions: climate & energy, digitization, enabling technologies and circularity transition.

# THE TOPSECTORS AND TKIS IN THE NETHERLANDS

| # | Top sector | #TKIs | TKI | Brand | Budget 2024 |
|---|---|---|---|---|---|
| 1 | Life Sciences and Health | 1 | TKI LSH = Life Sciences & Health | Health-Holland | € 59.402.053 |
| 2 | High Tech Systems and Materials | 1 | TKI HTSM = High Tech Systemen & Materialen | Holland High Tech | € 37.500.000 |
| 3 | Energy | 4 | TKI Offshore Energy | Energy InnovationNL | € 15.445.000 |
| | | | TKI Urban Energy | | |
| | | | TKI Hydrogen | | |
| | | | TKI Energy & Industry | | |
| 4 | Agri & Food | 1 | TKI Agri&Food | Agri&Food | € 11.420.604 |
| 5 | Chemistry | 1 | TKI Groene Chemie & Circulariteit | ChemistryNL | € 8.688.011 |
| 6 | Tuinbouw & Uitgangsmaterialen | 1 | TKI T&U | | € 8.490.000 |
| 7 | ICT | 1 | TKI ICT | Dutch Digital Delta | € 6.000.000 |
| 8 | Water & Maritime | 3 | TKI Deltatechnologie | | € 4.930.000 |
| | | | TKI Watertechnologie | | € 4.724.281 |
| | | | TKI Maritiem | | € 1.813.417 |
| 9 | Creatieve Industrie | 1 | TKI ClickNL | ClickNL | € 4.126.000 |
| 10 | Logistiek | 1 | TKI Dinalog | Dinalog | € 1.790.000 |
| **10** | | **15** | | | **€ 164.329.366** |

TKI = Top consortium for Knowledge and Innovation

A top-sector can have one or more TKI's to fund Public Private Partnerships (PPS)

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Holland High Tech
Global Challenges, Smart Solutions

# TKI HTSM

- TKI HTSM is one of the largest TKI's, covering a wide range of technologies.
- For years, it has been the most relevant TKI for the technical universities and TO2s.
- The scope of TKI HTSM has been defined by 15 roadmaps.
- Implemented through roadmap leaders gathered in the Roadmap Council (RMC).

# 15 ROADMAPS

Holland High Tech
Global Challenges, Smart Solutions

| | | |
|---|---|---|
| Advanced Instrumentation › | Aeronautics › | Automotive › |
| Electronics › | Healthcare Technology › | High Tech Materials › |
| Lighting › | Nanotechnology › | Photonics › |
| Printing › | Security Technology › | Semiconductor Equipment › |
| Smart Industry › | Space › | Systems Engineering › |



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# HTSM INTRODUCED "STRATEGIC PROGRAMMING"

Holland High Tech
Global Challenges, Smart Solutions

- Under suggestion of MinEZK, the board of the TKI wants to focus more on transitions.
- This is why Dutch research organisation connected to TKI HTSM were invited by TKI HTSM to develop strategic programmes on different topics:

I. one document describing a "Strategic Program";
II. with a clear definition of the subject being addressed (within the scope van HTSM);
III. with budget claim for the years 2024 – 2027.

*21 Strategic Programmes have been submitted to HTSM, 10 SPs have been approved*

*Assumption is 1-to-1 matching,*
*so, PPS innovation subsidy = private cash contribution*

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# APPROVED HTSM STRATEGIC PROGRAMMES

| SP# | Strategic Program | Yearly PPS-budget | TUD | TU/e | UT | TNO | M2i | RUG | NLR | NWO-i | Penvoerder |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 23SP001 | Systems Engineering for High Tech Systems | € 2.900.000 | X | X | X | P | - | - | - | - | TNO-ESI |
| 23SP002 | Medical Technology & Wellbeing* | € 3.300.000 | X | X | P | X | - | x | - | - | UT |
| 23SP006 | Photonics & Optical Technologies | € 700.000 | P | X | X | x | - | - | - | - | TUD |
| 23SP007 | Space | € 5.600.000 | X | - | - | P | - | X | x | X | TNO-ESI |
| 23SP008 | Battery Integration | € 1.100.000 | P | x | X | X | - | - | - | - | TUD |
| 23SP013 | High-tech materials | € 2.600.000 | X | X | X | - | P | X | x | x | M2i |
| 23SP014 | Semiconductor Manufacturing Equipment | € 6.800.000 | X | X | X | X | - | x | x | P | ARC NL |
| 23SP016 | Microelectronics | € 4.200.000 | X | X | P | X | - | - | - | x | UT |
| 23SP017 | Quantum | € 2.500.000 | P | X | X | P | - | - | - | - | QuTech |
| 23SP021 | Advanced Instrumentation | € 625.000 | - | - | - | x | - | - | - | P | NWO-i |
| | | **€ 30.325.000** | | | | | | | | | |

*N.B. PPS-budgets for 2025 and beyond will be approx. 80% of the 2024 budget*

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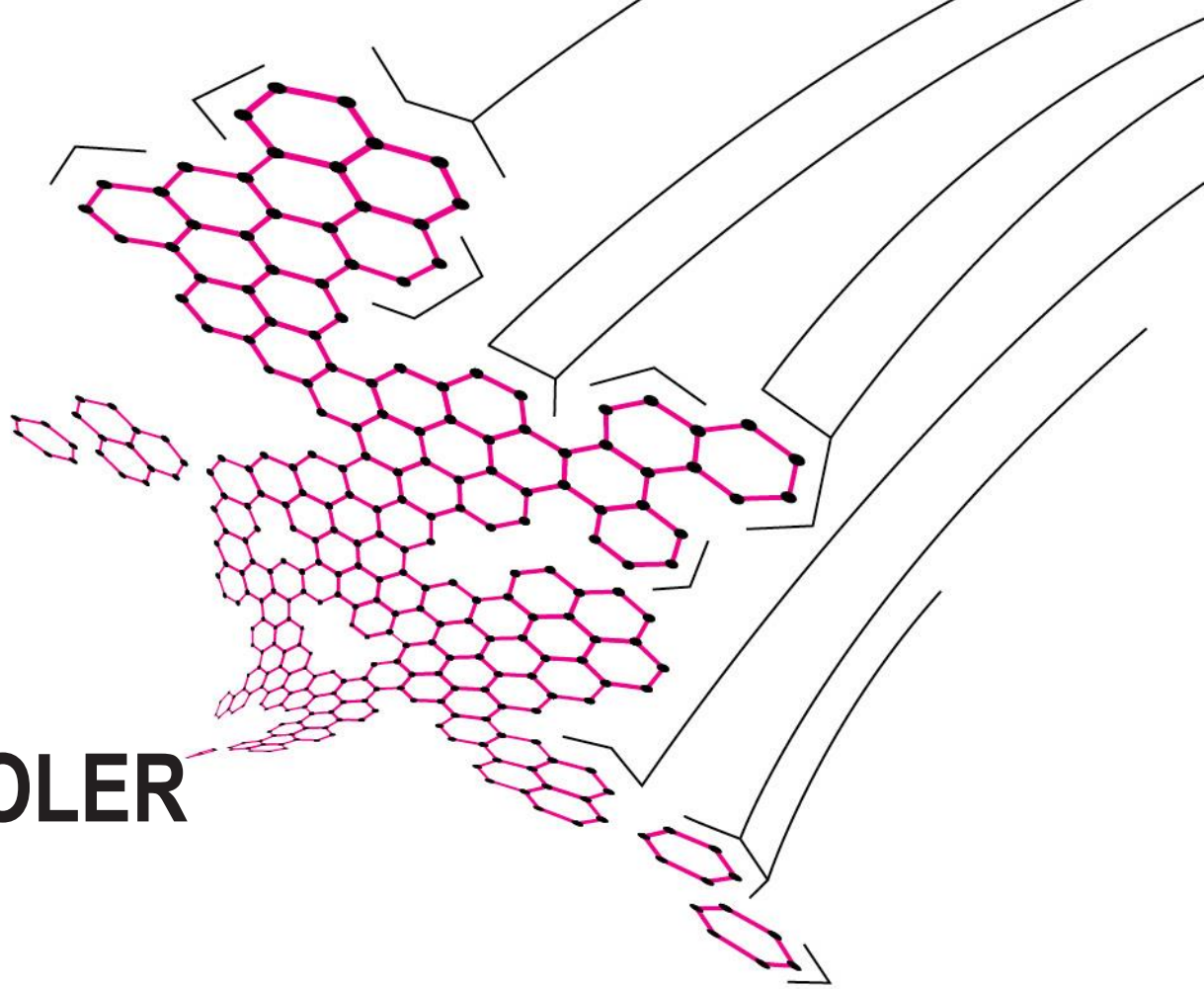
# STRATEGIC PROGRAMME MICROELECTRONICS

## SMALLER, SAFER, FASTER, COOLER



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# STRATEGIC PROGRAMME MICROELECTRONICS

| Organisation | PPSI subsidy available | | | |
|---|---|---|---|---|
| | 2024 | 2025 | 2026 | 2027 |
| NWO-I | €200.000 | €160.000 | €160.000 | €160.000 |
| TNO | €1.000.000 | €800.000 | €800.000 | €800.000 |
| TU/e | €1.000.000 | €800.000 | €800.000 | €800.000 |
| TUD | €1.500.000 | €1.400.000 | €1.400.000 | €1.400.000 |
| UT | €500.000 | €400.000 | €480.000 | €480.000 |
| | **€4.200.000** | **€3.560.000** | **€3.640.000** | **€3.640.000** |

# CONTRIBUTORS TO THE MICROELECTRONICS SP





# COMPANIES

- Analog Devices
- Altum RF
- Ampleon
- ASML
- Axign
- BESI
- Bruco
- Chain-IC
- Infineon
- MemsIC
- Nokia
- NXP
- Philips
- Qorvo
- RRS
- Salland Engineering
- Sencure
- Signify
- Teledyne Dalsa
- Thales
- The Antenna Company

# BUILDING A STRONG PUBLIC PRIVATE MICROELECTRONICS ECOSYSTEM

- Aligning the Dutch semiconductor mission and EU Chips ACT: Gateway to Europe's top chip design sector.
- In collaboration with the HTSM roadmaps act as a conduit/platform to coordinate the initiation of large national initiatives.
- Educating and training not only chip but electronic system designers for wide range of large companies and SMEs.
- Strengthening the Dutch position in semiconductor research, design and innovation and increasing the microelectronics exports.
- Contribution to the NTS, KIAs and transitions

# CONTRIBUTION TO THE NTS, KIAS AND TRANSITIONS

| Transitions / Technologies | NTS and KIA's | | | | Energy Transition | | Digitalisation | | |
|---|---|---|---|---|---|---|---|---|---|
| | Strengthening the micro-electronics ecosystem | Health & Care | Agriculture, Water and Food | Mobility | Sustainable and emission-free energy systems | Zero-emission mobility | Digital security | Opera-tional security | AI |
| **Analog and mixed signal circuits and systems** | X | X | X | X | X | X | | X | X |
| **RF & mm-wave circuits and systems** | X | X | X | X | X | X | | X | X |
| **Smart sensors** | X | X | X | X | | X | | X | |
| **Terahertz electronics** | X | X | X | X | | X | | X | |
| **Heterogeneous system integration** | X | X | X | X | X | X | X | X | X |
| **Power microelectronics** | X | | | | X | X | | X | |
| **Microelectronics for harsh environments** | X | X | X | | | | | X | |
| **Digital circuits and computational hardware** | X | X | | X | | | X | X | X |

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# ANALOG AND MIXED SIGNAL CIRCUITS AND SYSTEMS

- Strengthen the world-leader position of Netherlands in this domain. Dutch inventions continue to be part of everyday electronics around us.

- A continuous impetus in analog and mixed-signal design research is required for making them robust to environmental (noise, interference) disturbances to provide for a safe, secure and resilient digital society.

- Mixed-signal circuits and systems building blocks, e.g. wireline circuits, data converters, amplifiers, sensor interfaces, accurate voltage and current references are essential for enhancing connectivity between systems and external world.

- Low-power analog/mixed-signal circuit and system techniques are the need of the hour to make the systems energy-resilient, robust and autonomous for widescale integration in applications ranging from healthcare to agriculture to AI and data centres.

# RF AND mm-WAVE CIRCUITS AND SYSTEMS

- Highly innovative and breakthrough approaches are needed to meet the demands of bandwidth, energy-efficiency and dynamic range in 5G&6G systems.

- Ultra-linear receivers, waveform agile transmitters and digital pre-distortion techniques, and advanced beamforming approaches are some of the directions to challenge interference as a consequence of expected massive usage of wireless systems.

- Higher absolute bandwidth requires a re-invention of traditional communication systems concerning RF electronics, antenna systems, and analog-to-digital and digital-to-analog converters.

- Low-jitter, low-spur, and wideband frequency synthesizers are essential to the start-up time and switching time of the frequency references and synthesizers to enhance the communication systems' throughput and efficiency especially to enable modern technologies e.g. WiFi7.

# SMART SENSORS

- Sensors are the eyes, nose and ears of electronic systems and embedded in every IoT node. Need to become small, energy-efficient, robust, bio-compatible, safe and reliable.

- New sensing technologies to enable sensor operation in harsh environments, e.g. at extreme temperatures; new micro-electromechanical systems (MEMS) for ultra-high sensitivity inertial sensing; and the integration of flexible large-area thin-film electronics, circuits for photonics, MEMS and electronics integration to realize new classes of wearable, implantable, and even ingestible sensing devices.

- Autonomous operation – cost and environmental impact of battery replacement calls for research on highly-efficient sensors, power-management solutions and energy-harvesting technologies.

- Development of new sensing technologies needs to go hand-in-hand with the development of innovative interfacing solutions e.g., efficient analog-to-digital conversion, accurate on-chip references and signal processing, timing/phase references, robust transceivers

# THz electronics

- Terahertz (THz) and mm-wave technologies are crucial in addressing challenges in autonomous driving and zero-emission mobility, safety and operational security, 5G/6G communication, sensing & imaging, and non-destructive inspection of materials in process control, agriculture, and medical diagnostics.

- New automotive radars requiring components and systems operating from baseband to THz frequencies (140 GHz and beyond).

- Chips for broadband and digital modulations to reject mutual interference, packaging of more MIMO channels and arrays for super-resolution.

- Integrated antenna on-chip designs to enable electronic implementations of spectroscopy and high-resolution microscopy, in broadband sensor arrays

- Integrated circuit designs including packaged solutions to realize network of sensors that are reconfigurable and adaptable to the changing environment and user requirements.

# POWER MICROELECTRONICS

- For realizing an electrical resilient society, the need for high performance power microelectronic systems increases requiring high reliability, long lifetime high efficiency and low cost of ownership. Essential in any communication system e.g., power amplifiers

- High switching frequency help in applications which require both high power and high accuracy, for example in positioning, imaging, or plasma processing. A big challenge is to comply with the latest EMI requirements, especially if power electronic converters are used close to residential users.

- Power amplifiers, DC-DC converters, voltage regulators face continuous challenge from reliability and lifetime perspective as the environment in which they operate become harsher owing to heavy-duty industrial, automotive units and increased temperatures.

- Power microelectronics advancement will enable miniaturization of the audio devices e.g., in all mobile phones, headsets, bio-enabled devices (hearing aids), military and civilian applications employing acoustic sensing.

# MICROELECTRONICS FOR HARSH ENVIRONMENT

- Scientific instrumentation often pushes the boundaries of the operational conditions of microelectronic components and systems. The Netherlands excels in technical innovation in several domains, including: (radio) astronomy, particle physics, maritime, space exploration

- Such unique systems require radiation hardened integrated circuits that cover technologies ranging from operational amplifiers to digital circuits, to photonic integrated circuits

- Extremely faint signals need to be observed in the presence of strong interfering signals. To enable such high dynamic range detection of weak signals, analog/RF electronics and analog-to-digital converters with high dynamic range are essential to ensure the purity of future scientific observations.

- Cryogenic electronics are required demanding operation in low-temperature environments where electronic circuits are intentionally cooled to improve system sensitivities, e.g., in medical imaging and astronomical instruments. Cryogenic electronics operating at mK to 4K are required to address the interconnect bottleneck in the quantum computers.

# HETEROGENOUS SYSTEM INTEGRATION

- Heterogeneous integration (HI) technology including chiplet technology, and novel packaging solutions are essential for optimizing performance, reducing costs, and catering to a wide range of microelectronics applications.
- Meet the needs of "More than Moore”
  - cater to diverse devices such as MEMS, bio-MEMS, nanoelectronics, RF, power electronics, LED/OLEDs, optoelectronics, and quantum sub-systems.
- Advancements in HI enables the Dutch ecosystems (large and small companies, research institutes, and academia) being leaders in the microsystem design domain, to expand using microelectronics design-enabled ICs into applications in electronic-photonic communication, sensing technologies, and bio-, and nano-devices.
- The complex nature of the combined-aspects involved in HI necessitates the understanding of multi-disciplinary interactions, to address the modern societal challenges in Energy, Mobility, Healthcare, Food, and Security.

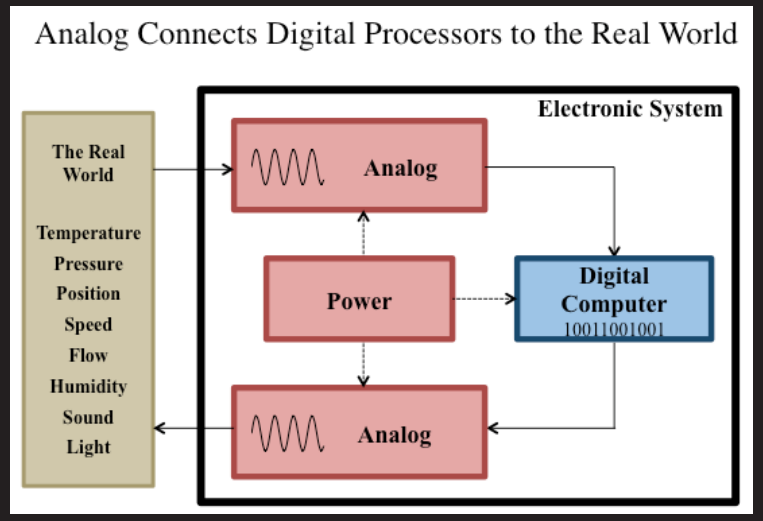
# DIGITAL CIRCUITS AND COMPUTATIONAL HARDWARE

- With technology nodes of 7nm and below now being available, technology scaling based on Moore's law has not only directly benefited digital circuits in terms of efficiency, area, and speed, it has also enabled integrating increasingly smart systems

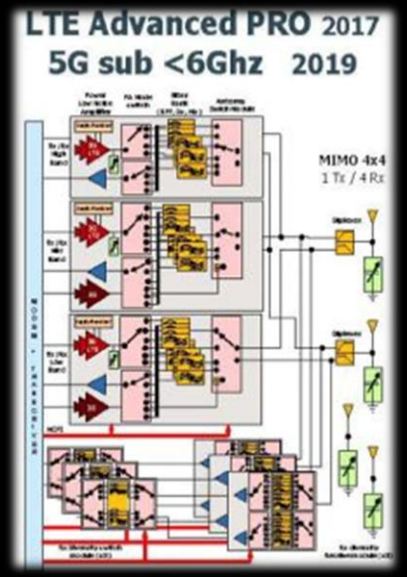
- Advanced digital circuits, comprising the computational hardware for AI and brain-inspired computing, will be key technologies for smart electronics and efficient edge-computing devices

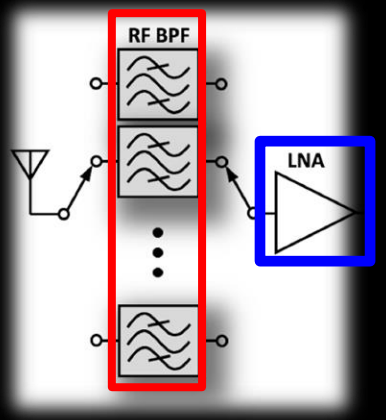
- Circuits that assist the operation of analog and mixed-signal circuits such as data converters, clock generation and timing circuits, and transceivers. These include digital calibration, built-in self-test functions, and reconfigurability and adaptability for multi-mode operation

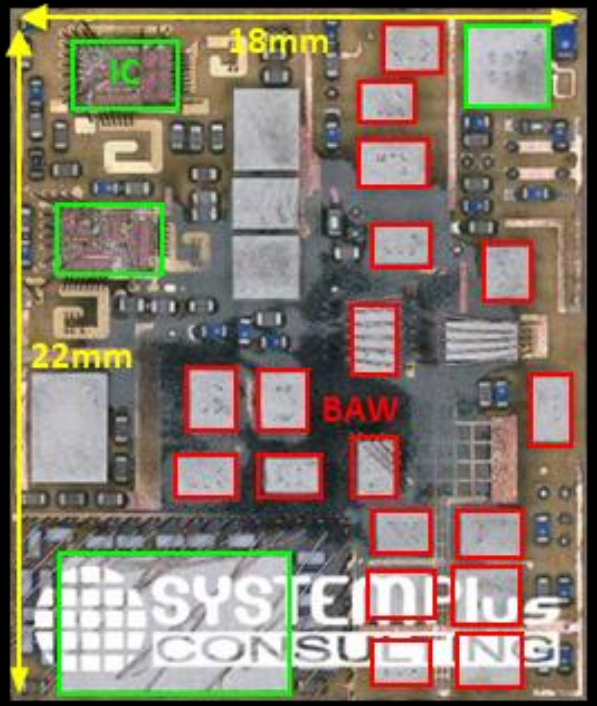
# THE WORLD IS ANALOG!



# Some Smartphone Inventions

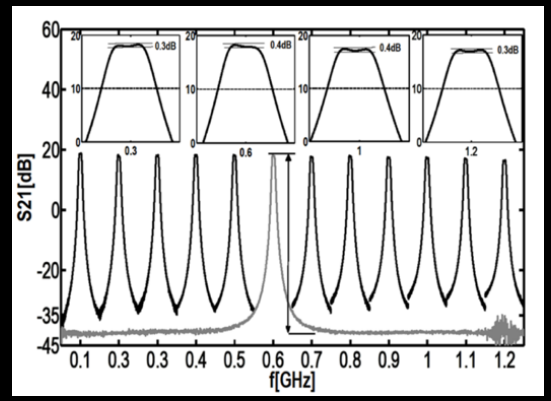


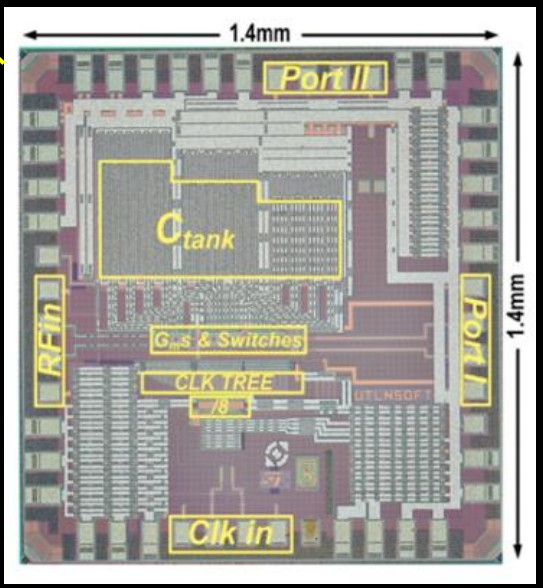




iPhone X

## N-Path Filter

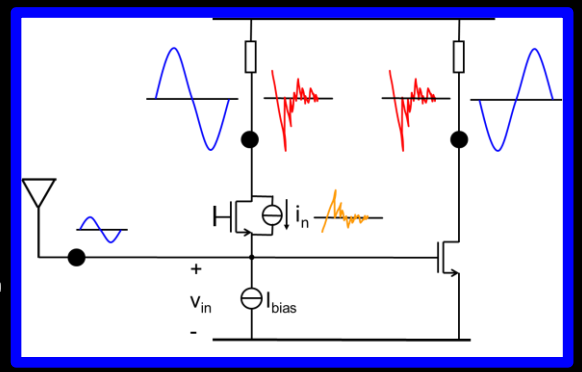



Darvishi, 2013

(same scale)

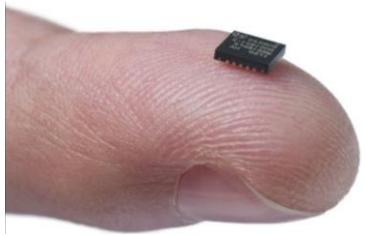
## Thermal Noise-Canceling Low-Noise Amplifier




Bruccoleri, 2002

# INTERNET OF THINGS – WHAT'S INSIDE

SENSOR



Integrated Circuit (IC)

10010….

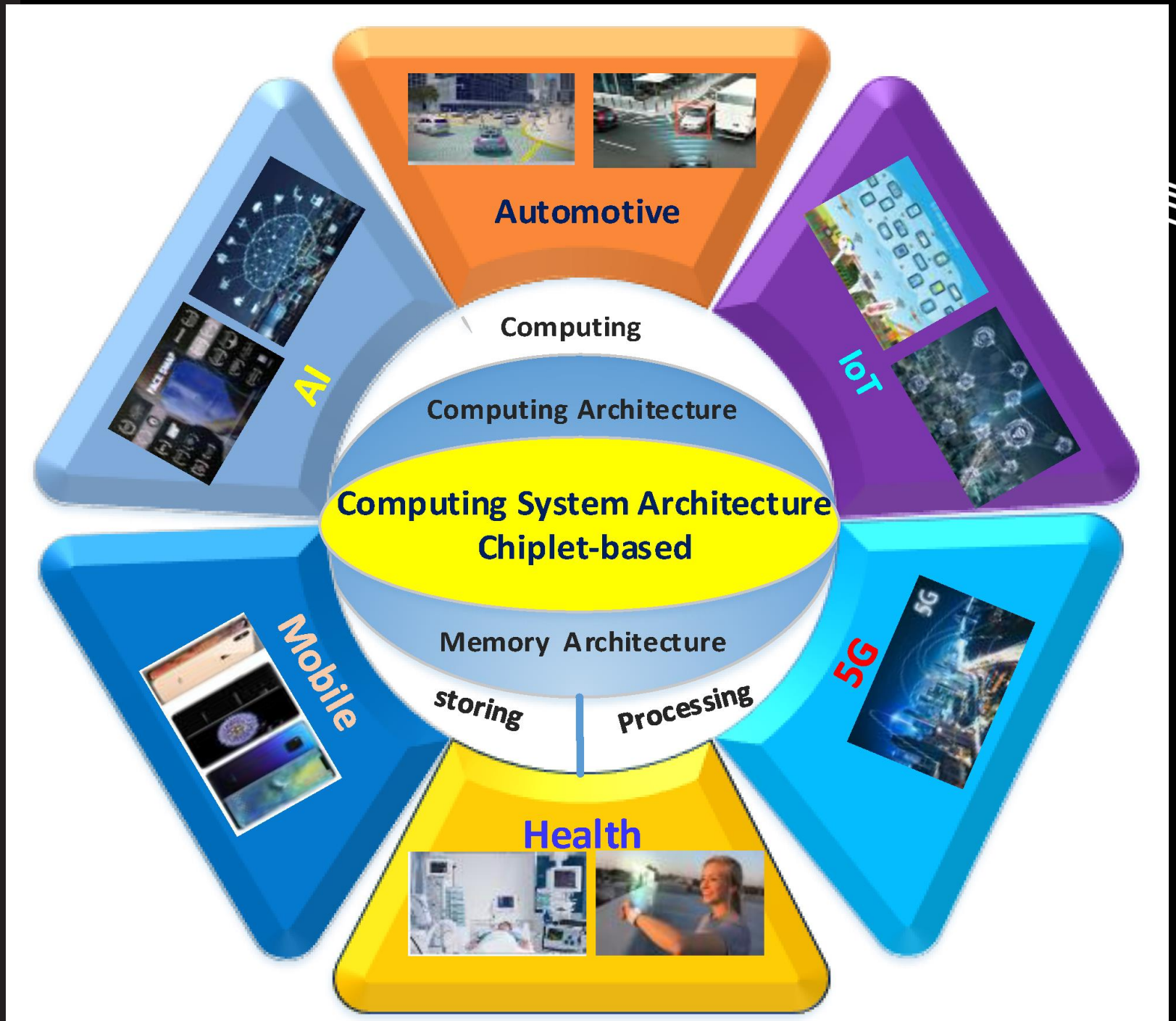
Digital O/P

**World record low-power digital conversion**

Battery & Power Management

Energy Harvester

# ADVANCING DIGITAL ECOSYSTEM!



Digital Wallet

Smart Industry

Smart Cities

**Internet Of Things**

Digital Health

Smart Environment

Smart Agriculture

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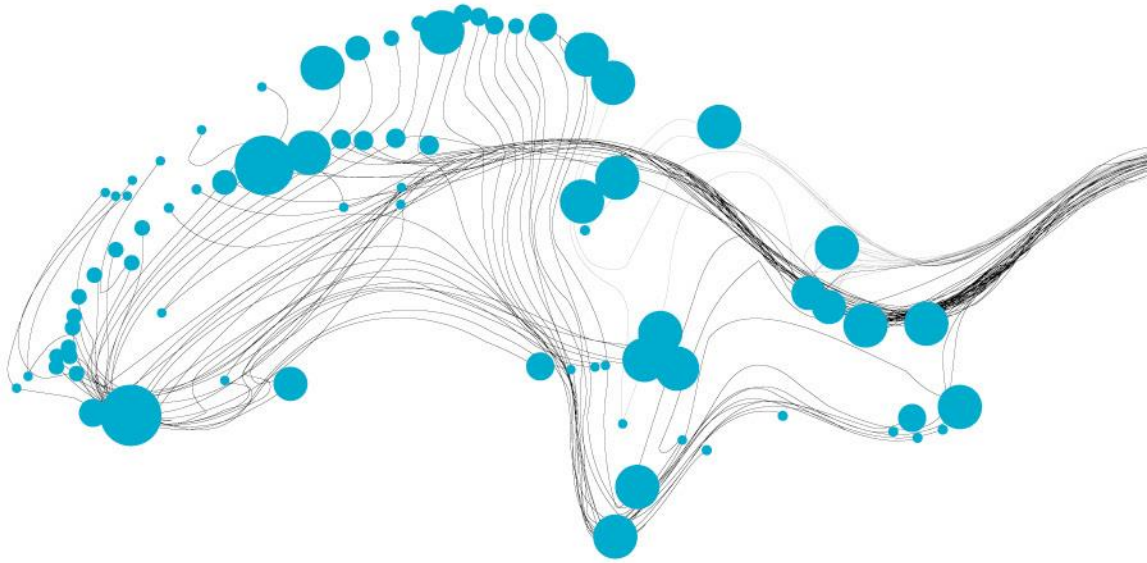
# HOW TO APPLY?



# HOW TO APPLY?

1. Researchers can apply for the PPSI subsidy through their own organisations.
2. Private cash cofunding should approximately equal the PPS-I subsidy (your organisation may have specific rules on top of the HTSM/RVO rules).
3. Full cost tariffs (IKS) apply.
4. A consortium agreement must be included on submission (or max 6 weeks after submission).
5. Preferred: “participation of SMEs (by preference in the form of cofunding). If this is not the case, an explanation of the absence of SMEs is needed.”
6. A convincing substantiation of the type of research (FO/IO/EO)
7. Organisations have sovereignty over their budgets.
8. But this may all change in the coming years, very much depending on the success of the HTSM strategic programmes.

# Q & A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# BACK UP SLIDES


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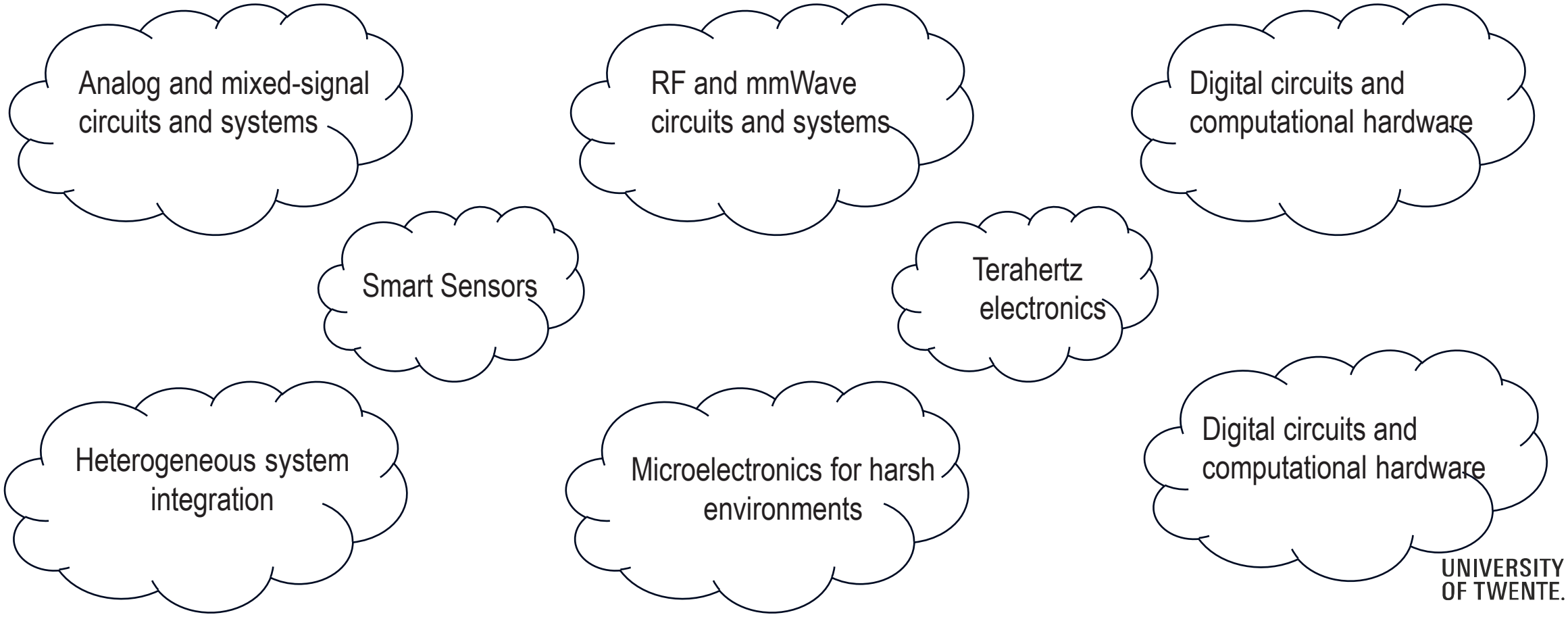
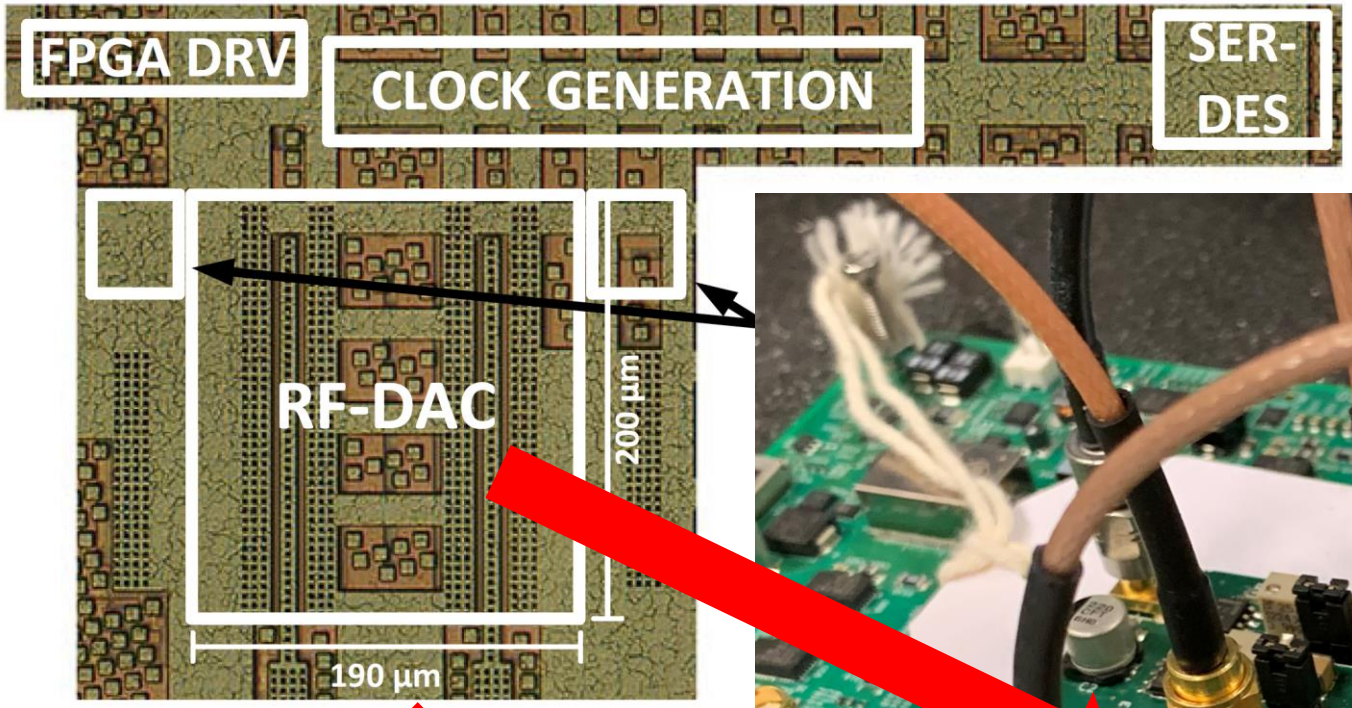
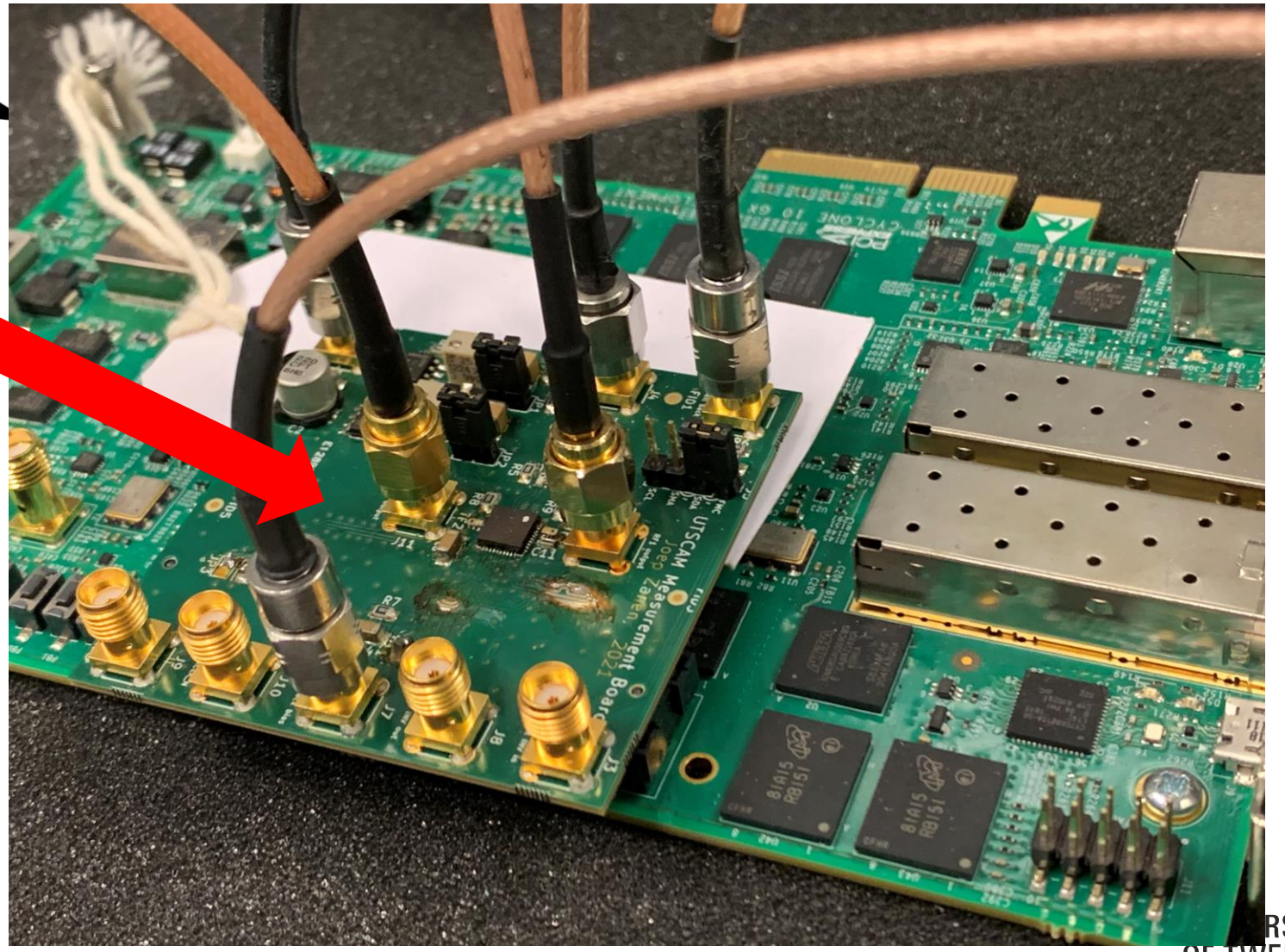
# STRENGTHENING MICROELECTRONICS ECOSYSTEM

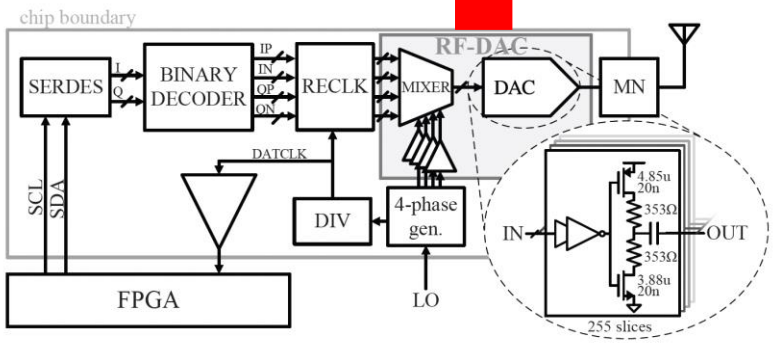
- Mapping each technology pillar to NTS, KIA and transitions



# DAC -> ANTENNA


FPGA DRV
CLOCK GENERATION
SER-
DES
RF-DAC
200 µm
190 µm




chip boundary
SERDES
BINARY DECODER
RECLK
RF-DAC
MIXER
DAC
MN
IP
IN
QP
QN
DATCLK
SCL
SDA
DIV
4-phase gen.
FPGA
LO
IN
OUT
1.85u
20n
353Ω
353Ω
3.88u
20n
255 slices