



Satellites and 5G

A satellite operator's perspective

Avanti is a market leader in satellite backhaul services

MOBILE OPERATORS.

We enable Mobile Network Operators to offer effective 2G, 3G, 4G LTE coverage in areas where backhaul is unavailable, uneconomic or unreliable. Our cost-effective backhaul services seamlessly integrate into complex mobile networks. They can be rolled out to rural and remote areas, extending network coverage further than ever before.

With our built-in flexibility and bandwidth pooling concept, we provide extra capacity to multiple sites to manage those peak data times, taking the strain off the mobile network, whether it's keeping customers connected at an event or during summer at a popular destination.

We are also entrusted to provide 4G backhaul to emergency services, providing them access to critical communications when they need it most.

BENEFITS

Our satellite backhaul has been designed to deliver the optimal user experience your customers demand:

Speed

- Deliver rapid reach into rural and remote locations

Flexibility

- Seamlessly integrates into your existing network management systems

Quality

- 'Always on' with 99.95%+ availability

Adaptability

- Supports multiple backhaul scenarios

Affordability

- Cost-effective network expansion

Reach

- Extensive coverage of UK, Europe, Middle East and Africa

VERTICALS & APPLICATIONS

- Cellular backhaul
- Cell on wheels
- Network extension and infill
- Small cell
- Backhaul backup
- Fast response capacity
- Seasonal loading

PRODUCTS



CONNECT



ADAPT



PURE



KA BAND SATELLITE COVERAGE AND A RESILIENT GROUND NETWORK

Trusted by UK Government to deliver on the ESN program with EE/BT

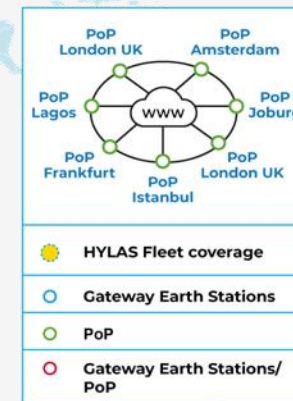
Fully operational and fully regulatory approved ground network

Interconnected via redundant fibre links

Fully licenced operations in Africa

Dual redundant antennas serving all satellites from different Ground Stations

99.9%+ SLA



POWERED BY



Avanti's involvement in 5G





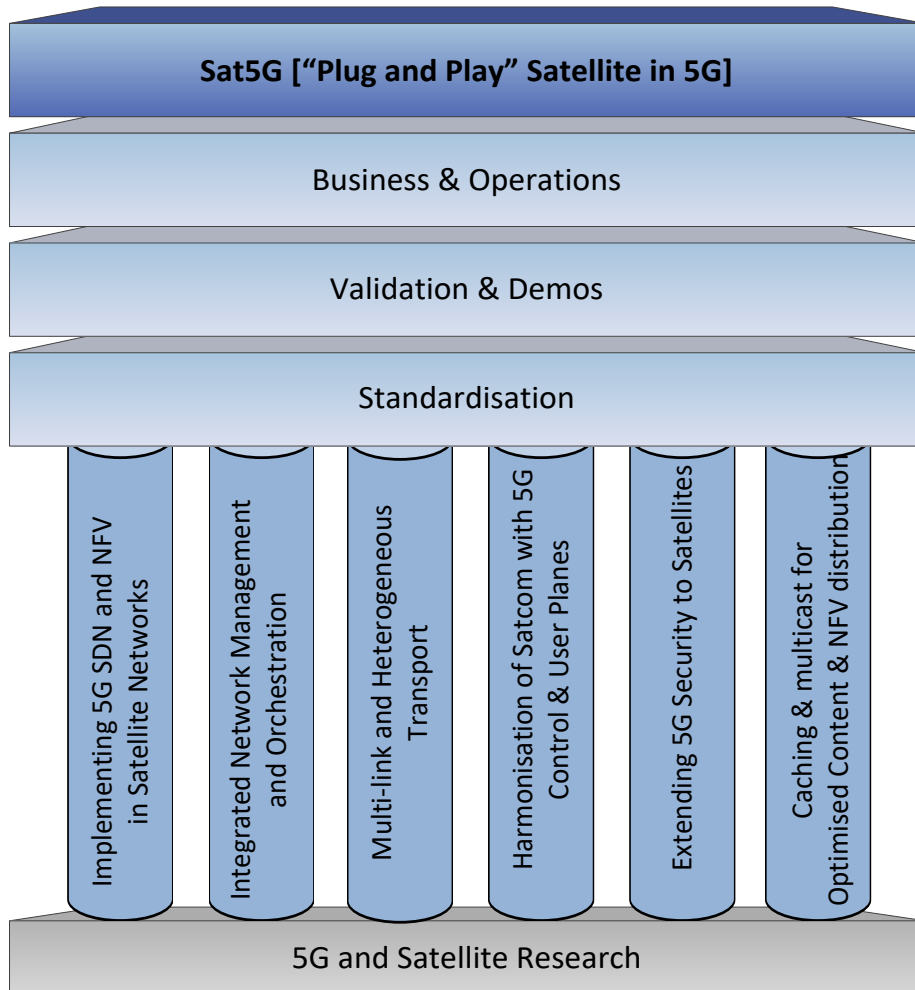
16 organisations
9 countries



| | |
|---------------------|--|
| Acronym | SaT5G |
| Title | Satellite and Terrestrial Network for 5G |
| Programme | H2020 |
| Call | H2020-ICT-2016-2 |
| Topic | ICT-7-2017 5G PPP Research and Validation of critical technologies and systems |
| Type of Action | Research and Innovation Action (RIA) |
| Grant Agreement No. | 761413 |
| Duration | 30 months (+3 months for some parts) |
| Start date | June 2017 (so Sept 19 is M27) |
| Project Coordinator | Avanti Communications |
| Technical Manager | Now UoS |
| More information | http://sat5g-project.eu/ |



SaT5G Concept



- ➔ Looking at eMBB and primarily backhaul
- ➔ Build compelling business cases and commercial models
- ➔ Validate and demonstrate solution in 3 testbeds
- ➔ Contribute to standardisation of satcom as an intrinsic element of 5G
- ➔ Research the key technology enablers for the integration of satellite in 5G
- ➔ Build on current 5G research and contribute to the 5GPPP WGs

SaT5G Use Cases



Underlying Scenarios

SaT5G Use Case 1: Edge delivery & offload for multimedia content and MEC VNF software

- Providing efficient multicast/broadcast delivery to network edges for content such as live broadcasts, ad-hoc broadcast/multicast streams, group communications, MEC VNF update distribution

2

SaT5G Use Case 2: 5G Fixed backhaul

- Broadband connectivity where it is difficult or not (yet) possible to deploy terrestrial connections to towers, for example, maritime services, coverage on lakes, islands, mountains, rural areas, isolated areas or other areas that are best or only covered by satellites; across a wide geographic region

3

SaT5G Use Case 3: 5G to premises

- Connectivity complementing terrestrial networks, such as broadband connectivity to home/office small cell in underserved areas in combination with terrestrial wireless or wireline

2

SaT5G Use Case 4: 5G Moving platform backhaul

- Broadband connectivity to platforms on the move, such as airplanes or vessels

3



Used for business analysis and validation activities

5Genesis



- H2020 ICT 17 project
 - 36 months starting July 2018
 - 29 partners
- Builds five platforms to validate KPIs for vertical use cases
 - Four not using satellite for this project (Athens, Malaga, Surrey, Berlin)
- One platform specifically including satellite communications
 - Limassol using Avanti capacity
 - Addressing the underserved and near shore communications
- Sister project – 5G Vinni
 - Also had a satellite link component



ESA and 5G

- Satellite for 5G initiative
- Multiple projects including
 - Satis5 – complementary to SaT5G adding mMTC use cases
 - Support for 5Groningen
 - ...
- SSIG (Standards special interest group)
 - Regular calls to coordinate standards activities
 - Led by TAS and ESA



European Space Agency
Agence spatiale européenne



Satellite and 5G standards activities include

| SDO | WG | WI Reference | WI Title | Output Document | Target Completion Date | Rapporteur |
|----------|------------|---------------------|--|----------------------|------------------------|------------|
| 3GPP | SA1 | FS_5GSAT | SI - Study on using Satellite Access in 5G; Stage 1 (Release 15) | 3GPP TR 22.822 | June 2018 | TAS |
| 3GPP | RAN | FS_NR_nonterr_nw | SI - Study on NR to support non-terrestrial networks (Release 15) | 3GPP TR 38.811 | June 2018 | TAS |
| 3GPP | SA1 | 5GSAT | WI - Service requirements for the 5G system; Stage 1 (Release 16) | CR to 3GPP TS 22.261 | December 2018 | TAS |
| 3GPP | SA2 | FS_5GSAT_ARCH | SI - Study on architecture aspects for using satellite access in 5G (Release 16) | 3GPP TR 23.737 | September 2019 | TAS |
| 3GPP | SA5 | FS_5G_SAT_MO | SI - Study on management and orchestration aspects of integrated satellite components in a 5G network (Release 16) | 3GPP TR 28.808 | December 2019 | TAS |
| 3GPP | RAN3/2/1 | FS_NR NTN_solutions | SI - Solutions for NR to support Non Terrestrial Networks (NTN) (Release 16) | 3GPP TR 38.821 | March 2020 | TAS |
| 3GPP | SA3 | tbd | tbc – security issues related to satcom links | tbc | Not yet started | (TNO?) |
| ETSI | SCN TC-SES | DTR/SES-00405 | Integration of satellite and/or HAPS (High Altitude Platform Station) systems into 5G and related architecture options | ETSI TR 103 611 | 2019 | TAS |
| ETSI | SCN TC-SES | DTR/SES-00447 | Edge delivery in 5G through satellite multicast | TBD | 2019 | AVA |
| ETSI | SCN TC-SES | DTR/SES-00446 | Reference Virtualised Network Functions data model for satellite communication systems | TBD | 2019 | iDR |
| CEPT ECC | FM44 | FM44/ECC PT1 | Satellite solutions for 5G | ECC Report 280 | May 2018 | SES |
| ITU-R | WP4B | NGAT_SAT | Key elements for the integration of satellite systems into Next Generation Access Technologies | TBD | Q2 2020 | SES |
| ITU-T | FG-NET2030 | FG-NET2030 | ITU-T Focus Group for 2030 on future network scenarios beyond 5G | TBD | TBD | UoS |

Other groups

- ESOA
 - Include a very active standards working group
 - Market Representation Partner in 3GPP
- Recently signed a co-operation agreement with NGMN
 - Joint project emerging for deep rural communications
- Networld2020
 - Has a satellite working group
- Horizons 5G
 - UK group
 - Space as an embedded and integrated part of the 5G network



Where is this all going?



Where is this all going – a health warning

- 1876:** *"The Americans have need of the telephone, but we do not. We have plenty of messenger boys."* – William Preece, British Post Office.
- 1876:** *"This 'telephone' has too many shortcomings to be seriously considered as a means of communication."* – William Orton, President of Western Union.
- 1889:** *"Fooling around with alternating current (AC) is just a waste of time. Nobody will use it, ever."* – Thomas Edison
- 1903:** *"The horse is here to stay but the automobile is only a novelty – a fad."* – President of the Michigan Savings Bank advising Henry Ford's lawyer, Horace Rackham, not to invest in the Ford Motor Company.
- 1920:** *"No flying machine will ever fly from New York to Paris."* – Orville Wright
- 1936:** *"A rocket will never be able to leave Earth's atmosphere."* – The New York Times
- 1946:** *"Television won't be able to hold on to any market it captures after the first six months. People will soon get tired of staring at a plywood box every night."* – Darryl Zanuck, 20th Century Fox.
- 1955:** *"Nuclear powered vacuum cleaners will probably be a reality within 10 years."* – Alex Lewyt, President of the Lewyt Vacuum Cleaner Company.
- 1959:** *"Before man reaches the moon, your mail will be delivered within hours from New York to Australia by guided missiles. We stand on the threshold of rocket mail."* – Arthur Summerfield, U.S. Postmaster General.
- 1961:** *"There is practically no chance communications space satellites will be used to provide better telephone, telegraph, television or radio service inside the United States."* – T.A.M. Craven, Federal Communications Commission (FCC) commissioner.
- 1966:** *"Remote shopping, while entirely feasible, will flop."* – Time Magazine.
- 1977:** *"There is no reason anyone would want a computer in their home."* – Ken Olsen
- 1981:** *"Cellular phones will absolutely not replace local wire systems."* – Marty Cooper, inventor.
- 1995:** *"I predict the Internet will soon go spectacularly supernova and in 1996 catastrophically collapse."* – Robert Metcalfe, founder of 3Com.
- 2005:** *"There's just not that many videos I want to watch."* – Steve Chen, CTO and co-founder of YouTube expressing concerns about his company's long term viability.
- 2006:** *"Everyone's always asking me when Apple will come out with a cell phone. My answer is, 'Probably never.'"* – David Pogue, The New York Times.
- 2007:** *"There's no chance that the iPhone is going to get any significant market share."* – Steve Ballmer, Microsoft CEO.

Where is this all going?

My personal view is something along these lines...

Short term

From today's 4G backhaul solutions to wider scale, easier to deploy, standards based 5G backhaul solutions (GEO, MEO, LEO)

Fixed and moving RANs

Increasing levels of integration

Relying on satellite strengths

- Reach
- Reliability
- Multicast

Medium Term

Edge delivery of content (GEO)

Delivering

- Cached content
- Streamed content
- Video, A/VR, games, etc.

Longer term

Satellite 5G RANs (LEO)

- Direct to consumer UE
- New satellites needed
- Complement other NTN

Quantum key distribution

- LEO distribute keys to edge somehow

Work still needed on
business arrangements,
planning and MANO

Thank you for your time

