



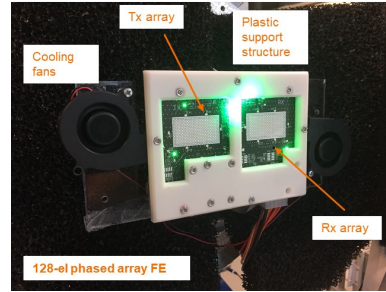
VTT

VTT Microelectronics and Quantum Technologies - 5G/6G Technologies for SNS JU

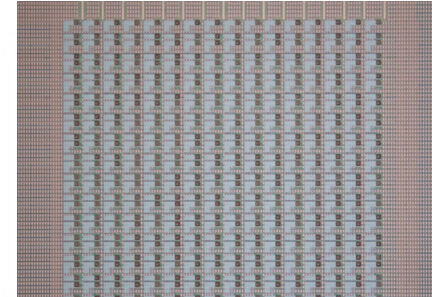
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23/01/2024 VTT – beyond the obvious

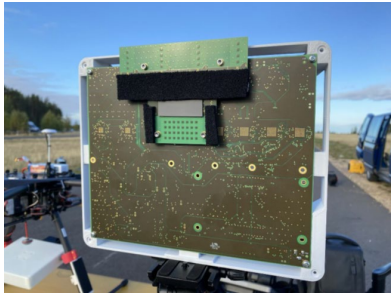
- Edge computing, AI/ML circuits
- Combined photonics & RF solutions for wideband applications eg. beam steering
- Massive MIMO antenna systems with integrated RF filters and front-end modules.
- Millimeter wave and THz technologies eg. D-band link research and development
- Acoustic filter technologies for radio front end



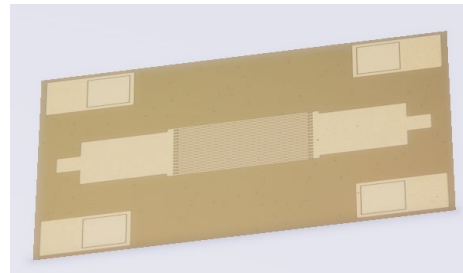
E-band 128-element phased array transceiver



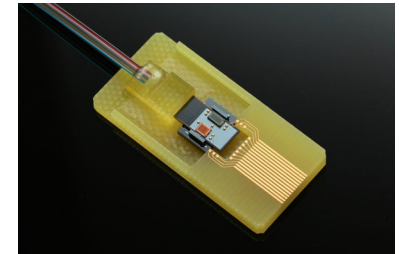
Integrated post-CMOS array of ferroelectrical transistors for analog in-memory computations



34 GHz MIMO radar prototype for long-range applications. Targets detecting human or small UAV approximately up to 0.5 -1.5 km distance & car from about 5 km's distance

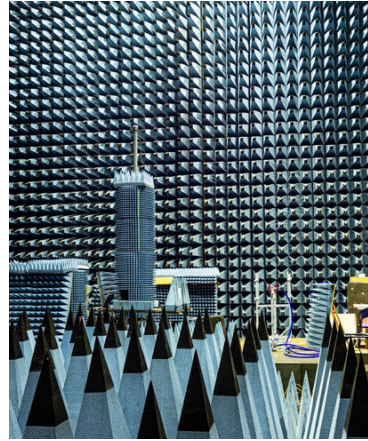


Solidly mounted laterally coupled BAW filter – a monolithic acoustic thin film filter.

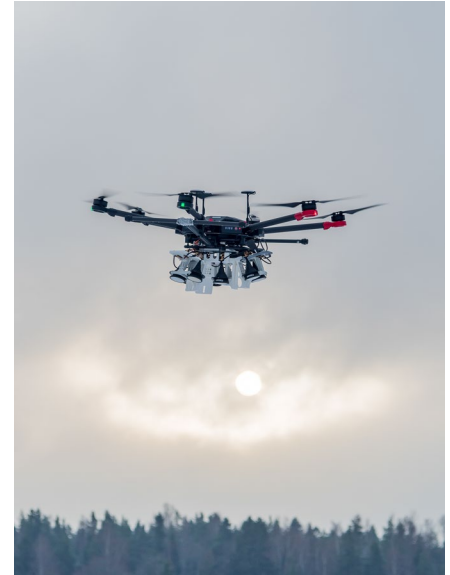


Silicon photonics chip

- 5G/6G test network and link
 - Testing of radio access and services
 - Satellite test link for W band
- Antennas and RF components testing
 - Anechoic rooms,
 - Millimetre Wave Laboratory of Finland
- Fabrication
 - 2600 m² clean room (under extension)
 - MEMS
 - Integrated photonics
 - Post-CMOS integration
 - Superconducting quantum sensors and comp.
 - LTCC



Un-echoing antenna measurement room



Drones: 77 GHz FMCW radar in a drone.

Initiative 1: Optilink – Silicon photonics for 6G hardware

Call:

- **STREAM-B01-03:** Communication Infrastructure Technologies and Devices (RIA)

Status

- Mature silicon photonics (SiPh) platform:
 - ultra-low loss (3-4 dB/m)
 - polarization independency
 - dense integration (1 m long waveguide fits into an area of $< 1 \text{ cm}^2$)
 - monolithic PDs and flip-chip integration of SOAs/lasers
 - High speed modulators and light sources provided by partner companies
- Demonstration of optical delay lines with a wide dynamic range of true time delay (TTD)
- Tools and expertise for co-simulation of RF and optics for hardware development

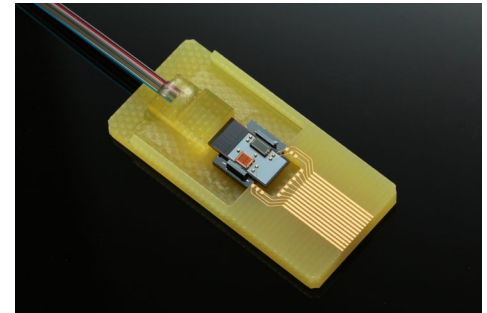
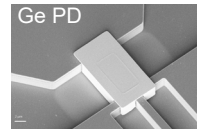
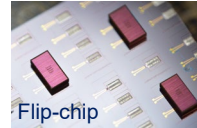
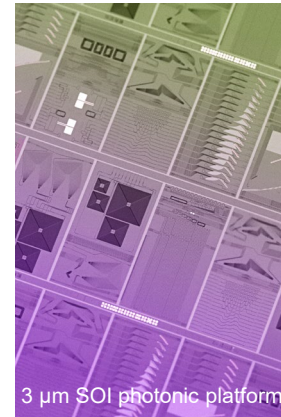
Proposal

- Develop energy-efficient EO/OE conversion in RF
- Realize optical delay lines with true time delay (TTD)
- Using SiPh platform in 6G compatible hardware development
 - Analog Radio over fiber (ARoF) and Optical beam forming network (OBFN)
 - OBFN with focus on new 6G RF communication band 7 – 15 GHz

Partners needed

- We are especially looking for
 - end users in the 6G
 - photonics/RF packaging expert
 - RF electronics chip manufacturer

- Contacts: paivi.Heimala@vtt.fi, timo.aalto@vtt.fi, ari.Alastalo@vtt.fi



Initiative 2: 6G radio-based weather sensing

- *HORIZON-JU-SNS-2024-STREAM-B-01-02: Wireless Communication Technologies and Signal Processing – Standardisation and Follow-up/PoCs*
 - Sub-topic: joint communication and sensing (JCAS) and energy efficient radio solutions
- **Propose:** Hyperlocal weather sensing using 6G frequency OFDM radars or base stations used in radar-operating mode
 - Hardware and **JCAS** signal processing development
 - ❖ mm-wave frequencies (~30-100 GHz)
 - ❖ periodogram processing
- **Recent work:**
 - ❖ MIMO radar development (34 to 60 GHz)
 - ❖ 5G parametrized OFDM JCAS simulator (National funded projects and IEEE publications [1])
 - ❖ Analysis of radar weather sensing (weather radar parameters, periodogram processing, rain rate calculations)
- **Consortium:** looking for partners
 - VTT (radars and JCAS algorithms), telecom partners, operator partners, ...
- Contact: Jussi.Varis@vtt.fi, ari.Alastalo@vtt.fi



6GSNS

Initiative 3: Validation and demonstration of key 6G candidate HW technologies for D band and above frequency bands

Call:

- **STREAM-C-01-01:** SNS Microelectronics Lighthouse

Status

- D band link (130-175 GHz) with beam steering functionality is realized (including original RF chipset, antennas and integration technology)
 - H2020 DREAM & DRAGON projects as background
- Understanding what should be improved on bases of the D band link testing
- Micromachining technology for RF waveguides is developed. The technology is ready to be used as integration technology for radio systems up to 300 GHz and above.

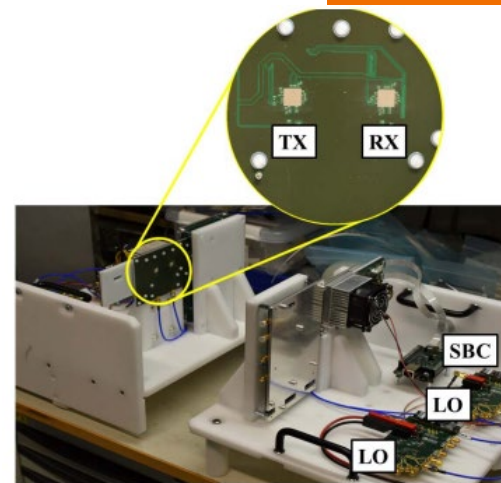
Proposal

- Push the disruptive D band technologies to higher TRL levels
- Utilize the developed micromachining technology into a complete THz communication demonstrator,

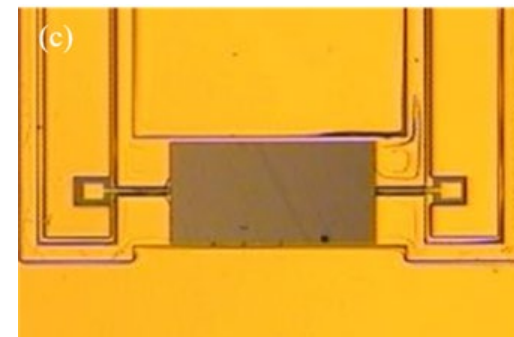
Partner needed

- Partners with relevant competences especially key European industrial supply side players

Contact: Vladimir.Ermolov@vtt.fi, ari.Alastalo@vtt.fi



Laboratory link setup.



Flip-chipped CPW line on Si.

bey⁰nd

the obvious