



KONGSBERG

Microtechnology for Space Applications

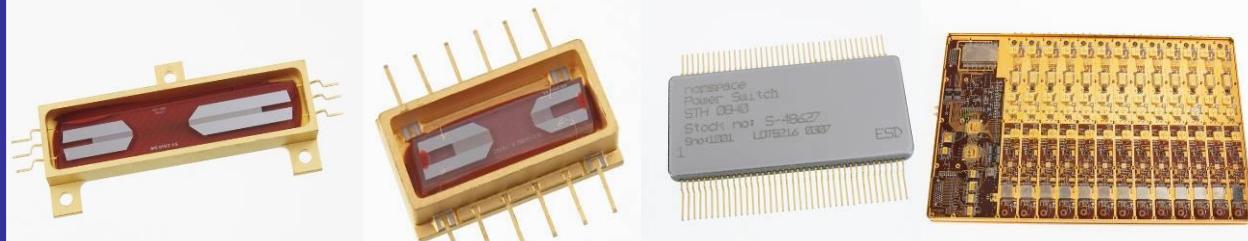
Romteknologi NTNU 29 Sept 2016
Grunde Joheim, R&D Project Manager



Kongsberg Norspace



- Kongsberg company with 100 employees in Horten, Norway.
- Development and production of electronic components and communication equipment for use in satellites.
- Based on microelectronics designs and advanced manufacturing processes
- World leader in high performance SAW-Technology
- Products supplied worldwide;
 - onboard more than 180 satellites in orbit
 - More than 2 metric tonnes of space electronics delivered



Kongsberg Gruppen ASA

Division Space & Surveillance



KONGSBERG Satellite Services*



- Ground stations and satellite data collection systems
- Operator of worldwide network of ground stations including on Svalbard and Antarctica

*50% ownership

KONGSBERG Spacetec



- Satellite operation and data reception services

KONGSBERG Space



- Satellite solar wing control mechanisms
- Electro-optical systems for environmental monitoring/earth observation satellites

KONGSBERG Norspace



- On-board electronic equipments and components
 - Analogue signal processing (payload) equipment
 - TT&C/TCR Units

KONGSBERG Norcontrol



- Turn-key supplier of maritime domain awareness and surveillance solutions including satellite and terrestrial sensors and information sources
- Surveillance systems in-service at the world's leading maritime organizations, most successful port authorities, and safest offshore operators

Kongsberg Norspace key customers

North America

Europe

Asia



Our contribution to daily life

- payloads

- Internet everywhere
- Mobile communication everywhere
- Navigation services
- Search and Rescue services
- “Bulk” data traffic (FSS)
- TV/Video transmission and broadcasting
- Transmission of data from satellites to earth (observation)

Mass: 1 – 20 kg
volume < 15 litres

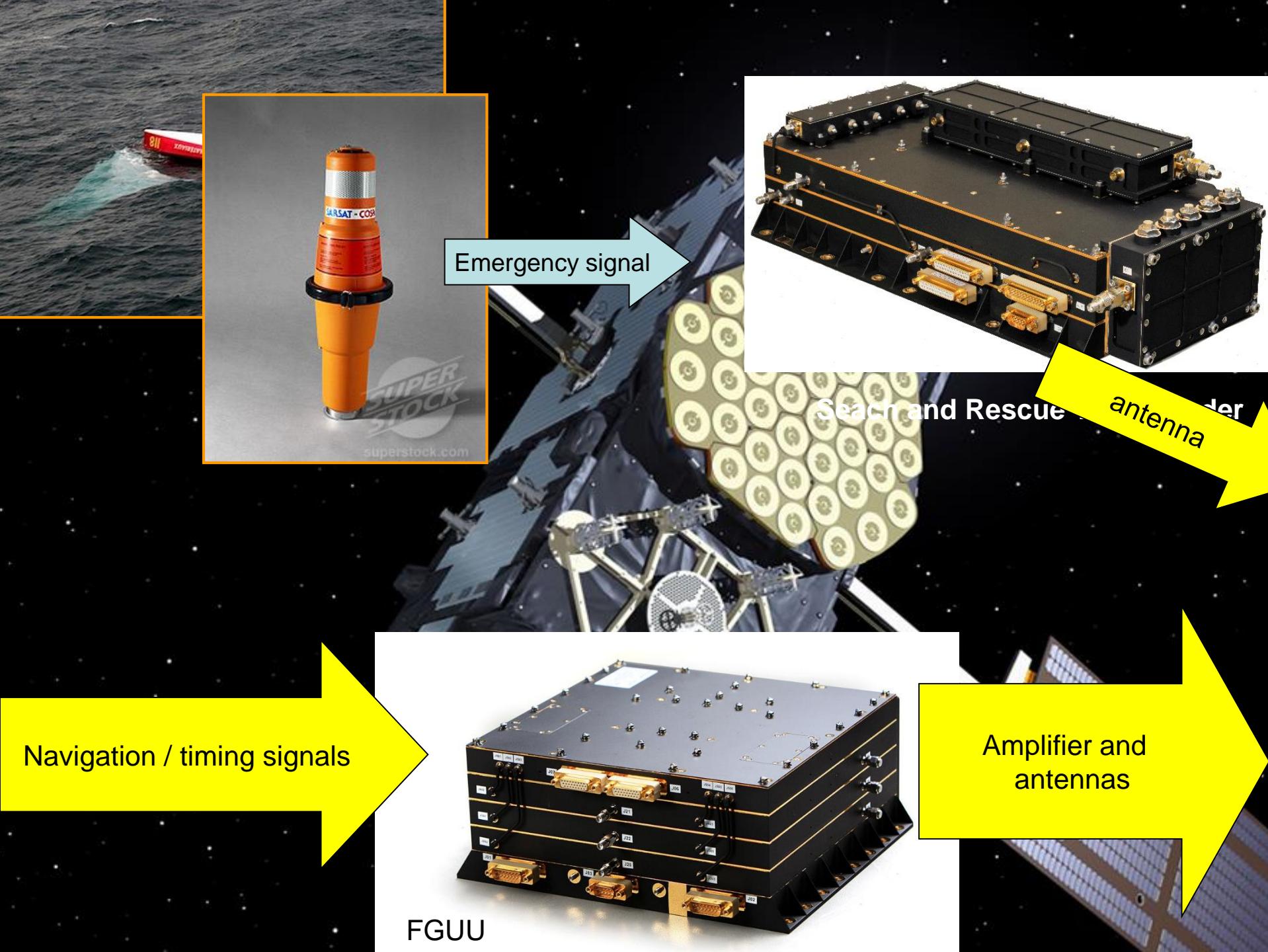


Products for satellites

- Electronic equipment for radio communication:
 - Conversion up/down between radiofrequencies (GHz) and Baseband
 - Signal Processing at RF and IF (intermediate frequencies)
 - Channalization, (de-)multiplexing, signal routing → use of SAW-filters
 - Frequency generation and distribution
 - Equipment for remote satellite control (Telemetry, Tracking & Command)



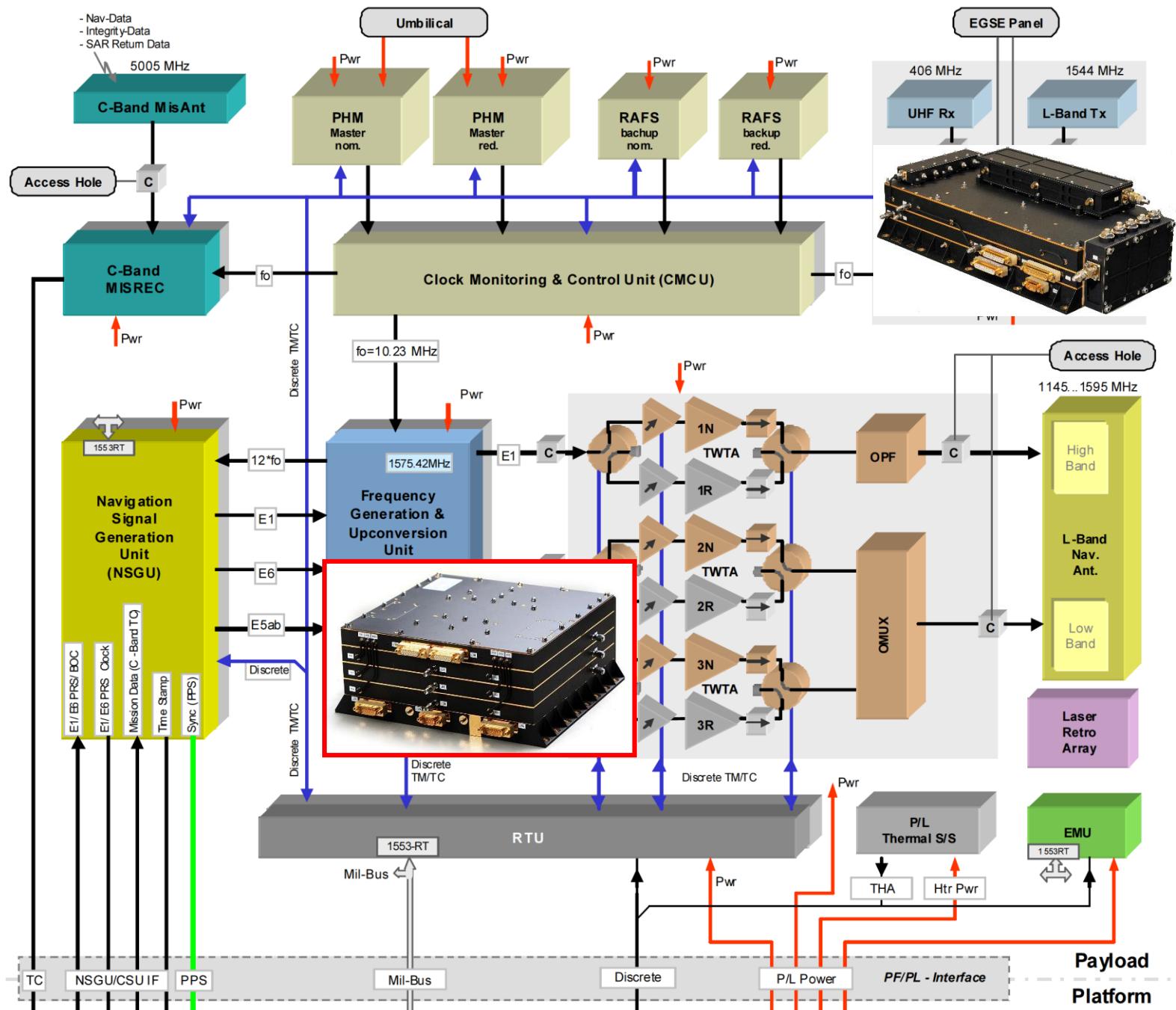




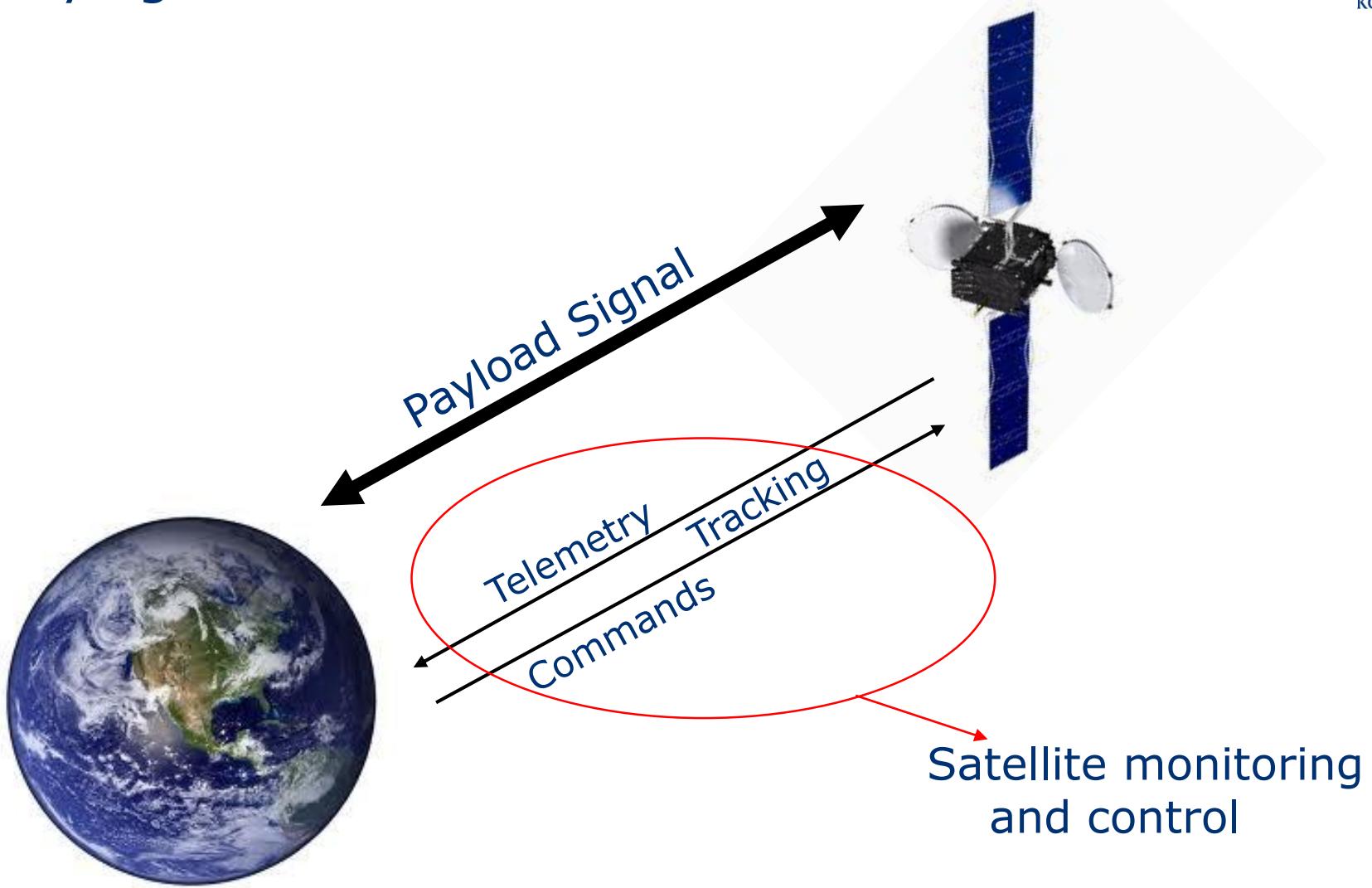
Navigation / timing signals

Amplifier and
antennas

FGUU

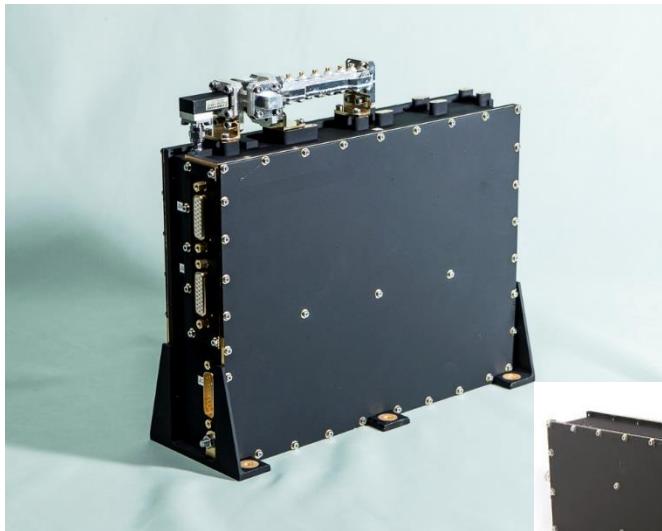


Flying the Satellite



Telemetry Tracking & Command

- Remote control of the Satellite
 - Command Receiver → reception of command signals
 - Telemetry Transmitter → Status signals from Satellite and Payload
 - Beacon → Tone generator (Satellite position, Antenna pointing)



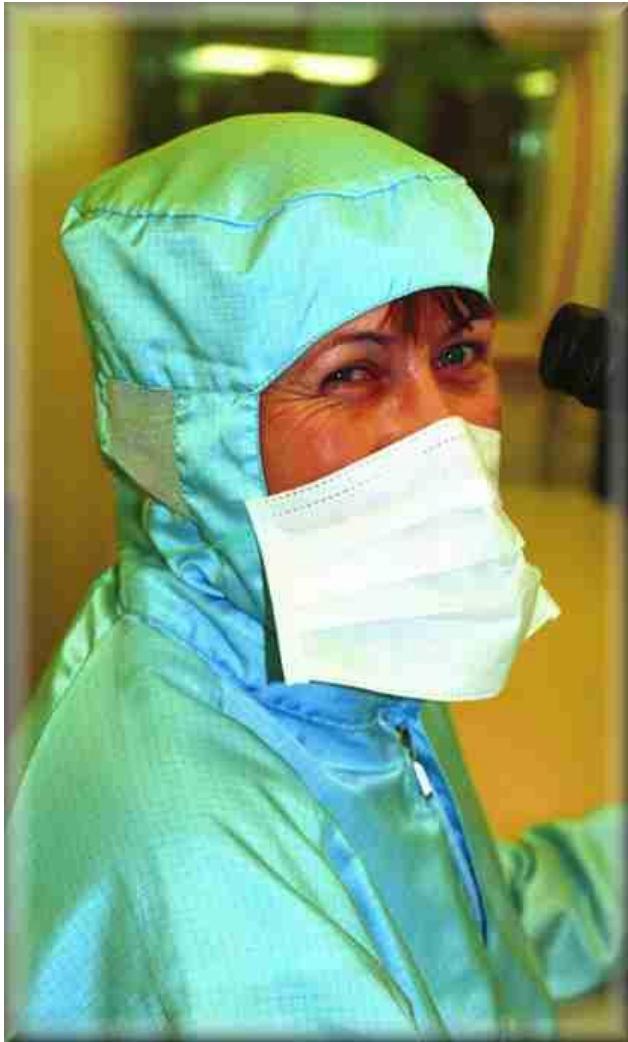
Requirements for Space “It simply must work!”

- Mechanical Environments
 - Launch / deployment: Vibration and Shock
- Superb performance in harsh environments
 - EMC (Electro Magnetic Compatibility)
 - Radiation hard designs
 - Limited available power
 - Thermal flow management in vacuum
- → Efficient use of available bandwidth.
- → Maximize the traffic.



Requirements for Space

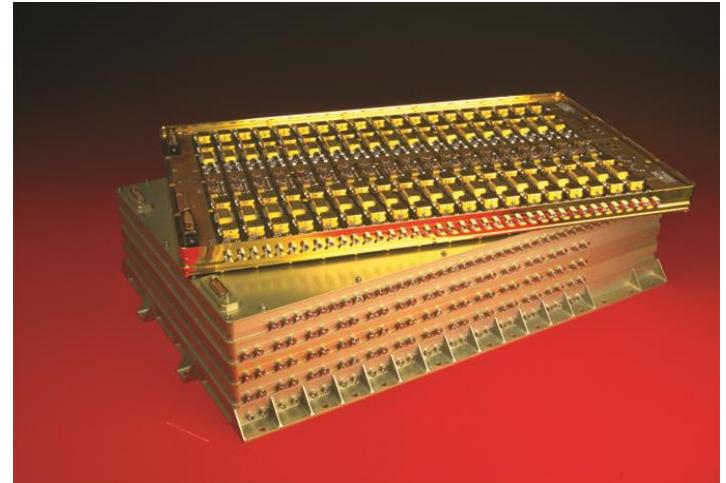
“It simply must work!”



- Reliability
 - Designs for 10 -18 Years Lifetime
 - Qualified processes and materials
 - Workmanship based on manual operations performed by operators certified for space equipment
 - Design with redundancy
 - Reliability Analysis (Calculate Failures In Time)
- Product Assurance Analysis
 - Performance Simulations / Budgets (all parameters)
 - Part Stress (all components)
 - Thermal/Mechanical
 - EMC / Radiation
 - Worst Case (drift over life)
 - And many more.....

Norspace Technology platform

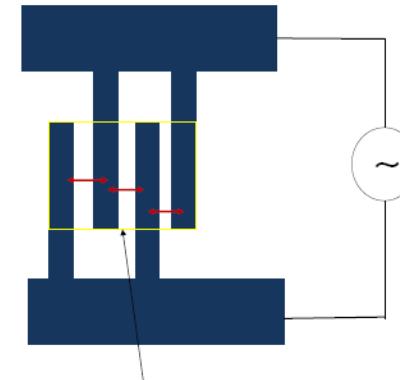
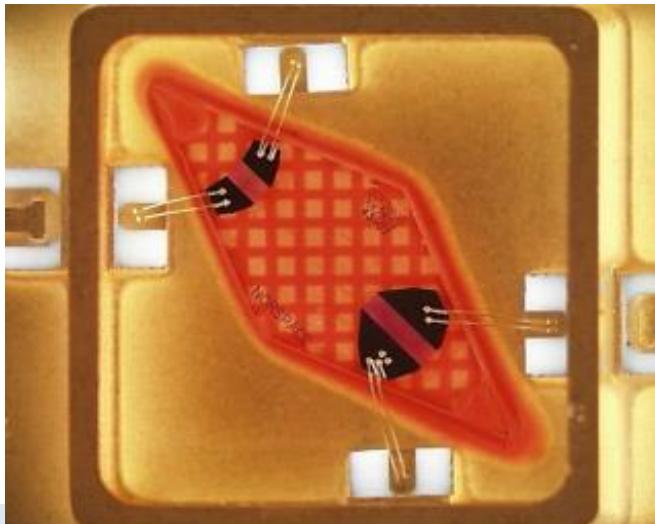
- SAW filter technology
- RF - Hybrid technology
- RF PCB Technology
- Equipment technology
- Advanced testing



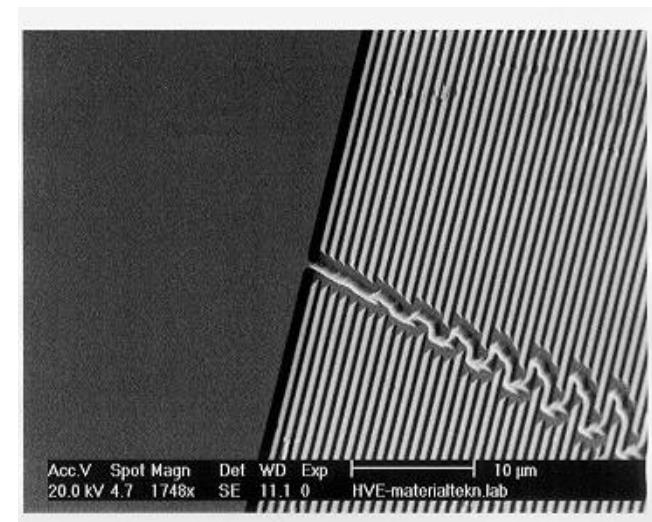
SAW (Surface Acoustic wave)

- Surface Acoustic Waves :

- Using the surface waves in crystals with piezoelectric properties.
- Waves are generated and picked up by transducers
- Metal pattern defined by lithographic wafer processes.



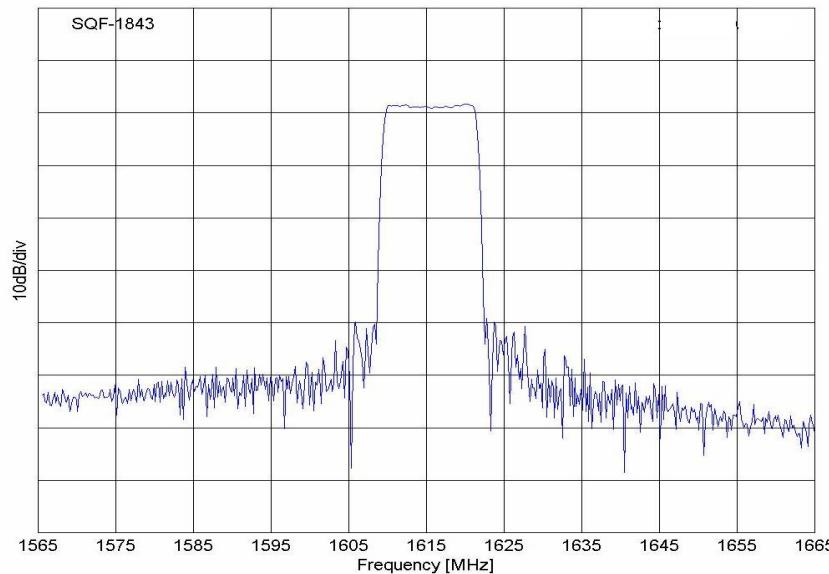
Piezo effect between fingers inside this area



>10.000 “fingers” in one transducer
Line widths down to 0,3µm

Benefits of using SAW filter

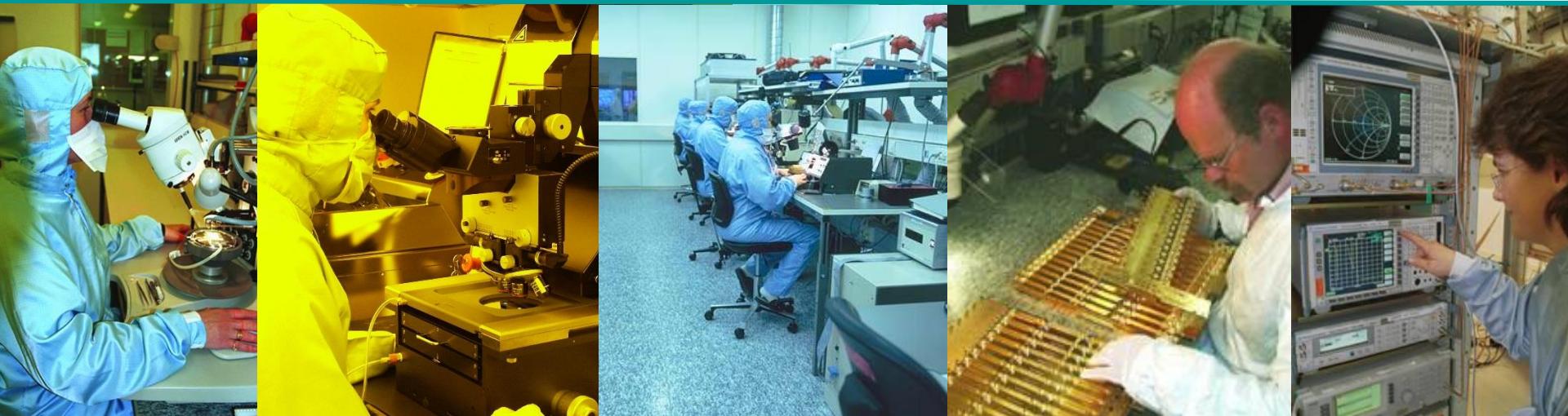
- SAW filters provide better quality transmission and better utilization of the satellite
- Very good stop band rejection.
- Steep flanges, ie narrow transition band, provides good utilization of the available frequency band. The channels can be stacked tight.
- Covers 10MHz to ~3GHz
- Requires advanced mathematical modelling and material knowledge!!
- Requires challenging lithographic processing



Manufacturing!

We deliver hardware!

- Six manufacturing and test clean rooms (1000 m²) for:
 - SAW crystal wafer processing, 80 m², class 100
 - Thin film substrates processing, 60 m², class 1,000
 - SAW filter and Hybrid Microcircuit assembly, 210 m², class 100 - 10,000
 - SAW and Hybrid Microcircuit test, 60 m², class 10,000
 - Equipment / PCB assembly, 230 m², class 100,000
 - Module and equipment test, 360 m², class 100,000



Case: SES-12 Mission

Operator: SES

Satelite manufacturing: AIRBUS



We provide services for



Video

We help broadcasters deliver over 7,400 digital TV channels to over 317 million homes worldwide.

- › [Broadcast](#)
- › [Distribution](#)
- › [Occasional use](#)

Enterprise

We deliver connectivity to companies through reliable networks, satellite broadband access and flexible services.

- › [Broadband](#)
- › [Mobile backhaul](#)
- › [Trunking](#)
- › [Occasional use](#)

Mobility

We provide high-quality inflight entertainment and fast broadband access regardless of locations.

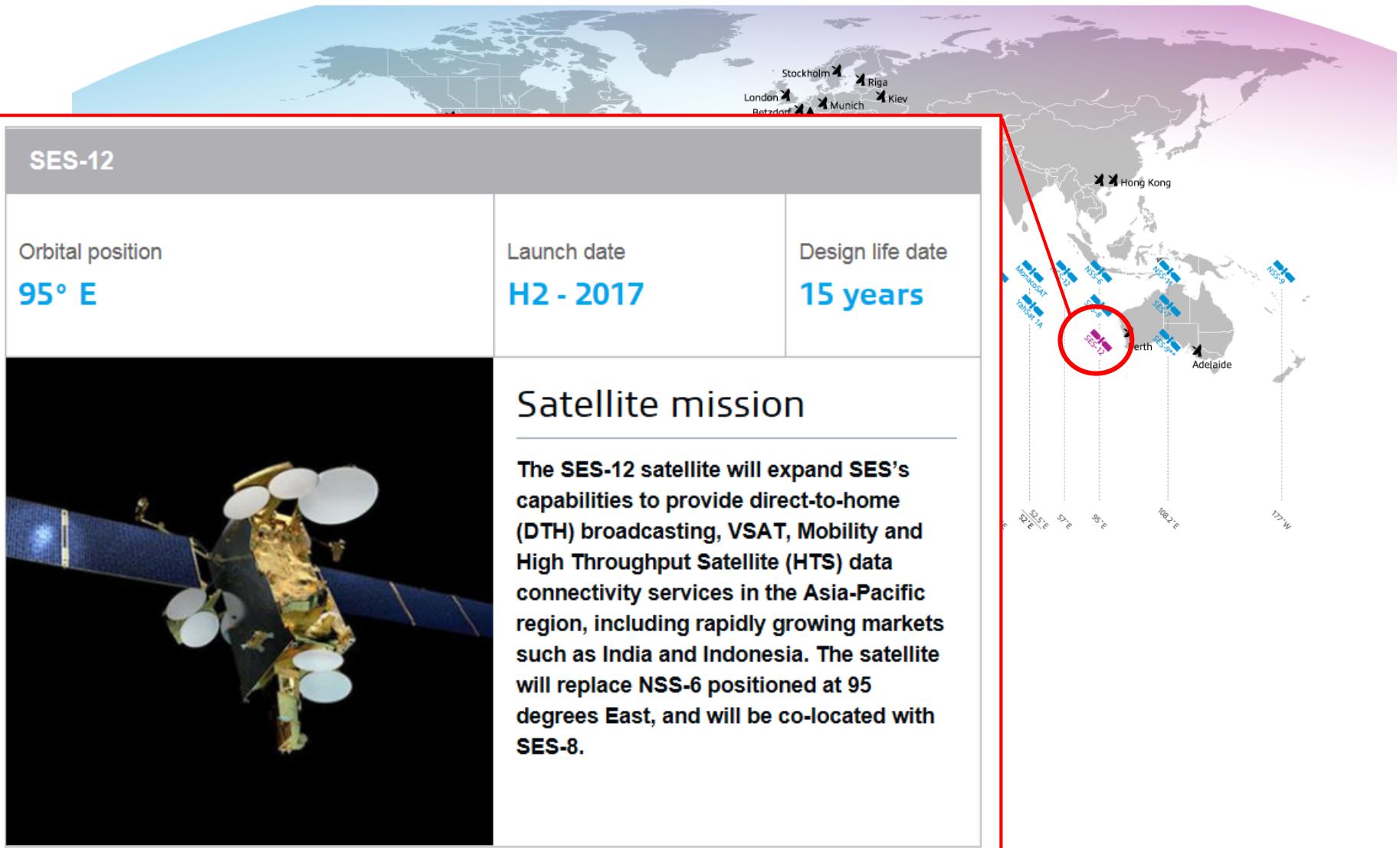
- › [Maritime](#)
- › [Aeronautical](#)

Government

We offer secure and reliable satellite communications links for governments and international institutions.

- › [Military communications](#)
- › [Government communications](#)
- › [Disaster relief](#)
- › [e-Health](#)

SES fleet, SES-12



AIRBUS: Satellite manufacturer

Electric Propulsion

Electric Orbit Raising / On station control



AIRBUS DEFENCE AND SPACE | SPACE | MILITARY AIRCRAFT | COMMUNICATIONS INTELLIGENCE AND SECURITY ▾

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DISCOVER ALL PROGRAMMES TELECOMMUNICATIONS ▶

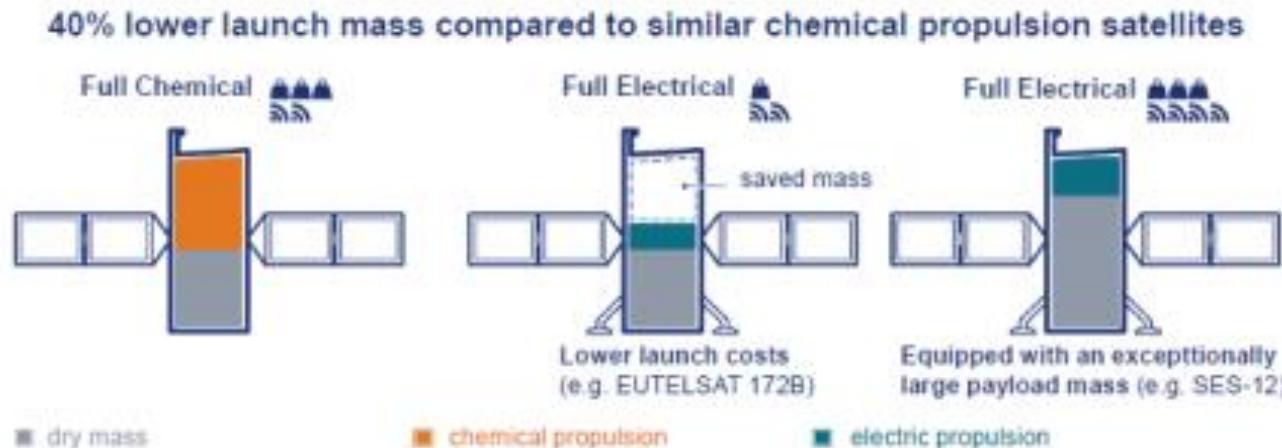


Dossier - Telecommunications
Telecommunications today increasingly travel via space.

Leading the race in electric propulsion satellites

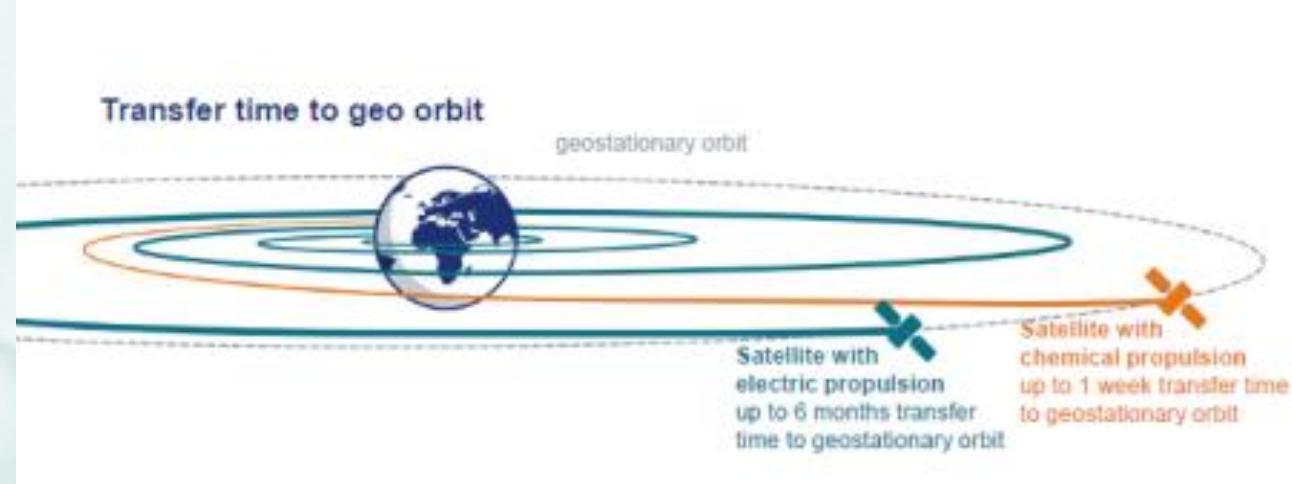
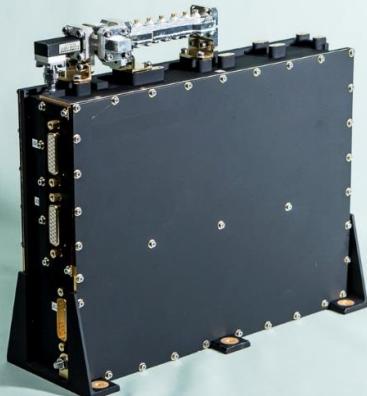
Satellite features

- Electrical Propulsion (EOR) → exceptionally large payload



Satellite features

- Norspace Flexible Command Receiver
 - **ENABLES** Electrical Orbit Raising and Fleet Management
 - Flexible selection of receive frequency to avoid interference
 - Extreme interferer immunity
 - Detected signal level: 0,000 000 000 000 006 W
 - Interfering signal: 1 W



Fleet Management

SES Satellite Fleet



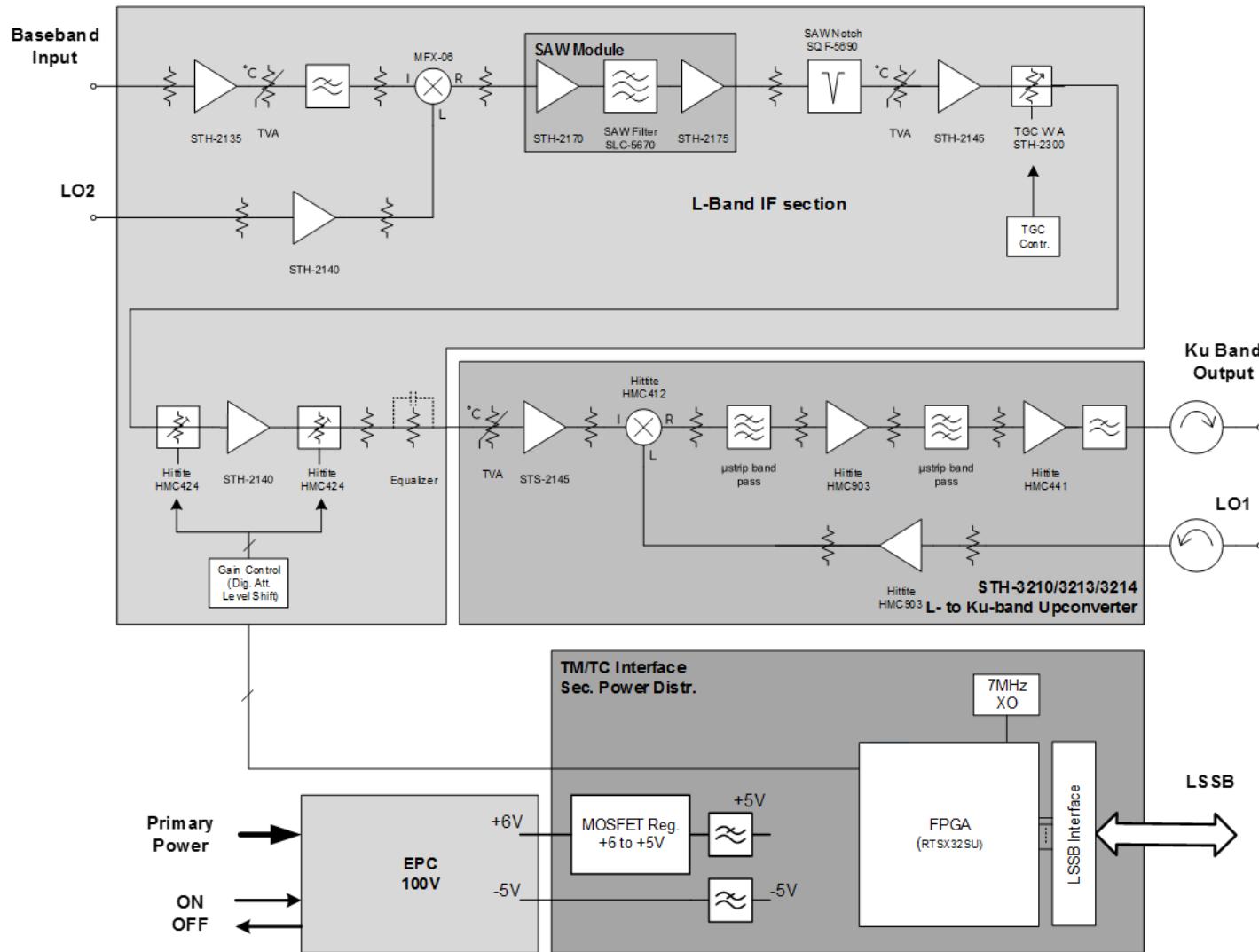
- Need for re-allocation of satellites
- Frequency coordination

SES-12 Satellite features

- Digital signal processor for beam allocation
- Norspace Deliveries (32 Frequency converters)
 - Ku-band (~14GHz) to baseband (<300Mhz) converters
 - Baseband (<300MHz) to Ku-band (~12GHz converters



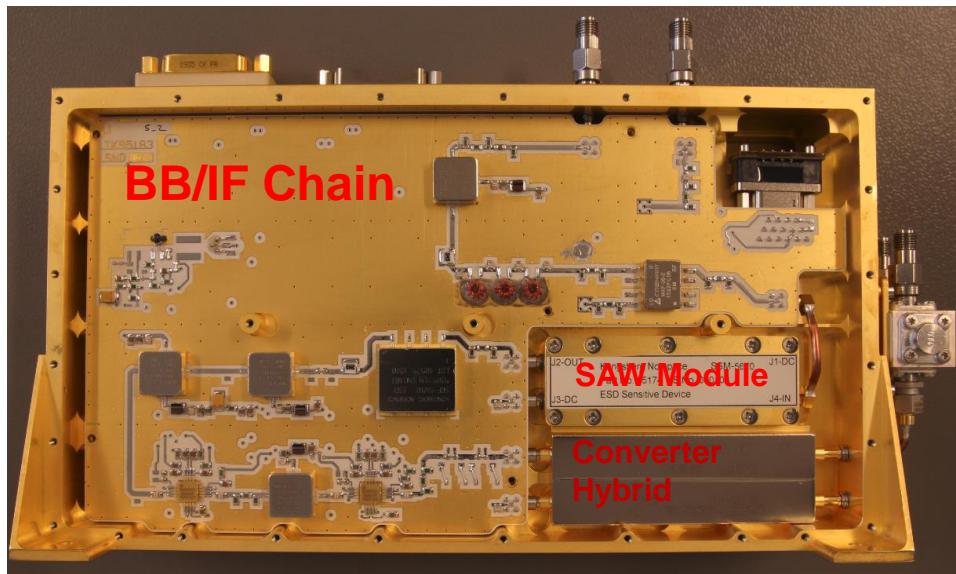
UpCon block diagram



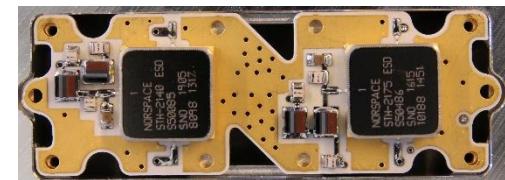
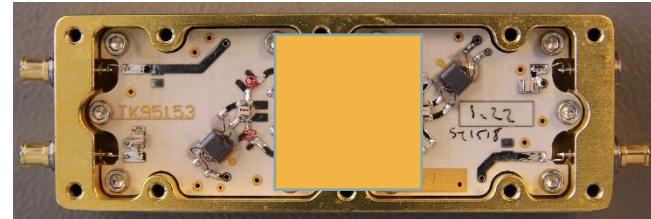
SES-12 Converters (UpConverter)



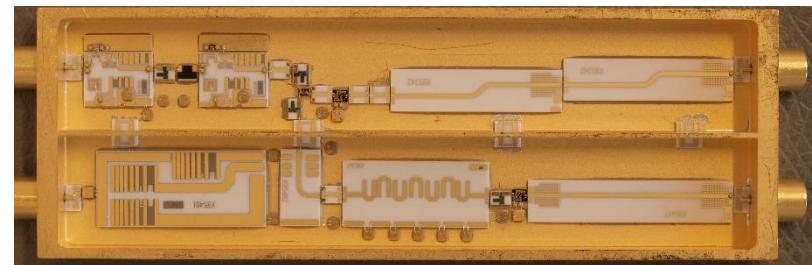
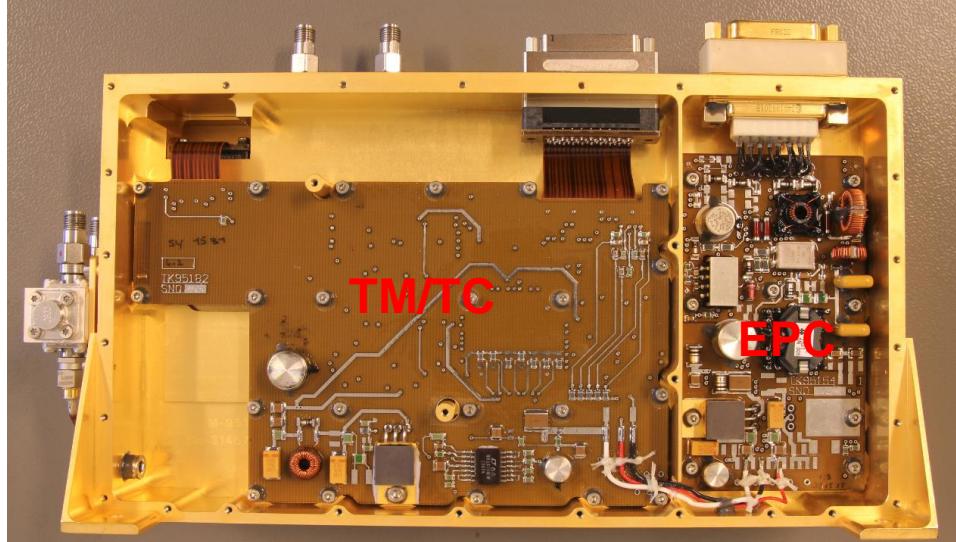
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SAW Module

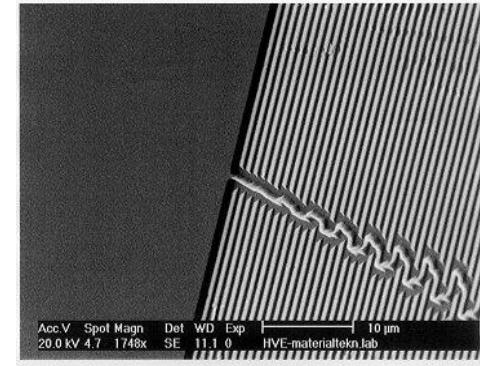
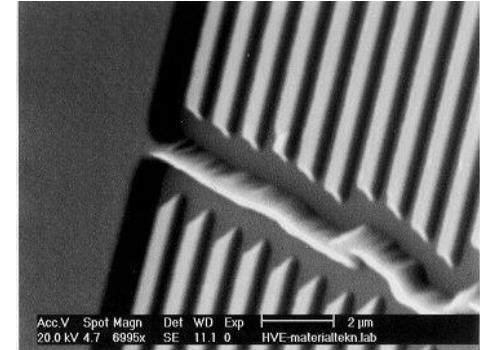
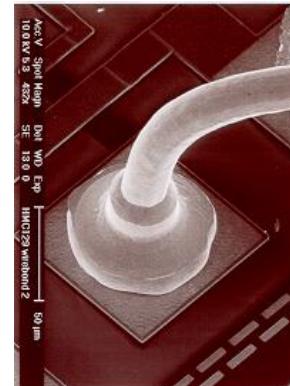
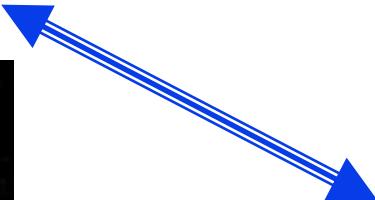
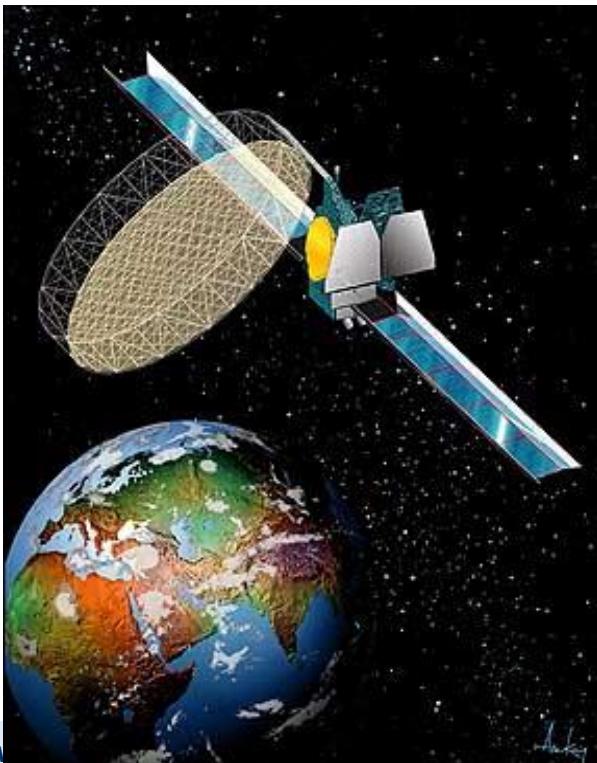


Converter Hybrid (Ku/IF)



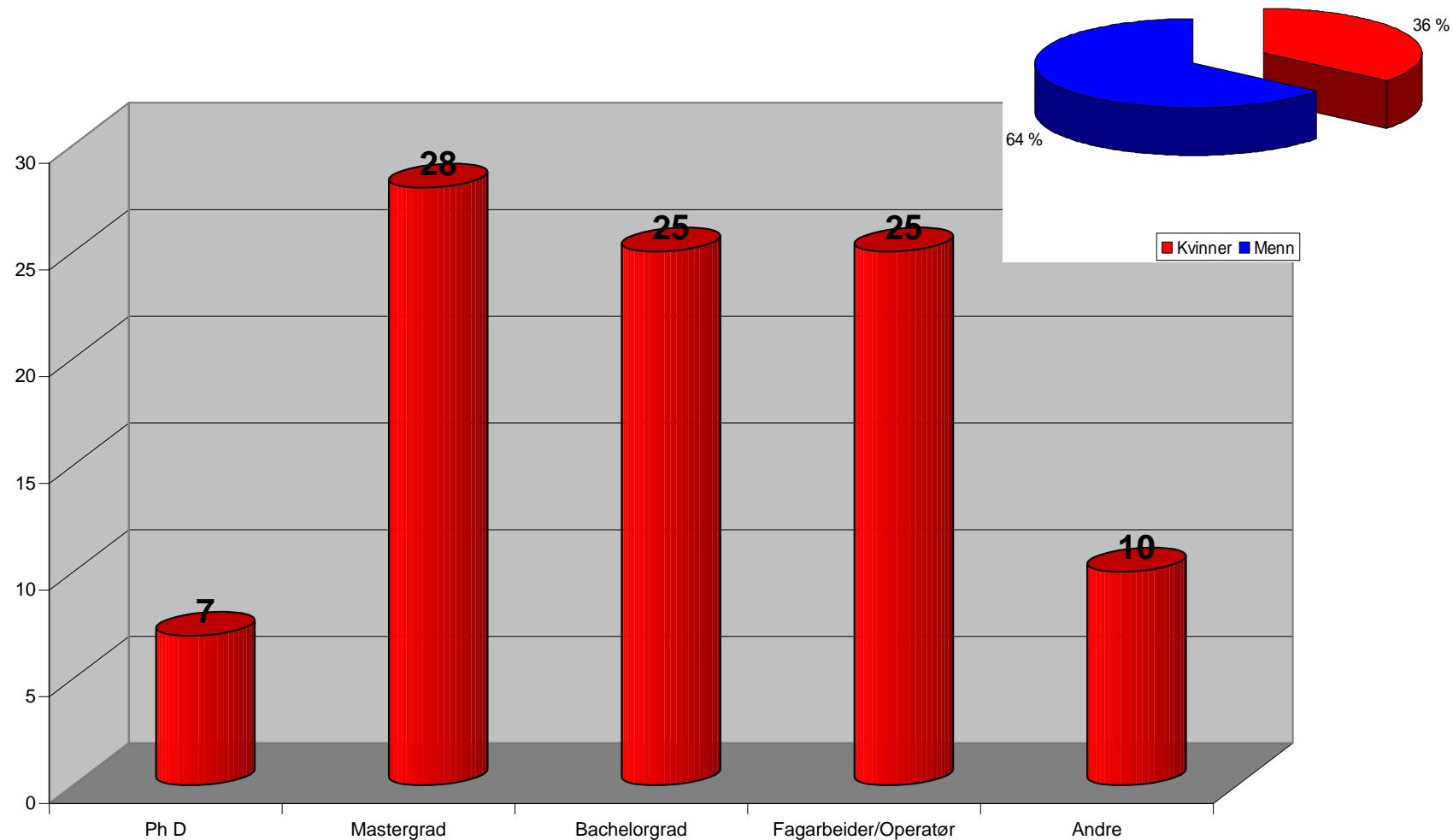
Competence Range

Detailed knowledge about satellites, satellites environments, system architecture and applications....



...to detailed process control and optimized performance on sub- μ level

Kongsberg Norspace - Competence



Team Work !!



Thank you!

- When you wish upon a star.....
- It just might be a satellite with equipment from Norspace



www.norspace.no

WORLD CLASS – through people, technology and dedication



KONGSBERG Starburst

@kogstarburst

Startside

Om

Bilder

Arrangementer

Liker

Melding

Lagre

... Mer ▾

Kommende arrangementer

[Se alle](#)

SEP.

30.

Teknologistudentenes Karrieredag 2016

I morgen kl. 10:00 · Scandic Lerkendal

1 person er interessert

Interessert



NAROM



ANDØYA SPACE CENTER