Overview of SES's Innovation Activities on Satellite Integration into 5G

SES beyond frontiers

PRESENTED BY
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PRESENTED ON
16 October 2018

Presentation Outline

Aim:

- To provide an overview of SES's technology innovation activities on satellite integration into 5G

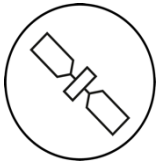
Outline:

- Intro to SES & related innovation activities
- SaT5G (Satellite and Terrestrial Network for 5G, EU H2020 5G PPP Phase 2)
- SATis5 (Demonstrator for Satellite-Terrestrial Integration in 5G Context, ESA ARTES AT)
- 5G-VINNI (5G Verticals Innovation Infrastructure, EU H2020 5G PPP Phase 3)
- Conclusion

SES

About SES

World's Leading Satellite Operator



70+

satellites covering

99%

of the globe and world population

Unique

GEO-MEO

constellation complemented by a ground segment, together forming a flexible network architecture that is globally scalable

Driver of

INNOVATION

in building a cloud-scale, automated, "virtual fibre" network of the future

LEADING IN THE INDUSTRY'S MOST INFLUENTIAL STANDARDS GROUPS

- Active proponent of integration of satellite into 5G
- Co-founder and Vice-Chair of the 5G Infrastructure Association (5G-IA)
- Collaborative standards, studies and open-source initiatives
- Member of the SB and relevant WGs of NetWorld2020 ETP
- Member of the ESA "Satellite for 5G" Task Force
- Ecosystem and technology development, e.g. SaT5G, 5G-VINNI (EU H2020), SATis5 (ESA)

O3b mPOWER

SES | Networks

MULTI-TERABIT CAPACITY

ULTIMATE FLEXIBILITY

ENABLING GLOBAL CONNECTIVITY

GLOBAL COVERAGE

LOW LATENCY, VIRTUAL FIBER NETWORK

LAUNCH 2021

O3b Next Generation MEO Constellation

The Most Powerful Satellite System Ever

O3b mPOWER

SES

- SES Networks already operates the only MEO satellites for the lowest-latency service from space
- In 2021, seven next-generation MEO satellites will be added to the O3b fleet
- Setting new industry benchmarks across multiple performance metrics

CAPACITY	FLEXIBILITY	COVERAGE	PRODUCTIVITY
Multi-terabit Scalable to 10s of Tbps globally	Shape, moderate, route, shift & switch **4,000+** beams per satellite	**~400M** Square kilometres covered	**100%** productive — Beams go to customers, not empty territory

SES is playing leading role in satellite integration into 5G

Leadership role in critical industry standards and technology initiatives

- Active contributor to relevant standards for promoting satellite integration into 5G

- Only CE 2.0 certified services (sub 150 ms latency) in industry
- Designing orchestration solutions aligned to MEF 55 LSO spec

- Founding member of Linux Foundation Networking Fund
- Designing network automation solutions aligned to ONAP

- Contributing to critical initiatives to lower cost of reaching underserved populations

- Co-founder and Vice-Chair of the 5G Infrastructure Association
- Providing policy, regulatory, standards, spectrum and technology narrative

- Member of ESA “Satellite for 5G” Task Force

- Active participation in publicly-funded collaborative innovation projects for ecosystem and technology development

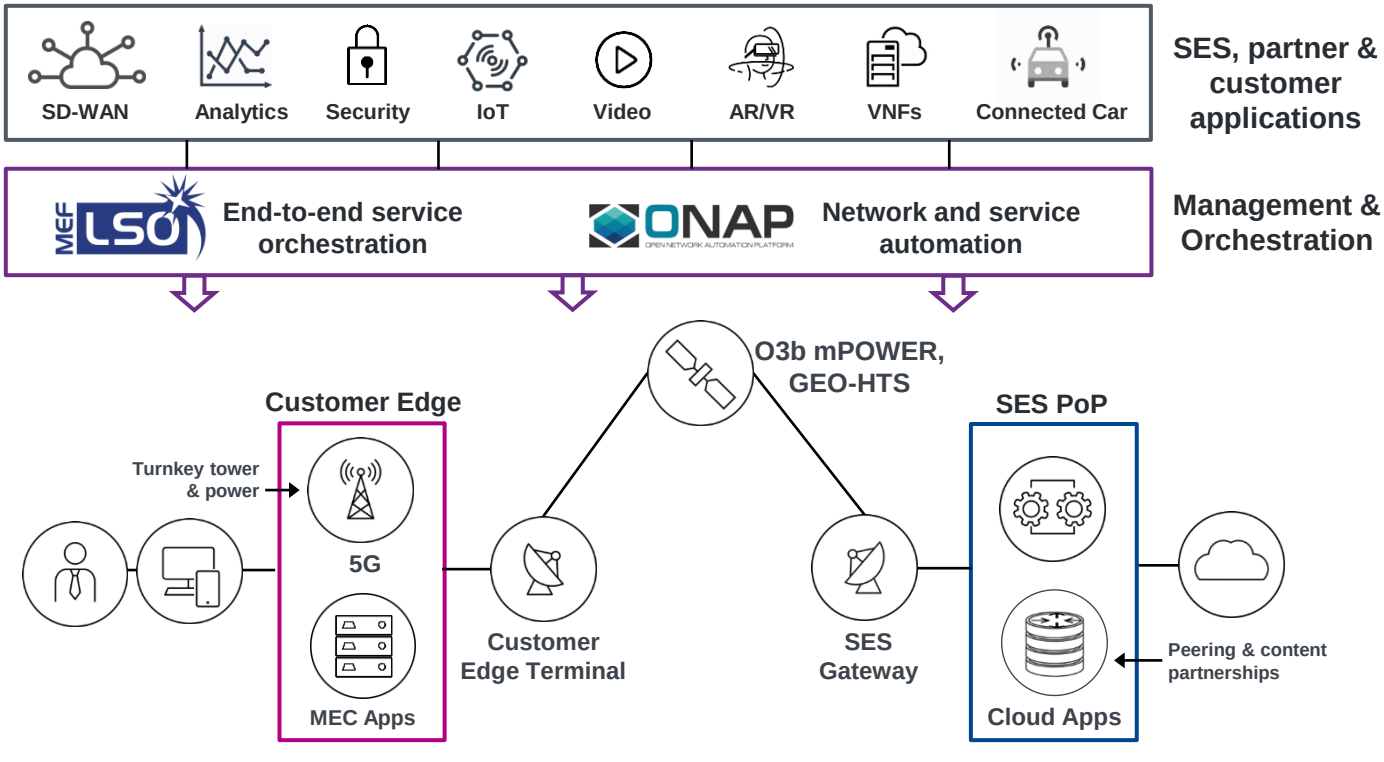
- Developing and demonstrating the technologies and capabilities needed for satellite integration into 5G

Our Vision: A Software-defined, Automated, Cloud-scale Platform

Planning for the future

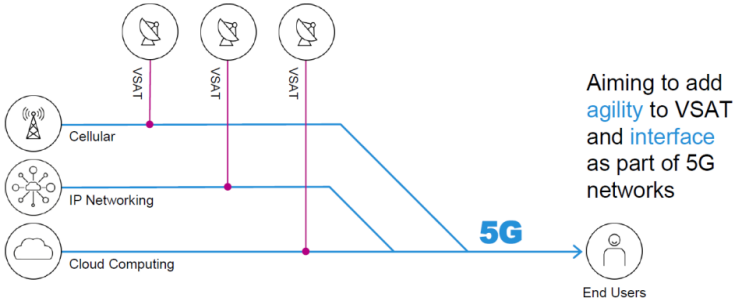
As your customers demand more, we chart a clear path to cloud-scale, software-defined networks

SATis5 · 5G Satellite and Terrestrial Network for 5G · 5G-VINNI · TELECOM INFRA PROJECT · ONAP · THE LINUX FOUNDATION · MEF · 3GPP · 5G PPP · ETSI



Satellite into 5G & Standardisation Approach

- **Short/Mid-term:** Fully-fledged implementation for operational integration of satellite into the heterogeneous 5G "network of networks" through plug & play approach with focus on higher layer enablers (SDN, NFV, Network Slicing, MEC, Security, etc) under common network management and orchestration



Aiming to add agility to VSAT and interface as part of 5G networks

Satellite into 5G is mainly about the higher layers, not about 5G waveforms, ultra-low latency, or cell towers in space

- **Long-term:** Possibility to use a 3GPP standardised version of 5G NR for the satellite waveform (nice-to-have feature)
- Partnership in standardisation between mobile and satellite industries is key to promote open standards for satellite integration in 5G ecosystem
- With such standards-compliant integration, satellite systems can be integrated into 5G even if some low-level satellite elements are proprietary or non-3GPP based (e.g. waveform)

SaT5G Project

- Acknowledgement:
  - The work presented has been conducted as part of the SaT5G project, which has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement no. 761413.

SaT5G Project at a Glance

SaT5G: Satellite and Terrestrial Network for 5G

Further info: http://sat5g-project.eu/

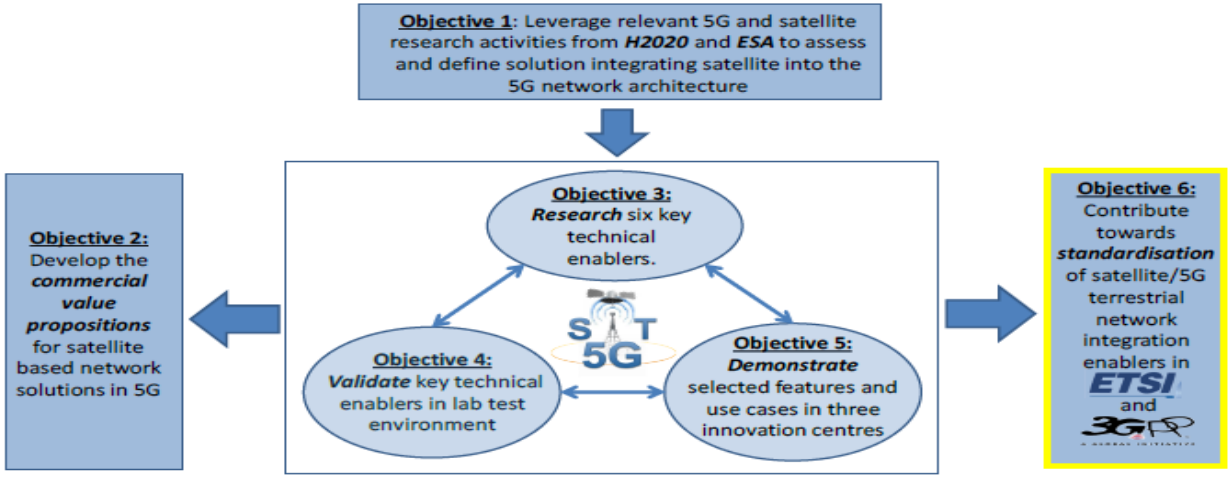
- Customer: **European Commission** (EC)
- Funding Programme: EC H2020 5G PPP Phase 2
- Total Budget: 8.3 MEUR (100% funded)
- T0 Date: 01 June 2017
- Duration: 30 months
- Main Objective:
  - To research, develop, validate and demonstrate key technology enablers for **"plug-and-play" integration** of SatCom into 5G networks, with focus on 5G use cases for enhanced mobile broadband (**eMBB**)
- Consortium:
  - Project Coordinator: Avanti Communications (UK)
  - EU consortium comprising 16 partners from SatCom and non-SatCom industries
  - SES: Consortium Partner, Steering Committee Member, WP Leader

SaT5G Vision & Objectives

Vision

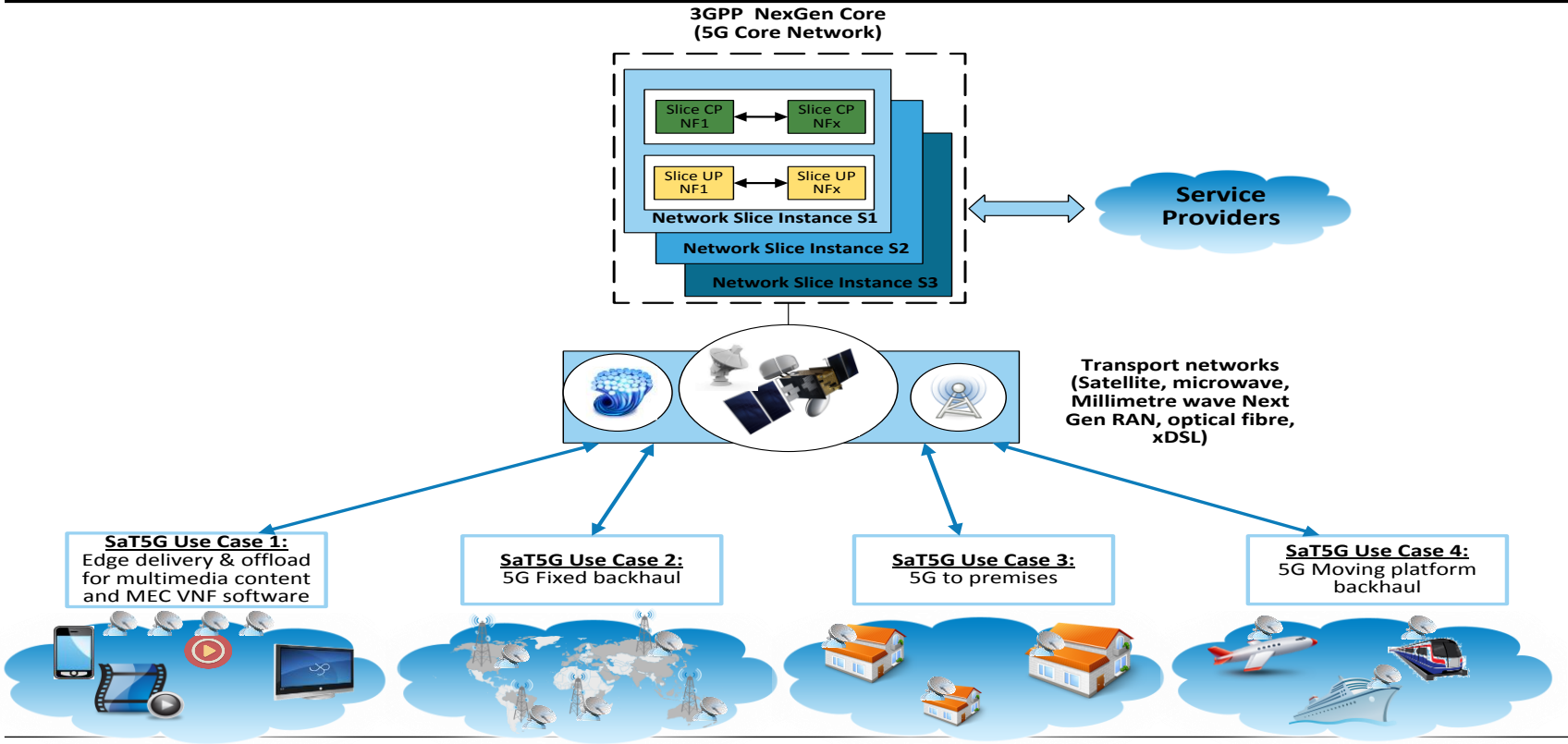
- To develop cost effective “plug and play” satcom solutions for 5G to enable telcos and network vendors to accelerate 5G deployment across all geographies and at the same time create new and growing market opportunities for satcom industry stakeholders

Objectives



SaT5G Use Cases

Focus on eMBB (Enhanced Mobile Broadband) 5G Usage Scenario

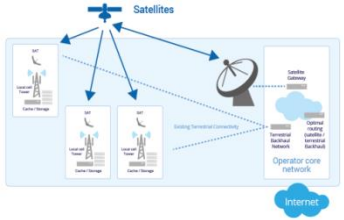


SaT5G Use Cases

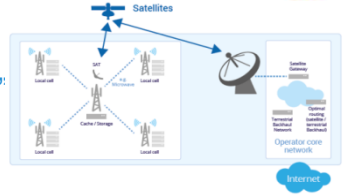
Correspondence to Satellite “Sweet Spots” in 5G Ecosystem

- **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.
- **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
- **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
- **SaT5G Use Case 4: 5G Moving platform backhaul**
  - Broadband connectivity to platforms on the move, such as airplanes or vessels

- **“Backhauling & Tower Feed”**

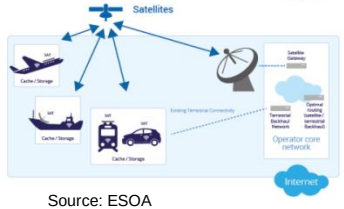


- **“Trunking & Head-end Feed”**



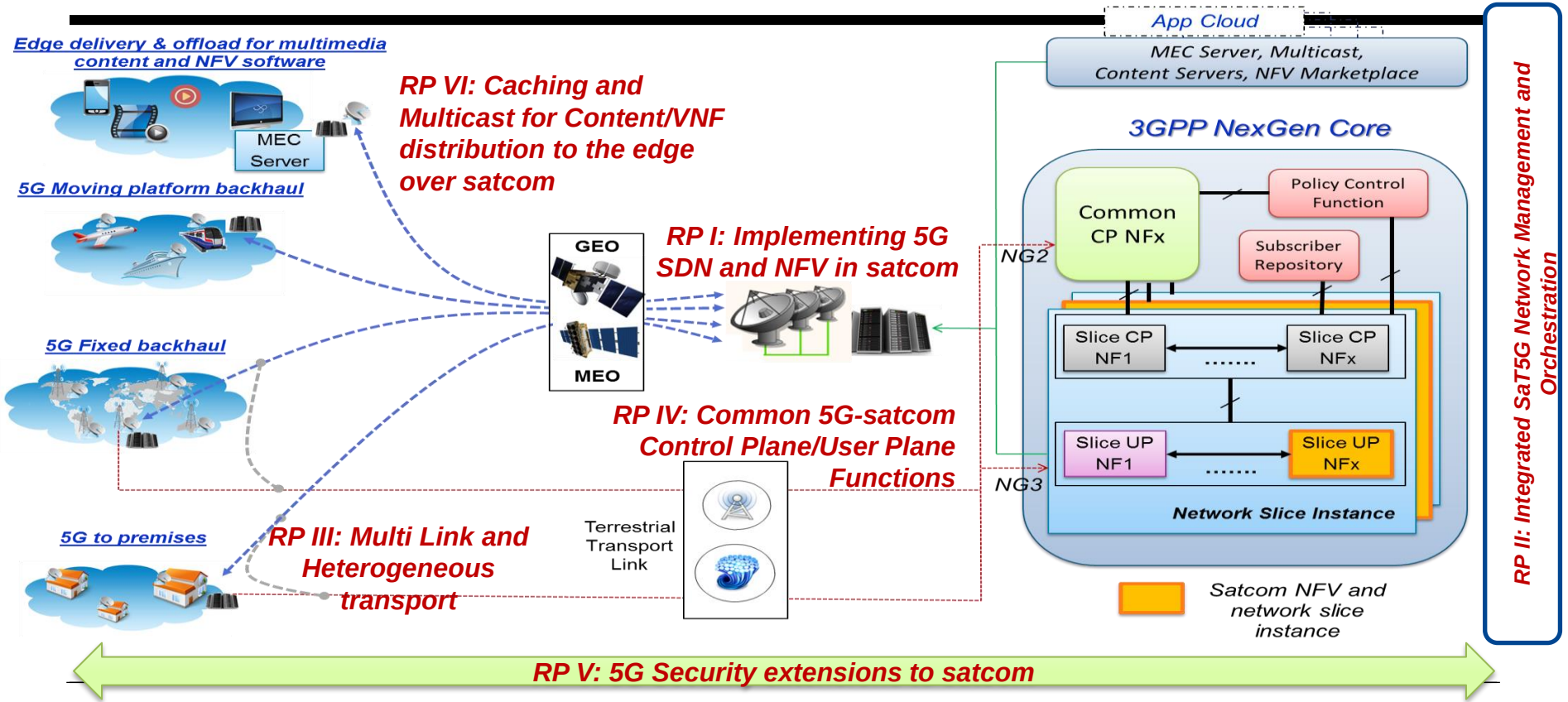
- **“Hybrid Multiplay”**

- **“Comms on the Move”**

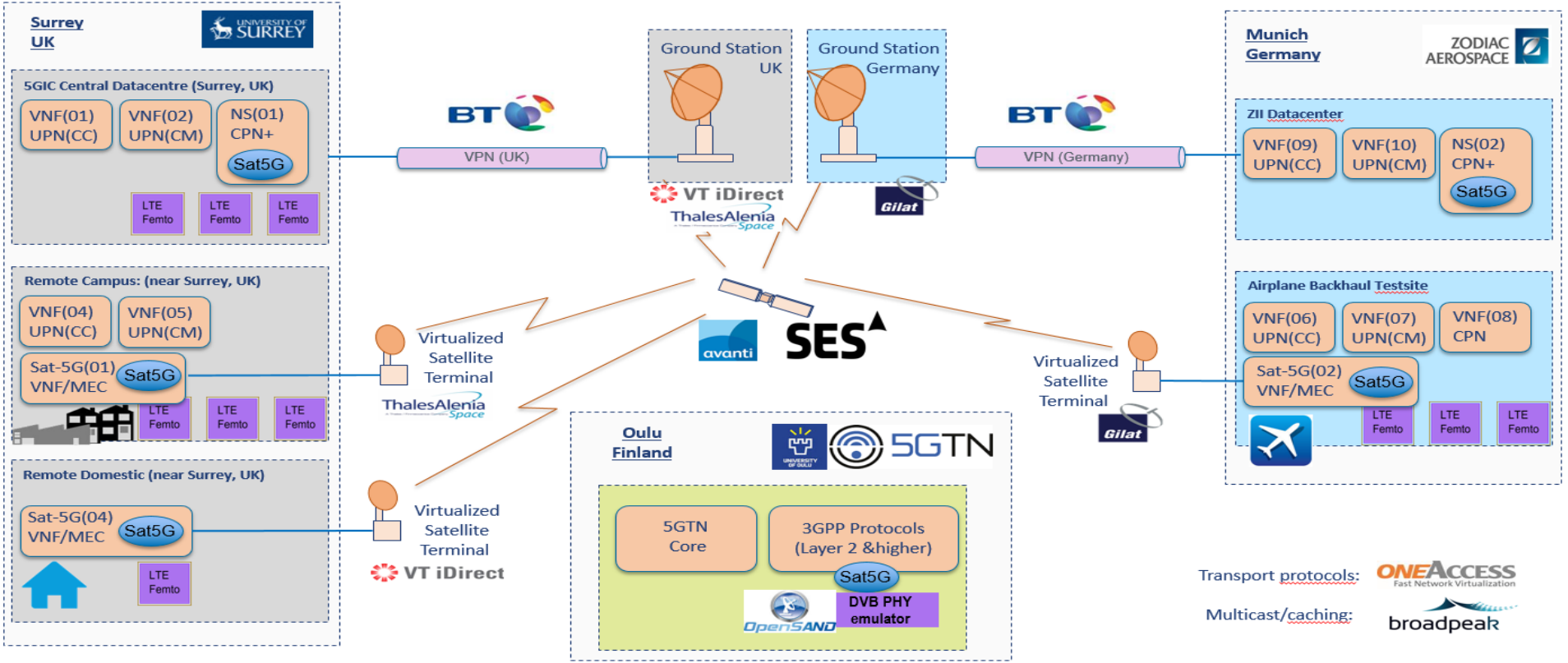


Source: ESOA

SaT5G Use Cases & Research Pillars



SaT5G Demo Testbeds



EuCNC 2018 Demo Setup Overview

First-of-its-kind over-the-air live demo towards integration of Satellite into 5G

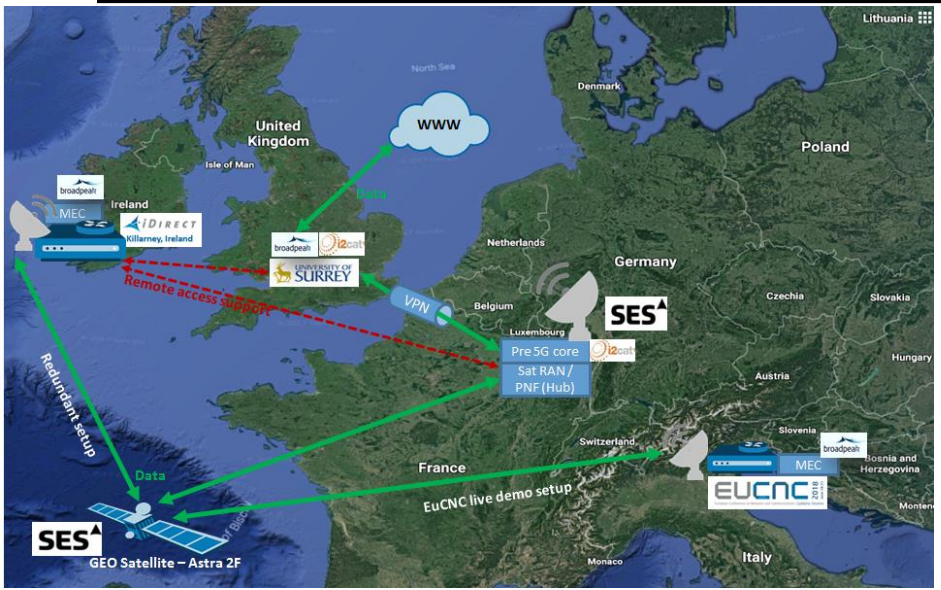
Demonstrated key benefits of satellite integration with an SDN / NFV / MEC-enabled pre-5G construction testbed, with an SES GEO in-orbit satellite system as a proof-of-concept for integration of those features into a full 5G network

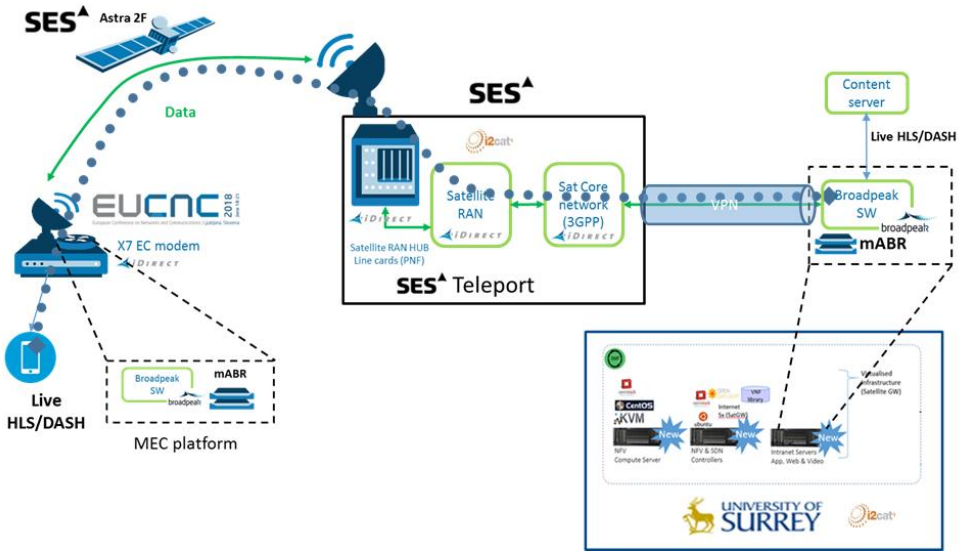
Objectives

- Satellite integration into standard 3GPP network architecture
- SDN and NFV integration into satellite communications
- Content delivery over Satellite
- Multi-access Edge Computing (MEC)

EuCNC 2018 Demo Setup Overview

First-of-its-kind over-the-air live demo towards integration of Satellite into 5G

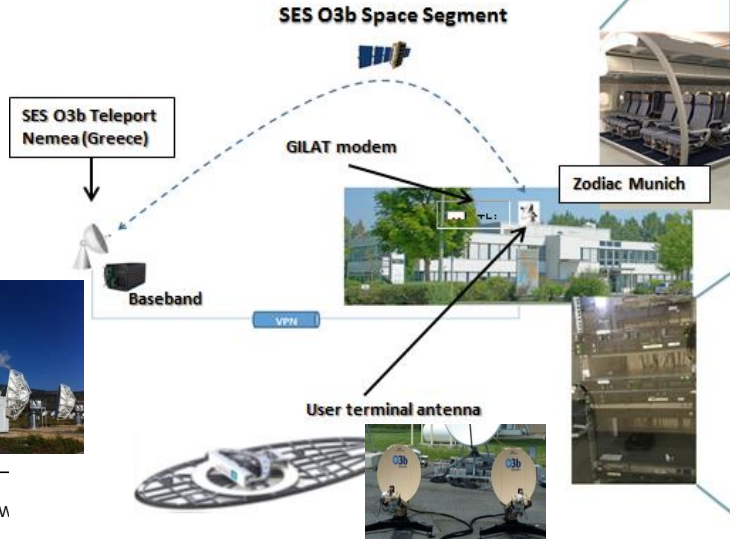


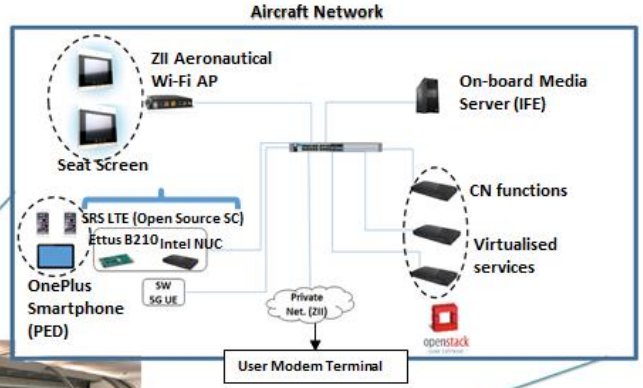


5G Aero Backhaul Demo Testbed Architecture

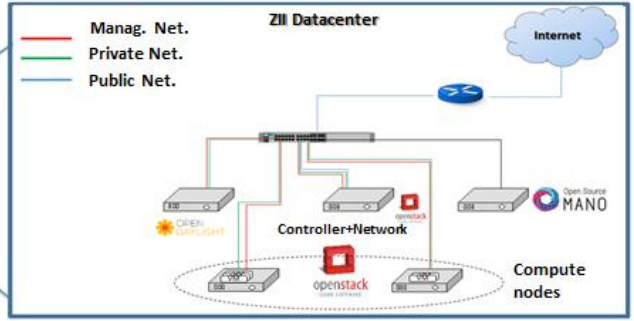
Over-the-air demo expected in Q4 2019

Use Case	Brief Use Case Description	Addressed 5G Functionalities	Demo Testbed Platform & Partners
SaT5G Use Case 4: 5G Moving platform backhaul	Broadband connectivity to airplanes for Next Gen IFEC	Satellite access for backhaul Support of SDN/NFV, Edge caching, Network Management and orchestration. Traffic steering between unicast and multicast resources. Mobility management in realistic aircraft scenarios.	5G Aero Testbed (Munich DE) Zodiac In-flight Innovation, SES, Gilat, BT, Quortus, i2CAT, Broadpeak





Aircraft cabin mock-up



Target Standardization Study/Work Items

SDO	WG	WI Reference	WI Title	Output Document	Target Completion Date
3GPP	SA1	FS_5GSAT	Study on using Satellite Access in 5G	3GPP TR 22.822	June 2018
3GPP	SA1	5GSAT	Release 16 New WID on Integration of Satellite Access in 5G	CR to 3GPP TS 22.261	December 2018
3GPP	SA2	FS_5GSAT_ARCH	Release 16 New SID - Study on architecture aspects for using satellite access in 5G	3GPP TR 23.737	June 2019
3GPP	RAN	FS_NR_nonterr_nw	Study on NR to support non-terrestrial networks	3GPP TR 38.811	June 2018
3GPP	RAN3/2/1	NR-NTN solutions	Release 16 New SID - Study on solutions evaluation for NR to support Non Terrestrial Network	3GPP TR 38.821	December 2019
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	December 2018
ETSI	SCN TC-SES	DTR/SES-00447	Edge delivery in 5G through satellite multicast	ETSI TR TBD	June 2019
ETSI	SCN TC-SES	DTR/SES-00446	Reference Virtualised Network Functions data model for satellite communication systems	ETSI TR TBD	March 2019
CEPT ECC	FM44	FM44/ECC PT1	Satellite solutions for 5G	ECC Report 280	May 2018
ITU-R	WP4B	NGAT_SAT	Key elements for the integration of satellite systems into Next Generation Access Technologies	ITU-R.M Report TBD	Q2 2020

SATis5 Project

- Acknowledgement:
  - The work presented has been conducted as part of the ESA ARTES project SATis5 – ESA Contract No.: 4000120663/17/NL/CLP. The views expressed herein can in no way be taken to reflect the official opinion of the European Space Agency.

SATis5 Project at a Glance

SATis5: Demonstrator for Satellite-Terrestrial Integration in 5G Context

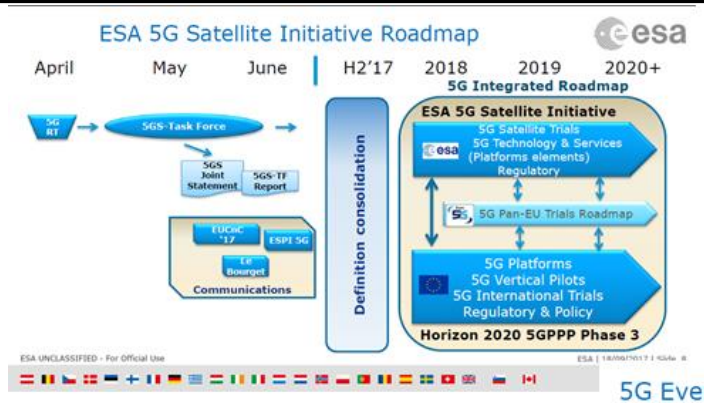
- Customer: **European Space Agency** (ESA)

Further info: https://artes.esa.int/projects/satis5

- Funding Programme: ESA ARTES Advanced Technology (former ARTES 5.1)
- Total Budget: 1.124 MEUR (100% funded)
- Kick-Off Date: 01 October 2017
  - Duration: 24 + 12 months
- Main Objective:
  - To build a large-scale real-time live end-to-end 5G integrated network **Proof-of-Concept testbed** that enables the satellite terrestrial convergence into the 5G context. Focus on both **eMBB** and **mMTC** use cases.
- Consortium:
  - Prime Contractor: Eurescom (DE)
  - Consortium comprising 7 partners based in Germany and Luxembourg
  - SES: Consortium Partner, WP Leader

SATis5 Project Highlights

SATis5 holds key position in ESA “Satellite for 5G” Task Force Roadmap



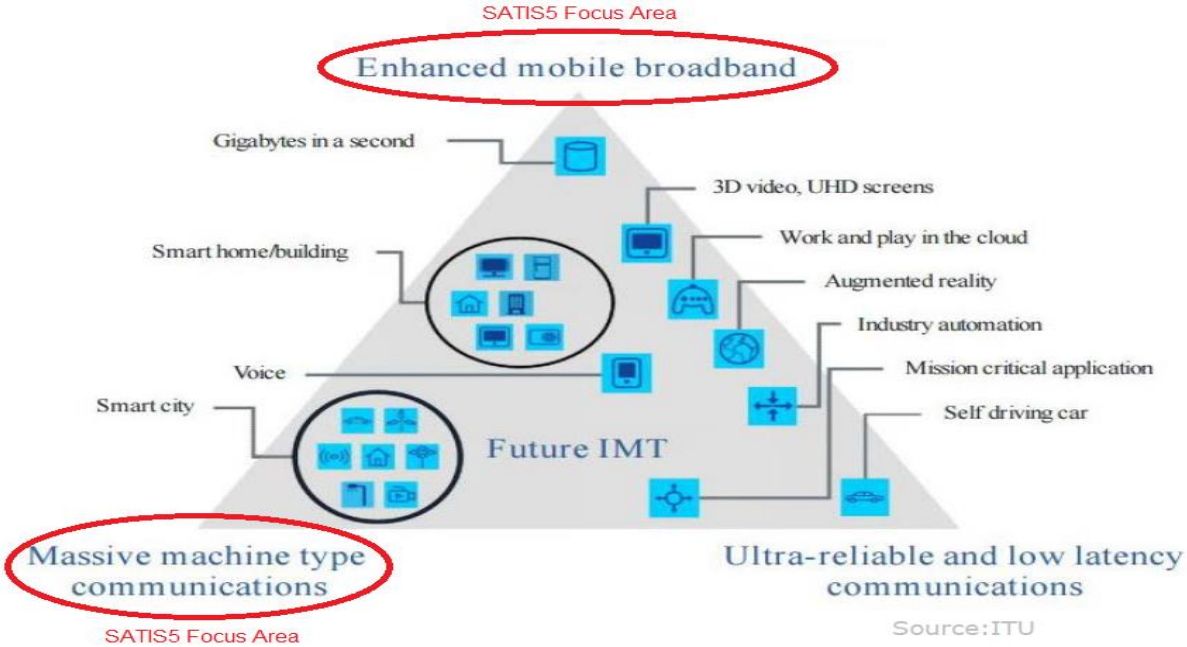
SATis5

Source: ESA

Satellite Use Cases in 5G

SATis5 focuses on eMBB and mMTC usage scenarios for 5G

- SATis5 focuses on **eMBB** (enhanced Mobile Broadband) and **mMTC** (massive Machine Type Communications) usage scenarios for 5G

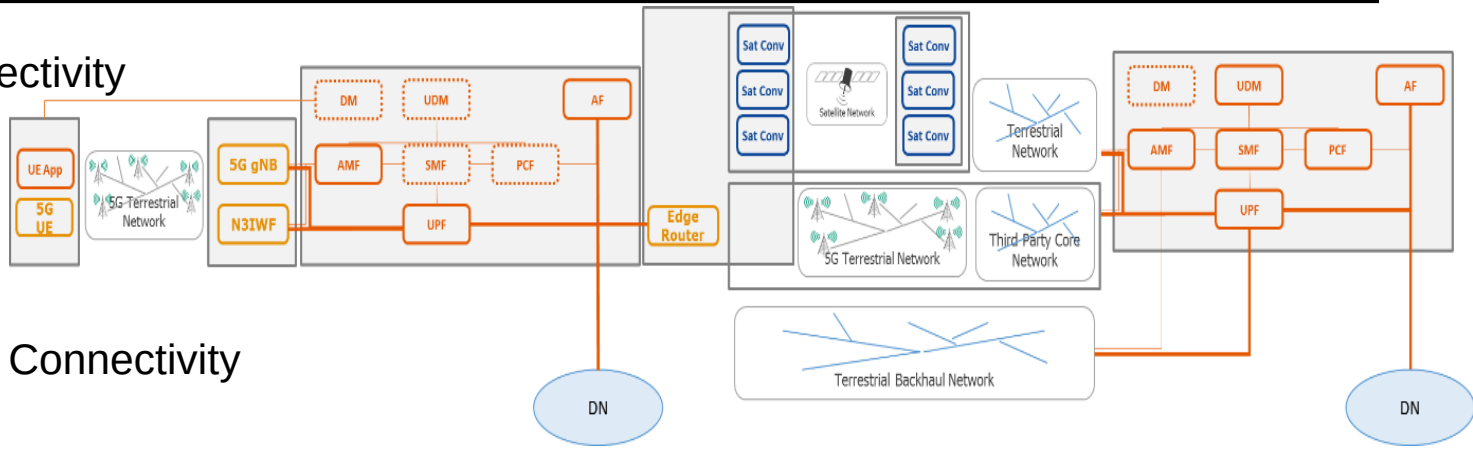


SATis5 Use Cases

5G Usage Scenario	Satellite Use Case Category	SATis5 Use Case	Correspondence to 3GPP SA1 Use Case (3GPP TR 22.822)	Comment
eMBB	Trunking and Head-end Feed	Broadband connectivity to areas where it is difficult or not (yet) possible to deploy terrestrial connections to towers, for example, 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.	*5G Fixed Backhaul between NR and the 5G Core*	-
	Backhauling and Tower Feed	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.	*Broadcast and multicast with a satellite overlay*	SATis5 main focus will be on media and entertainment delivery using DASH
	Communications on the Move	Broadband and content multicast connectivity to moving platforms such as airplanes, vessels, high speed trains/buses and other road vehicles, in conjunction with terrestrial-based connectivity link to base stations or relay on-board moving platforms, to ensure service continuity and service reliability.	*5G Moving Platform Backhaul*	SATis5 main focus will be on road vehicles
	Hybrid Multiplay	Connectivity complementing terrestrial networks, such as broadband connectivity to home/office small cell in underserved areas in combination with terrestrial wireless or wireline.	*5G to Premises*	SATis5 testbed readiness to validate/demonstrate this use case will be assessed at later stage
mMTC	Backhauling and Tower Feed	Broadcast service to end users (e.g., video, software download), support of low bit-rate broadcast service e.g. for emergency messages and synchronisation of remote sensors and actuators.	*Internet of Things with a satellite network*	SATis5 main focus will be on synchronization of remote sensors and actuators / OTA provisioning
	Communications on the Move	IoT devices on containers (e.g. for tracking and tracing) connected via a Relay UE on a transport vehicle such as a ship, train or truck.	*Indirect connection through a 5G satellite access network &* *Roaming between terrestrial and satellite networks*	SATis5 main focus will be on road vehicles and IoT data aggregation at edge
		Cyber and Managed Security Services for connected cars: Alternate secure channel for global certificate and key management; managed service for OEMs and Tier 1s patching latest vulnerabilities and attacks by updating firewall and IDS (Intrusion Detection Systems) systems.	N/A	SATis5 testbed readiness to validate/demonstrate this use case will be assessed at later stage

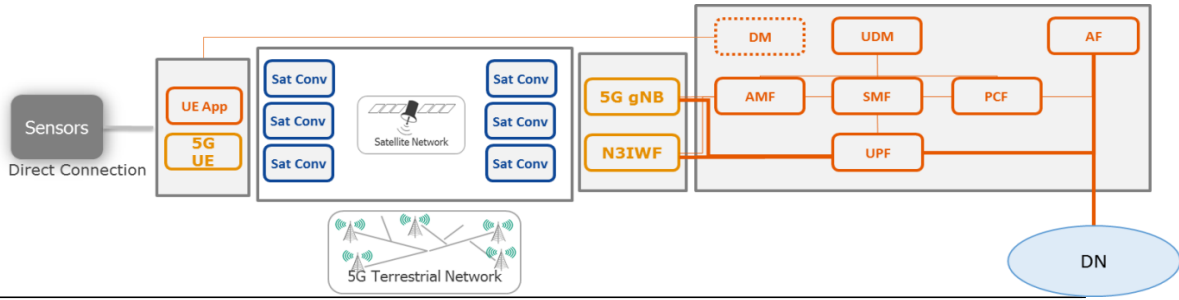
SATis5 Testbed Architecture

- Backhaul Connectivity



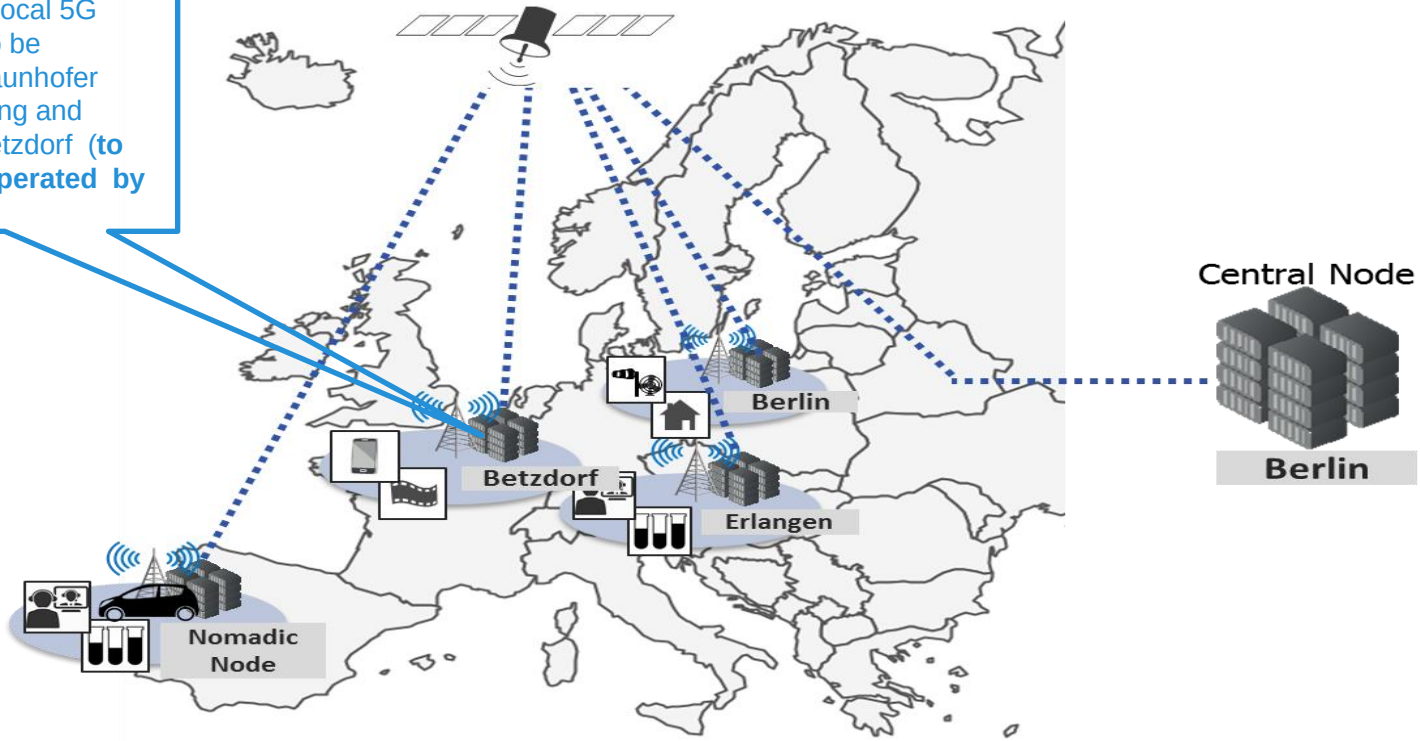
- Indirect (Proxy) Connectivity

- Direct to UE Connectivity

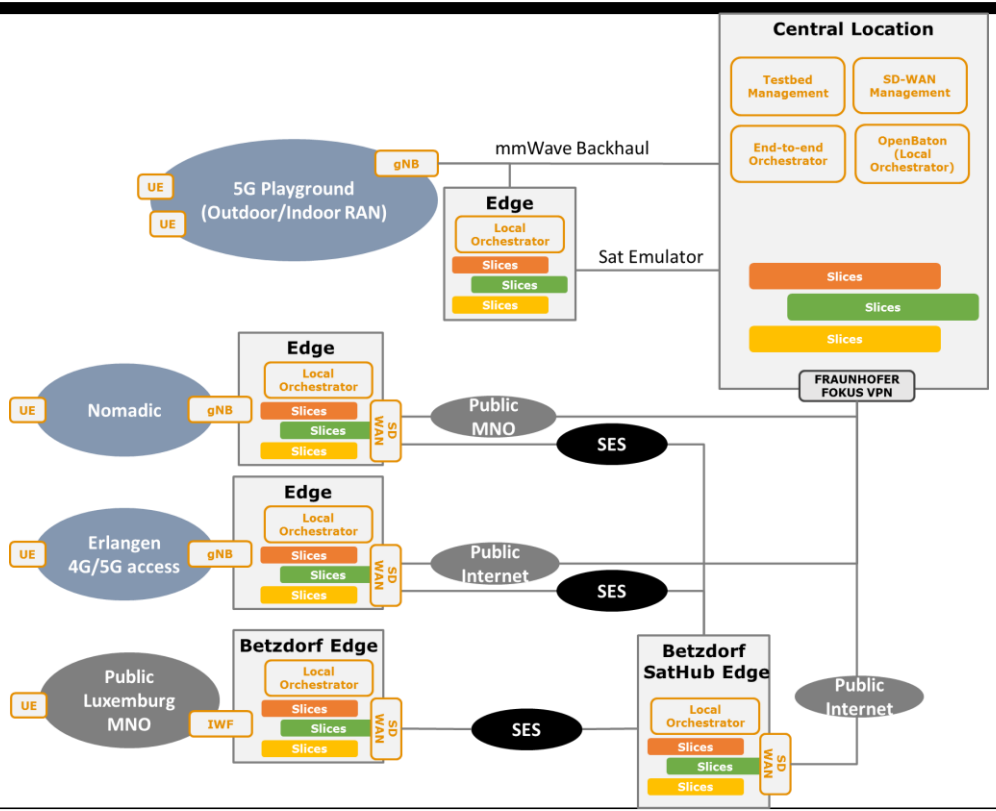


SATis5 Testbed Deployment Overview

Procurement of Local 5G Testbed Node (to be developed by Fraunhofer FOKUS) for cloning and deployment in Betzdorf (**to be owned and operated by SES**)



SATis5 Testbed Topology



SATis5 Testbed Elements

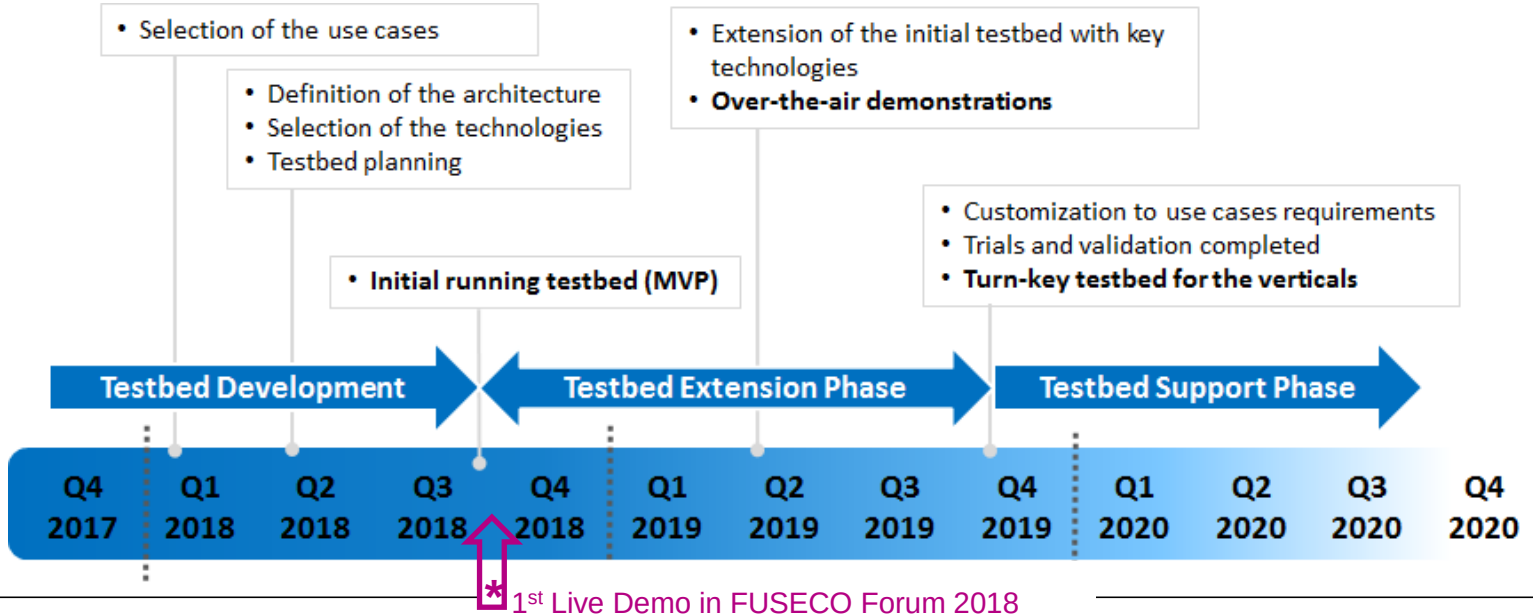
Based on existing prototype technologies & commercial networks

SATis5 aims towards immediate demonstrations using a comprehensive set of latest standard technologies implemented in the form of prototypes:

open5Gcore	Practical implementation of the 3GPP core network, supporting also connectivity for NB-IoT and LTE
Open SDN Core	Practical implementation of SDN routing, enabling backhaul management and selection, secure communication
open5GMTC	Device management and device connectivity management for edge networks and private environments
OPEN BATON	ETSI NFV standard orchestrator integrated in OSM and OPNFV
OSAT	Satellite emulator for GEO and MEO satellites enabling cost-effective evaluations
Kamailio IMS, KURENTO	OpenSource multimedia signaling and media servers
Newtec Dialog	Reference satellite communication platform
SES beyond frontiers	GEO and MEO satellite capacity for backhaul satellite use case demonstrations
5G Berlin	Integrated testbed with state of the art 5G/4G radio technologies in the center location of Berlin

SATis5 Project Roadmap

- **Goal:** to have asap a minimal viable product (MVP) testbed in order to be able to create momentum for the results of the project
- **Goal:** to be able to adapt and use the MVP in different use cases when needed



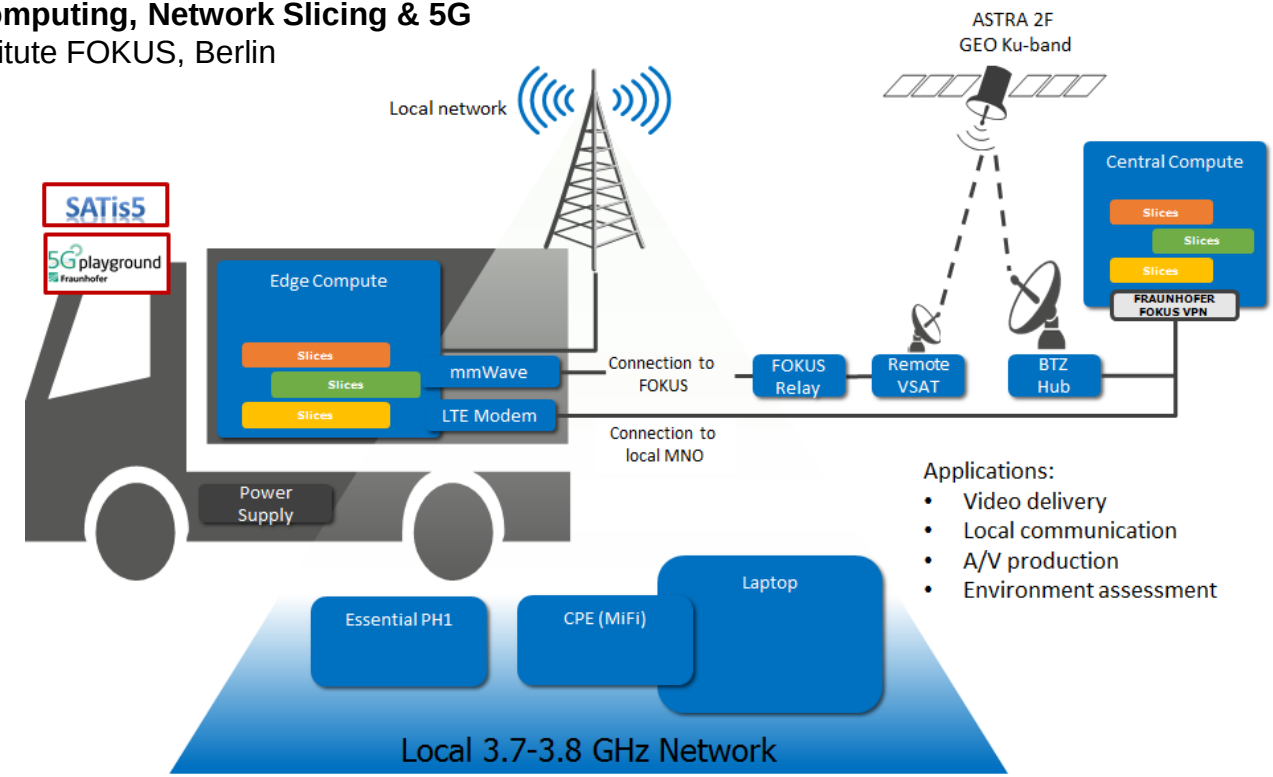
FUSECO Forum 2018 Demo Setup (Tentative)

Satellite Backhauling of Nomadic 5G Node: First over-the-air live demo of SATis5 testbed

Preparing Industry Verticals for Edge Computing, Network Slicing & 5G

15 – 16 November 2018 @ Fraunhofer Institute FOKUS, Berlin

Further info: www.fuseco-forum.org



5G-VINNI Project

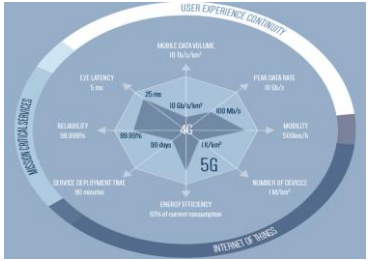
- Acknowledgement:
  - The work presented has been conducted as part of the 5G-VINNI project, which has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement no. 815279.

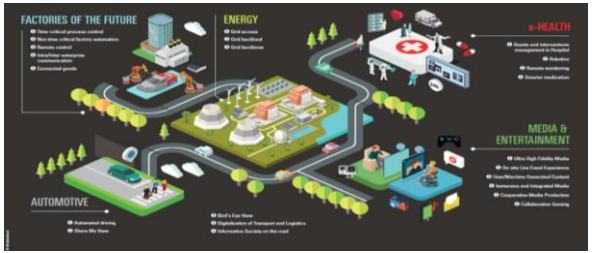
5G-VINNI Project at a Glance

5G-VINNI: 5G Verticals Innovation Infrastructure

- Customer: **European Commission** (EC)
- Funding Programme: EC H2020 5G PPP Phase 3
- Total Budget: 20 MEUR (100% funded)
- Kick-Off: 01 July 2018; Duration: 36 months
- Main Objective:
  - Build an open large scale 5G End-to-end facility that can:
    - demonstrate that key 5G network KPIs can be met
    - be validated, accessed and used by vertical industries (e.g. in H2020 ICT-19 projects) to test use cases and validate 5G KPIs
- Consortium:
  - Project Coordinator: Telenor (NO)
  - Large industrial EU consortium comprising 23 partners, incl. Major MNOs and Mobile Industry Vendors

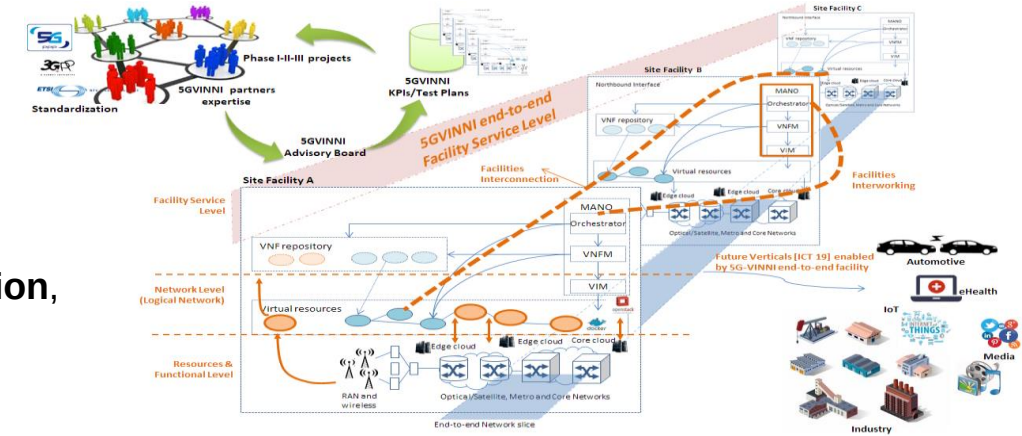
Further info: https://www.5g-vinni.eu/





5G-VINNI Key Objectives

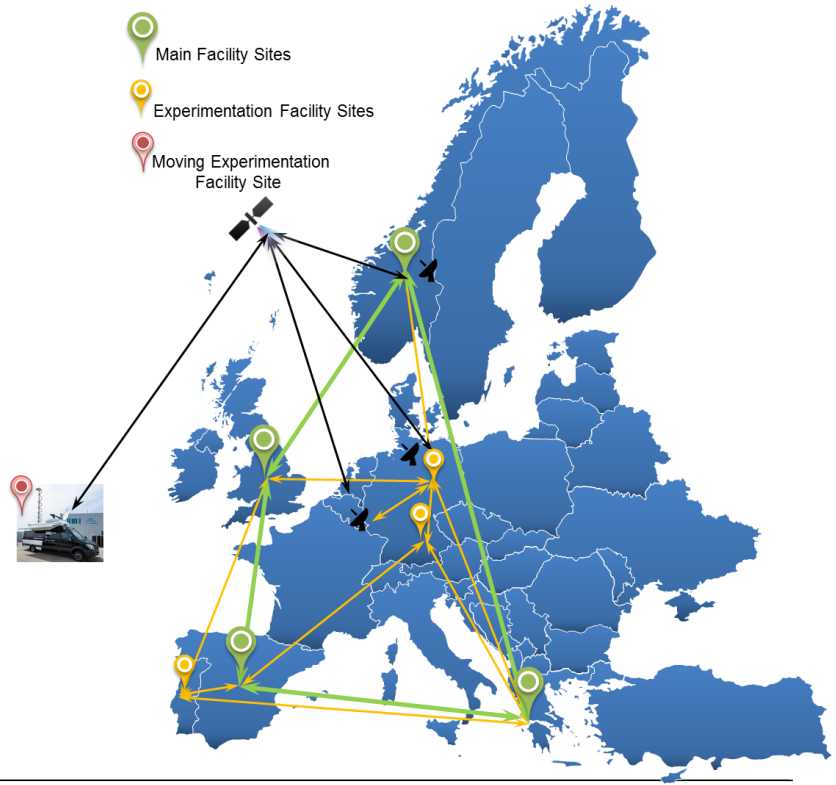
- Design an advanced and accessible **5G end to end facility** for vertical industries
- Build several **interworking** sites of the 5G-VINNI end to end facility
- Provide user friendly **zero-touch orchestration**, operations and management systems for the 5G-VINNI facility



- **Validate the 5G KPIs** and support the execution of E2E trial of vertical use cases to prove the 5G-VINNI capabilities
- Develop a viable **business and ecosystem model** to support the life of the 5G-VINNI facility during and beyond the span of the project
- **Demonstrate the value of 5G solutions to the 5G community** particularly to relevant standards and open source communities with a view to securing widespread adoption of these solutions

5G-VINNI Facility Sites

- **Main Facility sites**: E2E 5G-VINNI facility that offers services to ICT-18-19-22 projects with well-defined Service Level Agreements (SLAs)
  - Norway (Oslo, Kongsberg)
  - UK (Martlesham)
  - Spain (Madrid)
  - Greece (Patras)
- **Experimentation Facility sites**: provide environments for advanced focused experimentation & testing possibilities on elements & combinations of elements of the E2E model
  - Portugal (Aveiro)
  - Germany (Berlin)
  - Germany (Munich)
- **Moving Experimentation Facility site**: Satellite Connected Vehicle (SES's owned RRV - Rapid Response Vehicle)



5G-VINNI Facility Sites

Capabilities Summary

Main Facility sites

Norway (Oslo, Kongsberg)

- Slicing (eMMB, URLLC, mMTC)
- E2E Service Orchestration (Nokia)
- NFVI (OpenStack) and MANO (Nokia)
- MEC (Nokia)
- Four 5G gNBs (Ericsson, Huawei)
  - 3.5GHz, 90MHz BW
  - 26GHz, 800MHz BW
- 5G Core (Ericsson)
- 3GPP compliance
  - Rel'15 in 2019, Rel'16 in 2021
  - NSA in 2019, SA in 2021
- Satellite backhaul option (GEO)

UK (Martlesham)

- Slicing (eMMB, URLLC, mMTC)
- Service Orchestration (Nokia)
- NFV MANO, NFVI and vEMS (Samsung)
- MEC
- 5G RAN incl. 3.5 and 26GHz (Samsung)
- 5G Core (Samsung)
- 3GPP compliance
  - Rel'15 in 2019, Rel'16 in 2021
  - NSA in 2019, SA in 2021

Spain (Leganes)

- Slicing (OSM extension)
- Service Orchestration (OSM NBI)
- NFV MANO (OSM) and NFVI (OpenStack)
- SDN (ODL/ONOS)
- Support for micro-VNFs
- 5G RAN (SDR), low frequencies and 30-300GHz
- Advanced monitoring and data-driven management
- Edge computing (MEC and non-MEC)
- 5G Core (possibly SBA-based)

Greece (Patras)

- Slicing (eMMB, URLLC, mMTC, via OSM)
- Service Orchestration (via OSM NBI services)
- NFV MANO (OSM) and NFVI (OpenStack)+DPDK
- 5G RAN open source radio (Lime, SRS)-700-800MHz, 3.5.-3.8GHz
- 5G Core (Open5GCore)
- NB-IoT, LTE-M (FhG NB-IOT core)
- mmWave backhaul (Intracom)
- GEANT connectivity
- MEC

Experimentation Facility sites

Portugal (Aveiro)

- Service Orchestration (Alticelabs)
- NG-PON2-based 5G front/backhaul (Alticelabs)
- NFVI (OpenStack)
- SDN (ODL)
- Cloud RAN
- MEC

Germany (Berlin)

- 5G RAN prototype(s)
- 5G Core (Open5GCore)
- Edge cloud/e2e Orchestration (OpenBaton)
- mmWave backhaul
- Interconnection with remote islands in Betzdorf and Tokyo
- Large scale events, Nomadic networks, Disaster Relief

Germany (Munich)

- 5G NR SA RAN (Huawei) 3.5 GHz
- 5G Core (Huawei)
- MANO and NFVI (Huawei)
- SDN (Floodlight)
- V2I, V2P
- MEC, Edge Computing
- URLLC targeting Rel16/17
- Sensor fusion enabled by 5G

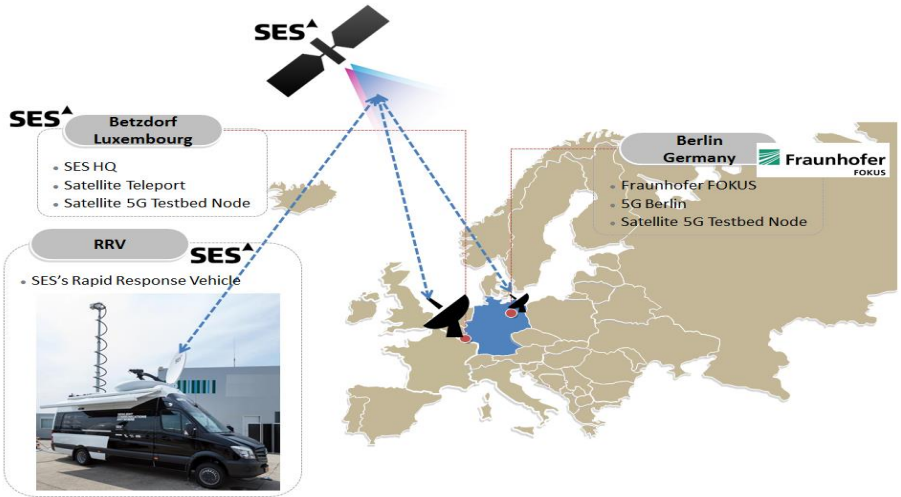
Luxembourg (Satellite Connected Vehicle)

- GEO/MEO satellites (SES)
- C/X/Ku/Ka-band (SES)
- Satellite teleport (SES)
- Satellite backhauling (SES)
- Satellite 5G testbed node with SDN/NFV/MEC (SES)
- Satellite interconnection with Berlin Facility site (SES)
- eMBB, mMTC use cases (SES)

SES Role in 5G-VINNI

SES brings in the satellite element to the 5G-VINNI end-to-end facility

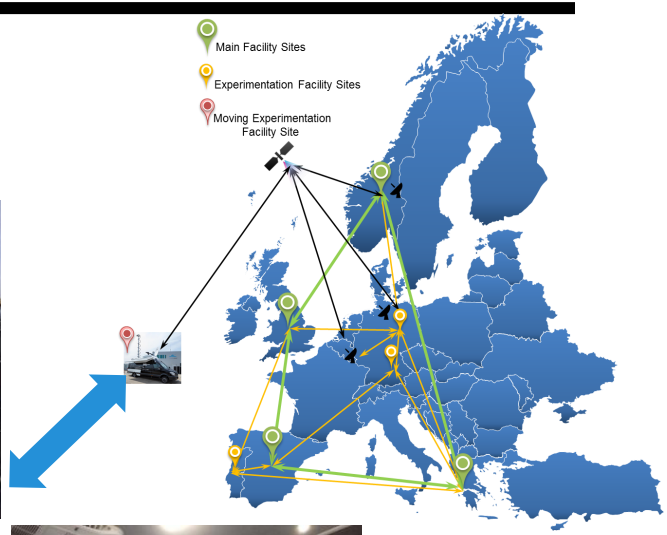
- SES will provide access to its owned and operated **multi-orbit (GEO/MEO) and multi-band (C/X/Ku/Ka-band) satellite** fleet, IP/MPLS global access teleport network, and satellite uplink/downlink facilities for 5G-VINNI live over-the-air demos and validation of the target 5G KPIs and use cases
- SES will provide access to its owned **Rapid Response Vehicle (RRV)** which can be rapidly deployed and provide satellite backhauling capabilities to local terrestrial communications, thus enabling the **5G-VINNI Moving Experimentation Facility Site** to become a rolling lab for 5G mission specific solutions mainly for PPDR use cases
- SES will provide access to its **satellite 5G testbed node**, with SDN/NFV/MEC capabilities, currently under development with Fraunhofer FOKUS as part of the ESA project "SATis5“, enabling **satellite interconnection with the Berlin Experimentation Facility Site**
- SES will contribute to various 5G-VINNI WPs to actively promote the **satellite integration into 5G**, incl.:
  - Architecture, Design, Implementation and Integration of 5G-VINNI End-to-End Facility
  - Validation of Use Cases and KPIs on 5G-VINNI End-to-End Facility
  - Standardization, Dissemination and Impact Creation



SES's Rapid Response Vehicle (RRV)

… enabling the 5G-VINNI Mobile Experimentation Facility Site

- RRV is a multi-purpose communications platform mainly for governmental and PPDR use cases
- Architecture is modular and supports evolution
- Highly resilient due to its multiband capability (X, mil-Ka, Ka, Ku)
- A rolling lab for mission specific solutions
- Designed to be easily configured, even remotely
- Quickly deployed and operational in minutes
- Built for client showcases and demonstrations

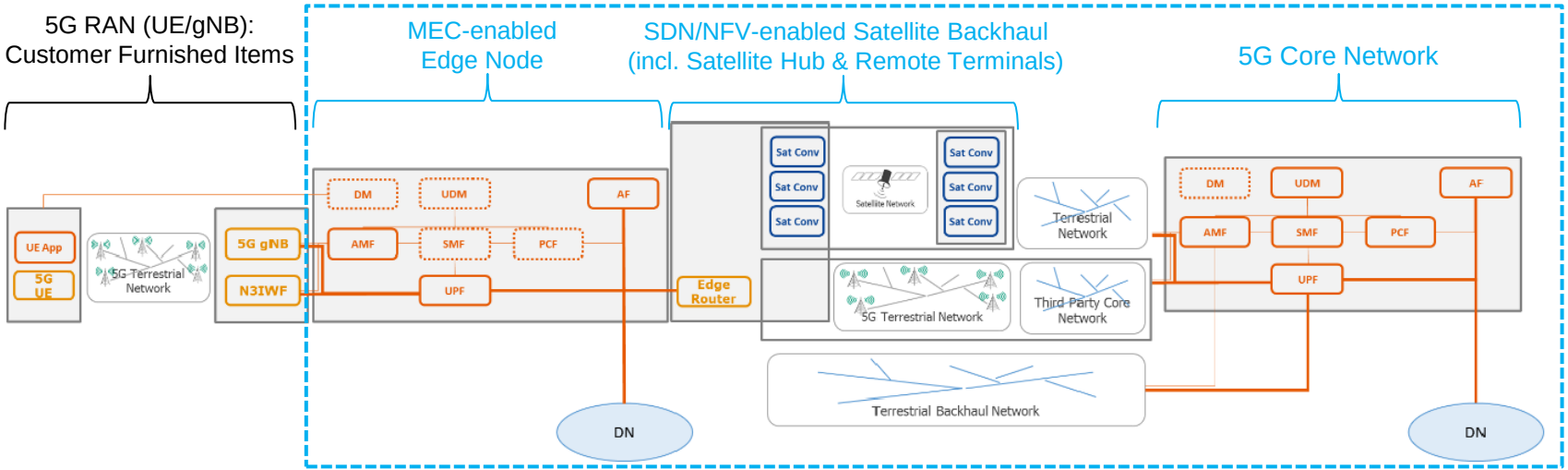


Further info: https://www.ses.com/rapid-response-vehicle-rrv

SES's Satellite 5G Testbed Node

… enabling the 5G-VINNI Mobile Experimentation Facility Site

- Satellite backhaul connectivity architecture
- Satellite interconnection with 5G-VINNI Berlin Experimentation Facility Site
- Synergies with ESA ARTES project "SATis5" in collaboration with Fraunhofer FOKUS



Conclusion

Conclusion

SES has leading role in promoting satellite integration in 5G

- Satellite can deliver secured high bandwidth and ubiquitous coverage to connect fixed and on-the-move 5G network sites as well as to enable highly scalable content distribution capabilities, accelerating 5G roll-out
- Satellite industry is investing in global network infrastructure which can be used to support 5G roll-out worldwide
- Satellite integration into 5G requires certain technology development, validation & demonstration as well as standardisation efforts (e.g., 3GPP, ETSI). Projects such as SaT5G, 5G-VINNI (EU H2020), SATis5 (ESA), support these initiatives. Further projects in the pipeline
- Fully-fledged implementation for operational integration of satellite into 5G through plug & play approach with focus on satellite backhauling and higher layer enablers (NFV, SDN, Network Slicing, MEC, etc) is possible in short/mid-term
- First of its kind live over-the-air demonstration at the EuCNC 2018 conference in Ljubljana, Slovenia; further demonstrations over GEO/MEO foreseen in 2018, 2019 (aero, mobile van, customer premises)
- SES has deep expertise in delivering tailored backhaul solutions with the industry's only multi-orbit, multi-band GEO/MEO fleet

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