Satellite communication as inherent component of 5G systems

5G-PPP 1st 5G Architecture Workshop

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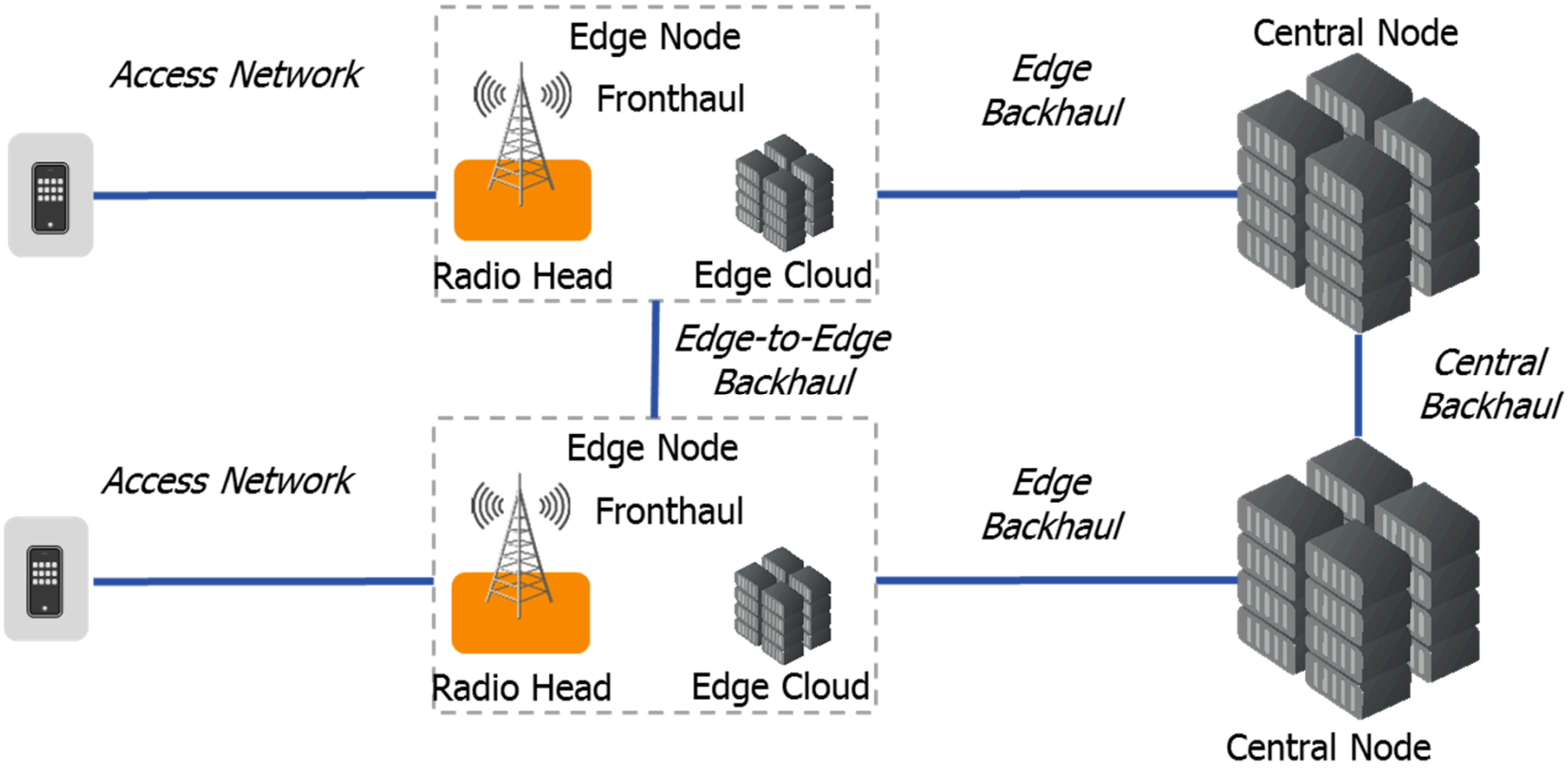
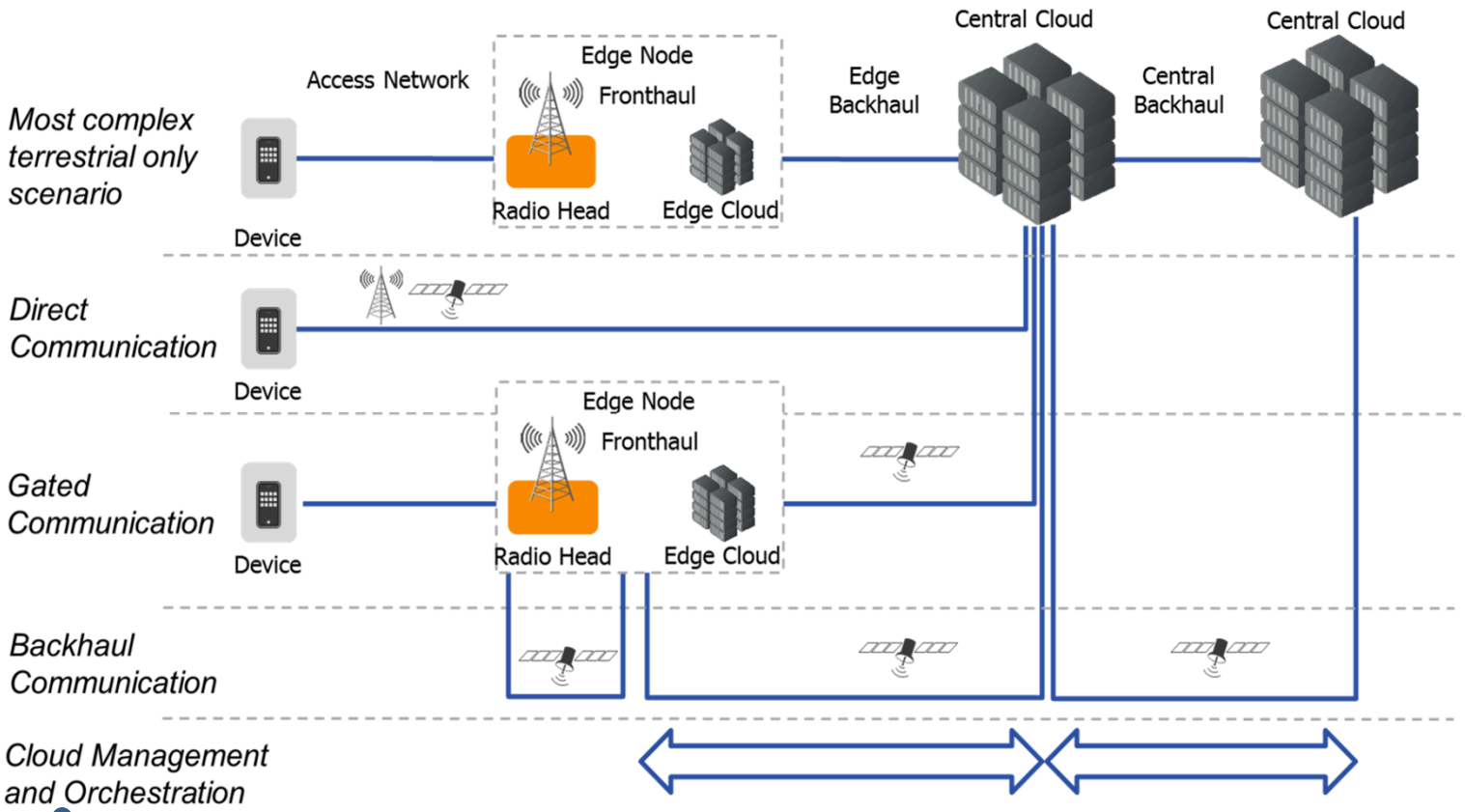
Study mission and implementation

- Consider virtualisation and cloud technologies and assess their impact on satellite communication
  - Describe typical architectures and operational models
  - Identify requirements and constraints for satellite-cloud convergence
  - Define integrated satcom – terrestrial cloud-networks service delivery architectures
  - Validate and benchmark (via real testbeds and simulations)
- A pragmatic use case driven and testbed oriented project, using a straightforward waterfall method

The network architecture – a new split of compute and networking



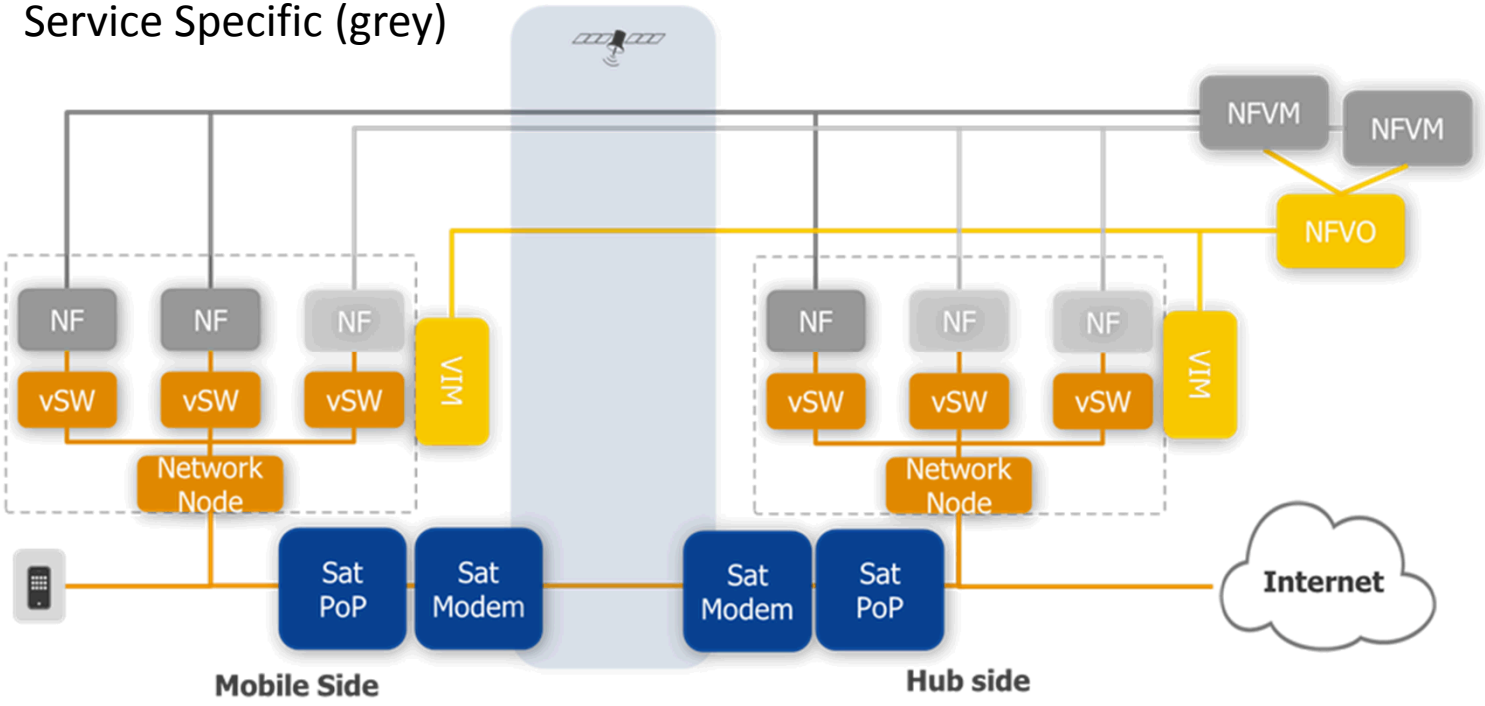
Communication Models



All communication models can be deployed in parallel!

Integrated architecture model

- The architecture integrates functionality from different domains:
  - Satellite networks (blue)
  - Network infrastructure (orange)
  - NFV Orchestration and Management (yellow)
  - Service Specific (grey)

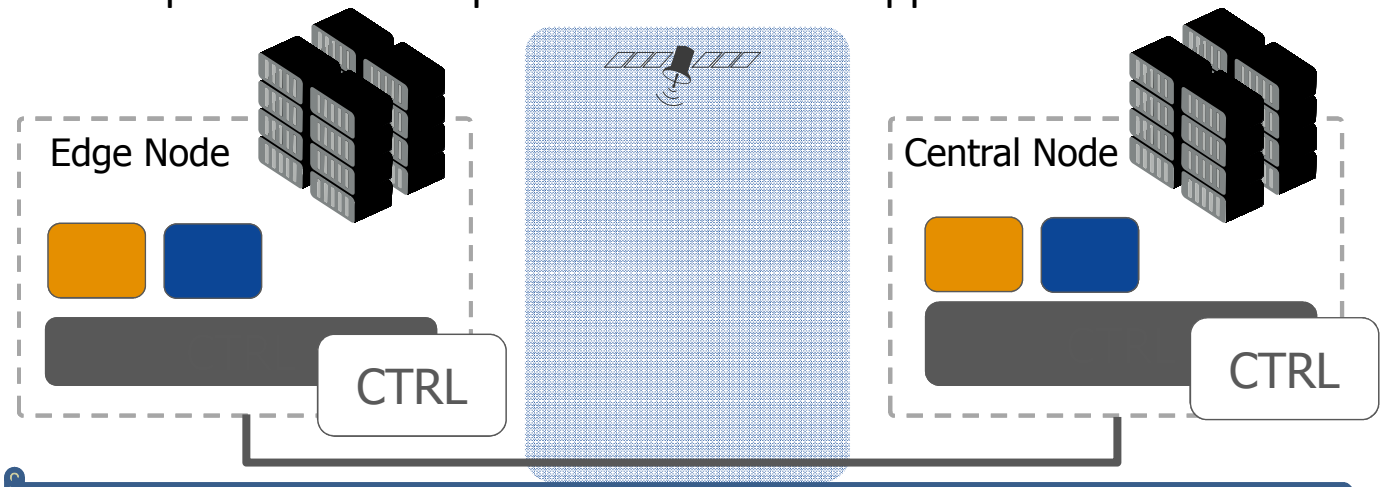


Evaluation scenarios used

- M2M scenario
- IMS communication scenario
- Content distribution scenario
- Large file download scenario

Satellite-Cloud Integration Levels

- Level 1: Cloud deployment at the end of the satellite networks
- Level 2: Network aware cloud at the end of satellite networks
- Level 3: Cloud with evolved networking integrated with satellite networks
- Level 4: Cloud platform with networking features (TCP, multicast, satellite modem)
- Level 5: Cloud PaaS for M2M and multimedia
- Level 6: Independent developed network aware applications



The question is not how far to integrate, but how *fast*

Conclusions

- A broad range of use cases would benefit from incorporating satellite technology as a delivery mechanism, including
  - Broadcats like services
  - Broadband access everywhere
  - Higher user mobility
  - Massive IoT
  - Lifeline communications
  - Ultra-reliable communications
  - Broadband access in dense areas
- Satellites offer some unique features
  - Global reach
  - Unparalelled efficiency in distributing large volume of content and data
  - Ensuring synchronised delivery

Conclusions (contd.)

- Satellite ground segment should adopt virtualisation concepts for the network and computing part
  - ensure a full alignment on the technology solutions level
  - immediate advantage of better resource utilisation and resource sharing across tenants
- Space segment: certain functionalities currently residing within terrestrial networks can be incorporated
  - much better utilisation of the inherent broadcast capability for populating content caches closer to users, but also pushing down software updates and patches
  - ultimately, advancement in space technologies in on-board processing and storage in satellite payloads will make orbiting mobile base-stations and data-centres in space feasible

Way forward

- Need for a large scale integrated satellite-terrestrial 5G demonstrator
  - Supporting a broad range of applications
  - To verify concepts and feasibility of end-to-end solutions
  - With potentially global reach
  - Assess handling and potentially sharing of finite resources, such as spectrum

Next steps

- Would be interested to contribute to or comment the 5G architecture white paper to ensure that some of the insight gained is captured and reflected – will there be a chance?

Thank you!

Prime contractor: Eurescom GmbH, Germany

Sub-contractors: Fraunhofer FOKUS, Germany

Newtec, Belgium

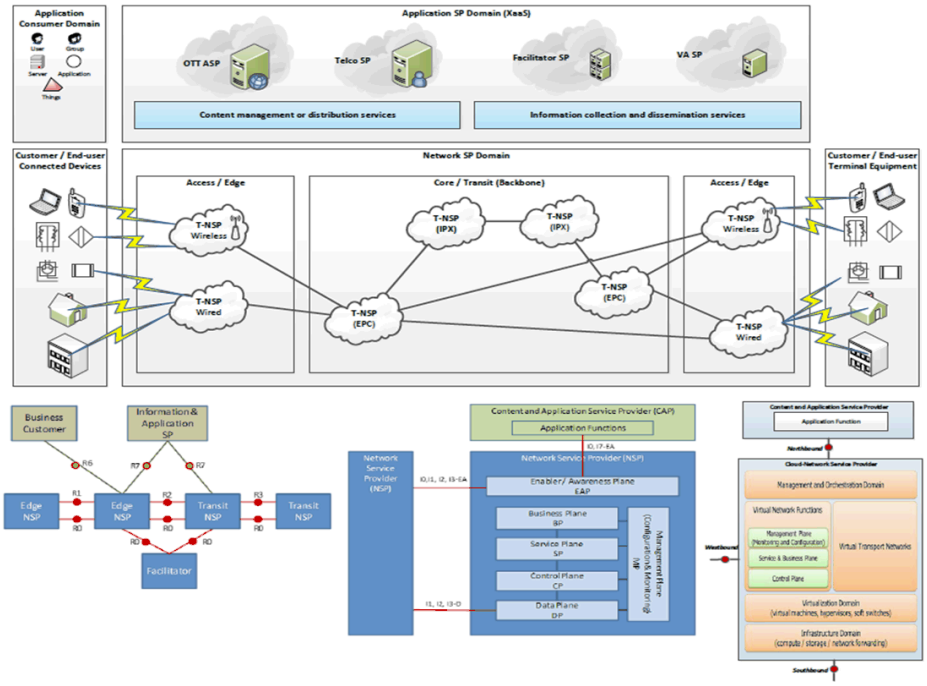
SES, Luxemburg

TU Berlin, Germany

University College London, UK

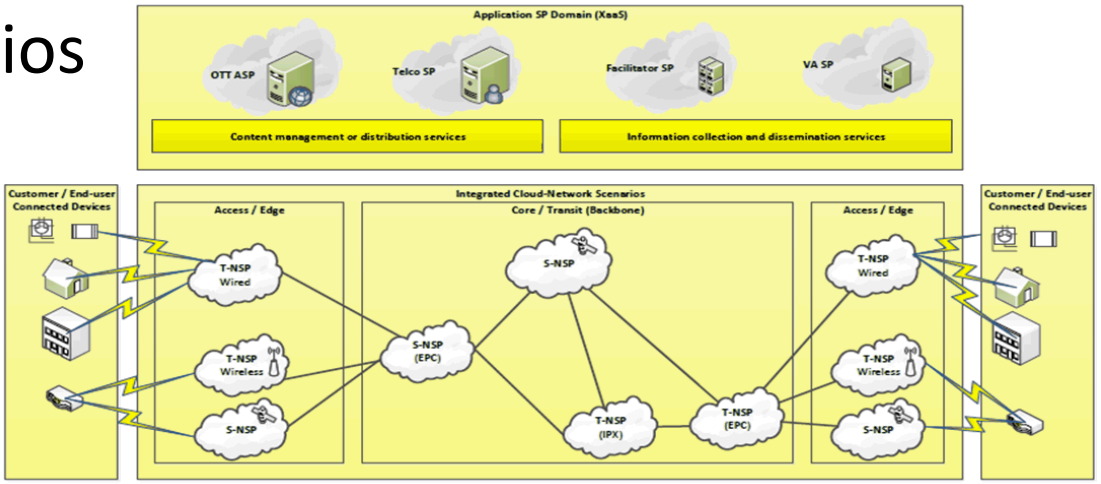
Cloud networking techniques and technology review

- Assessment of existing technologies in terrestrial cloud
- Major use case scenarios for the cloud
- Cloud stakeholders
- Architecture
- Issues and threats



Dimensions of suitability for integration with satellite networks and integration scenarios

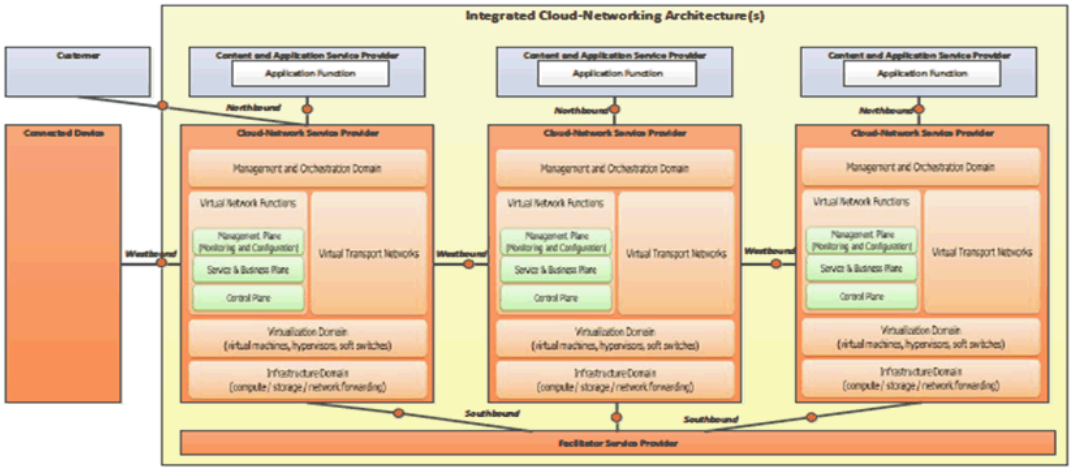
- Finding the role of the satellite network in terrestrial deployments
- Definition of a scenario evaluation framework
- Scenarios evaluation
- Integrated scenarios feasibility



Integrated architecture review

- Integrated cloud network architectures
  - Network functions
  - Operations
  - Networking limitations assessment

- Cost-gain analysis
  - Cost effectiveness
  - Economic gains



Practical Evaluation

- Testbed deployment
  - What are the limitations of an integrated cloud-satellite network infrastructure? How could they be overcome?
- Evaluation scenarios
  - What are the characteristics of M2M, multimedia and content distribution scenarios in an integrated scenario?