7th SG13 Regional Workshop for Africa on
"ITU-T Standardization Work on Future Networks:
Towards a Better Future for Africa"
(Abuja, Nigeria, 3-4 February 2020)

Achievements of ITU-T Focus Group on Network 2030 (FG NET-2030)

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FG NET-2030 organization

Structure and target outputs

MANAGEMENT AND CONTACT

Chairman
- Richard Li

Vice-Chairmen
- Mehmet Toy, Verizon
- Alexey Borodin, Rostelecom
- Yuan Zhang, China Telecom
- Yutaka Miyake, KDDI Research
- Dong-Hi Sim, SK Telecom
- Sundeep Bhandari, NPL

ITU Contact
- Secretariat: tsbfgnet2030@itu.int

Deliverables Plan
- **GAP:** Gap analysis (gaps and challenges), towards a Standardization Gap Report for ITU-T Study Groups
- **UC:** Use Cases and Future Scenarios *(including requirements)*
- **PDT:** Performance and design targets 2030
- **AF:** Architecture and Framework, including backward compatibility
- **TERM:** Report on Terminologies, Taxonomy and Definitions

FOCUS GROUP STRUCTURE

Sub-Group 1: Use Cases & Requirements
- Mostafa Essa, Vodafone

Sub-Group 2: Network Services & Technology
- Acting: Richard Li

Sub-Group 3: Architecture & Infrastructure
- David Dai, CICT
- Mehmet Toy, Verizon

Templates & Guidelines
- Basic template for contributions
- Guidelines - SharePoint

Deliverables New
- **White Paper:** "Network 2030 - A Blueprint of Technology, Applications and Market Drivers Towards the Year 2030 and Beyond" (May 2019)
- **Deliverable:** "New Services and Capabilities for Network 2030: Description, Technical Gap and Performance Target Analysis" (October 2019) New

https://www.itu.int/en/ITU-T/focusgroups/net2030/Pages/default.aspx

ITU-T FG-NET-2030
Established in July 2018
with ITU-T SG13 as parent Study Group

Marketing
Market awareness and development
Commercialization

Liaisons
SDOs, Alliances, Universities ...
Worldwide Cooperation

The FG NET-2030 serves as a global platform to study and advance international networking technologies.
It investigates the future network architecture, requirements, use cases and capabilities for the year 2030 and beyond

Sub-G1: Use Cases & Requirements
- Use Cases and Requirements (including related gap analysis)

Study of Future-oriented Application Scenarios and their Network Requirements

Sub-G2: Network Services & Technology
- New network service descriptions (based on technical gaps and requirements)

Exploration of Novel Network Services and Enabling Technologies

Sub-G3: Architecture & Infrastructure
- Architectural framework for the Future Network
- Gaps and roadmaps

Definition of Future Network Architecture (including Protocol advancements)

FG Network 2030: international team, global platform, forward-looking orientation and consensus building

FG NET-2030 leadership

Chair:
Richard Li (Futurewei)

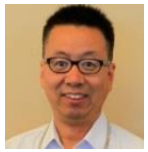
Vice Chairs:
Yuan Zhang (CT), Mehmet Toy (Verizon), Yutaka Miyake (KDDI Research), Alexey Borodin (Rostelecom), Dong-Hi Sim (SK Telecom), Sundeep Bhandari (NPL)





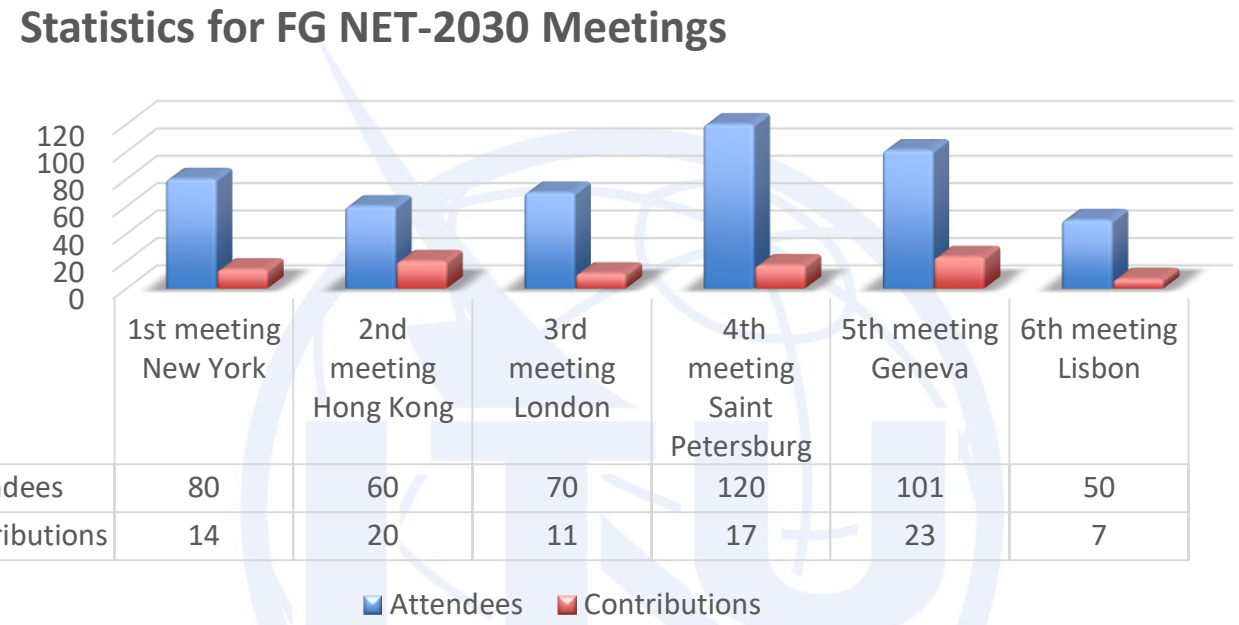

Sub-G1 Chair:
Mostafa Essa (Vodafone)

Sub-G2 Acting Chair:
Richard Li (Futurewei)



Sub-G3 Co-Chairs:
Mehmet Toy (Verizon)
David Dai (Fiberhome)


FG NET-2030 statistics

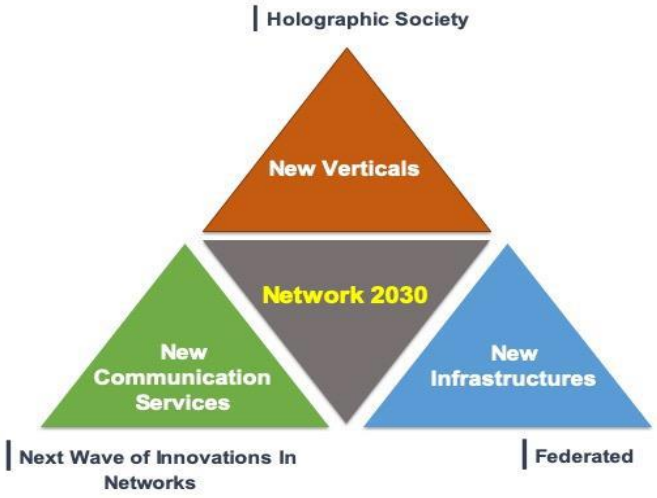


- **Worldwide participation from Providers, Vendors, Research Institute and Academies, Administrations**
- **Every FG meeting is complemented by a preliminary Workshop (1 or 1.5 days)**
  - numerous interesting presentations (accessible via the FG Web page)
  - relevant outcomes of the workshops have been/are taken into consideration in Sub-groups' activities

- **7th FG meeting planned in Tokyo, 20-22 May 2020 [7th Workshop on 20 May] – To be confirmed**

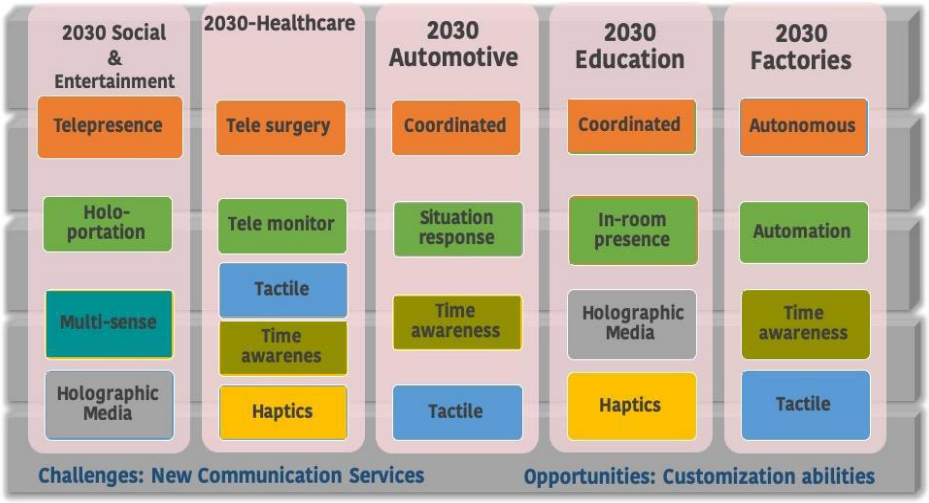
NOTE – At Oct 2019 SG13 meeting, upon FG members' request, SG13 agreed to extend the FG life time till 31 Oct 2020 with same ToR

"Network 2030: A pointer to the new horizon for the future digital society and networks in the year 2030 and thereafter" – Dr. Richard Li



Network 2030 Vision

Source: FG White Paper



Enabling Vertical Markets with Network 2030

Source: FG White Paper

"Enabling new verticals within the emerging holographic society, a future digital society empowered by holographic technologies through a wave of innovations in networks to provide new communication services over federated, new infrastructures."

"Enabling new services which in turn will foster creation of cutting-edge applications in a wide variety of industries.
Customization via the flexibility offered through customization and programmability of the utilized resources.
Network communication industry boost by widening applicability across many vertical markets"

Sub-Groups: activities and deliverables (1/2)

Electronic meetings held regularly by the three Sub-Groups

- Usually bi-weekly (Sub-G1, Sub-G2), weekly (Sub-G3) [https://extranet.itu.int/sites/itu-t/focusgroups/net-2030/Lists/Calendar/calendar.aspx]

Sub-G1 deliverables

- **Summary report "Representative use cases and key network requirements for Network 2030" (TR approved at last FG meeting, Jan 2020; it is now passed over to SG13)**
- **"Use Cases and Requirements for Future Networks towards 2030" (ongoing, May 2020 target)**

Sub-G2 deliverables

- **"New Services and Capabilities for Network 2030: Description, Technical Gap and Performance Target Analysis" (TR approved in 2019 and passed over to SG13; Q2/13 initiated at Oct 2019 SG13 meeting the "Supplement on Network 2030 Services: Capabilities, performance and design of new communications services for the Network 2030 applications")**
- **Sub-G2 decided at Jan 2020 FG meeting to extract the gap analysis from above Sub-G2 deliverable and deliver as standalone document to next FG meeting**

Sub-G3 deliverables

- **"Network 2030 Architecture Framework" (ongoing, target TBC [May meeting or final meeting])**
  - **Various Sub-G3 teams (post-3rd meeting) are working on different architectural aspects: team-specific deliverables might be possible produced**

Sub-Groups: activities and deliverables (2/2)

Cross Sub-Group deliverables

- **"Terms and Definitions" – TR initial draft at Jan 2020 FG meeting**
- **"Description of Demonstrations for Network 2030 on *Sixth* ITU Workshop on Network 2030 and Demo Day" – TR launch approved at Jan 2020 FG meeting**

White Paper

- **"Network 2030 - A Blueprint of Technology, Applications and Market Drivers Towards the Year 2030 And Beyond" – published in May 2019 (accessible on the FG home page)**

Sub-G1: Use cases for Network 2030

Use cases identified in ongoing Sub-G1 deliverable (O-025 output Oct 2019 meeting)

The 7 representative use cases included in the approved Sub-G1 Summary report

- Holographic-type communications (HTC)
- Tactile Internet for Remote Operations (TIRO)
- Intelligent Operation Network (ION)
- Network and Computing Convergence (NCC)
- Digital Twin (DT)
- Space-Terrestrial Integrated Network (STIN)
- Industrial IoT (IIoT) with cloudification

Sub-G1: Requirement Gaps Analysis of the use cases

a) Analysis of the use cases for different requirements dimensions and identification of gaps with respect to current network vision and/or existing capabilities

Dimensions from requirements gaps perspective	***Current vision and/or existing capabilities*** *(e.g. expected to be supported by existing networks)*	***Network 2030 goals*** *(Matching ToR)*	***Gaps for network requirements*** *(where applicable)*

b) Association of the representative use cases (use cases having some prominent requirements) to the different dimensions

DIMENSIONS AND ASSOCIATED USE CASES - ONGOING SUB-G1 DELIVERABLE DRAFT

- Extremely high bandwidth and capacity: HOL, LF3D, Tactile Internet, Deep Edge service access
- Extremely low latency: HOL, LF3D, Tactile Internet, Cloud PLC, Deep Edge service access
- Bounded latency and jitter: HOL, LF3D, Tactile Internet, Cloud PLC, Deep Edge service access
- Timing accuracy and synchronization: Cloud PLC
- Geolocation accuracy (Network related dimension)
- Consistent QoE
- Flexible QoS support
- High programmability (and softwarization): Space Terrestrial Integrated Networking, Network intelligence based operations
- Data computing, storage, collecting and analytics: Space Terrestrial Integrated Networking, Network intelligence based operations
- Autonomy: Network intelligence based operations
- Network security (incl. in-network security/DDoS prevention)
- Privacy
- Trustworthiness
- Resilience: Space Terrestrial Integrated Networking
- Traceability
- Enahced lawful intercept
- New transport
- Flexibility of Addressing: Space Terrestrial Integrated Networking
- Edge capabilities
- Aggregation
- Mobility: Space Terrestrial Integrated Networking
- User network interface: Space Terrestrial Integrated Networking

Ongoing draft to be revisited and aligned (terminology, use cases and requirements) with Jan 2020 approved Sub-G1 Summary report

Sub-G1 Use Case examples [from Sub-G1 Summary Report]
Holographic-type communications (HTC)

Towards Holographic Society

Industry, Digital Twin
Control of real objects through Digital replica

Interactive Telepresence
Multi-site collaborations

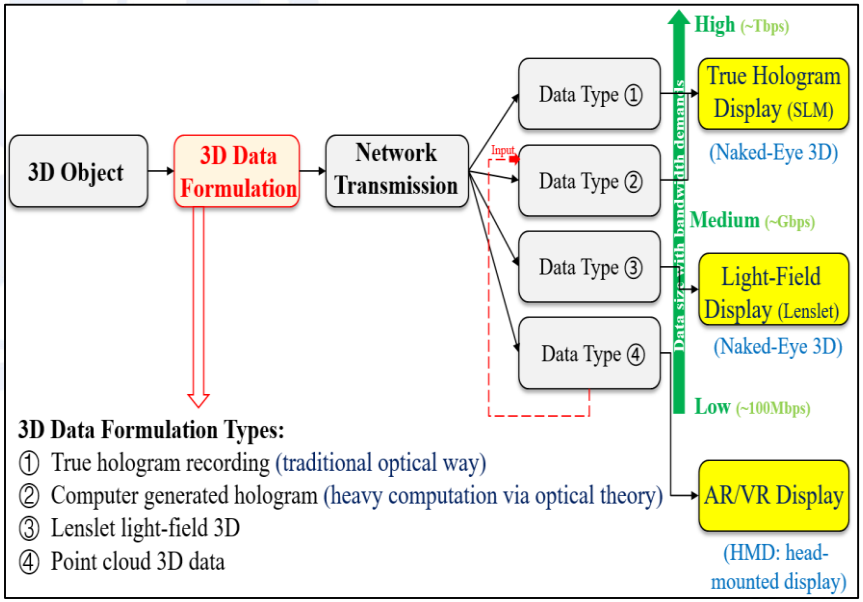
Medicine, 3D Hologram imaging
3D Scans with floating view

Personalized Message Delivery
Receive messages in person Star Wars way


Screenshot source: Lucasfilms, Star Wars

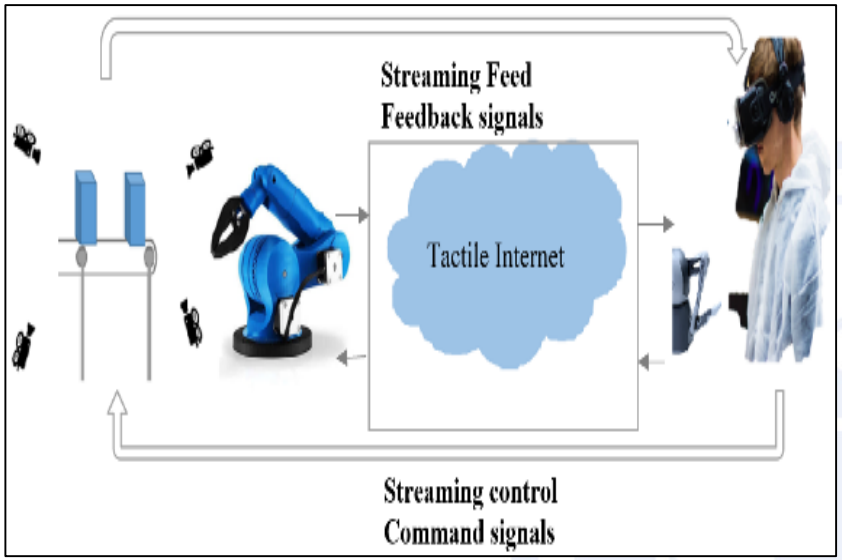
Key network requirements

- *High bandwidth*
- *Low latency*
- *Multi-stream synchronization*
- *Edge computation*
- *Security and reliability*

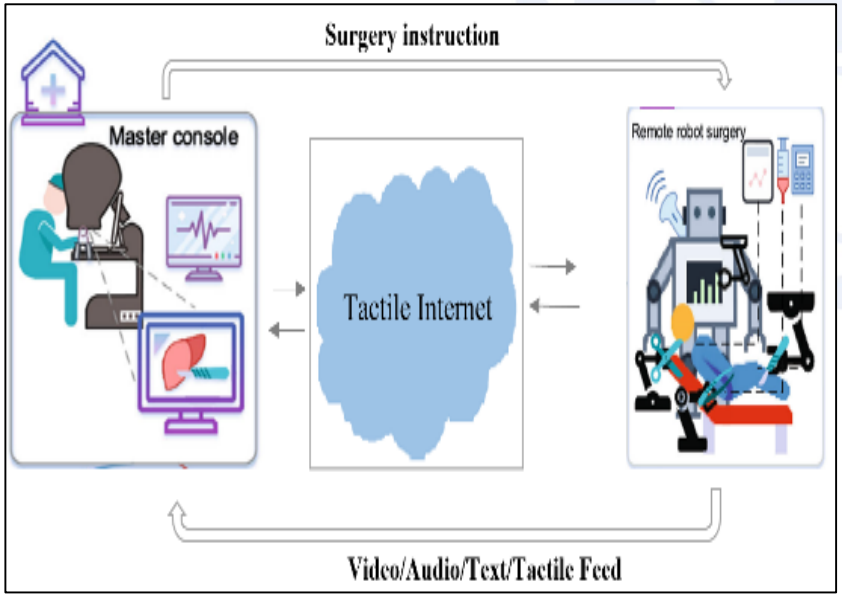


Types of 3D data transmission in HTC

Sub-G1 Use Case examples [from Sub-G1 Summary Report]
Tactile Internet for Remote Operations (TIRO)



Typical use case A: remote industrial management (involves real-time monitoring and control of industrial infrastructure operations)

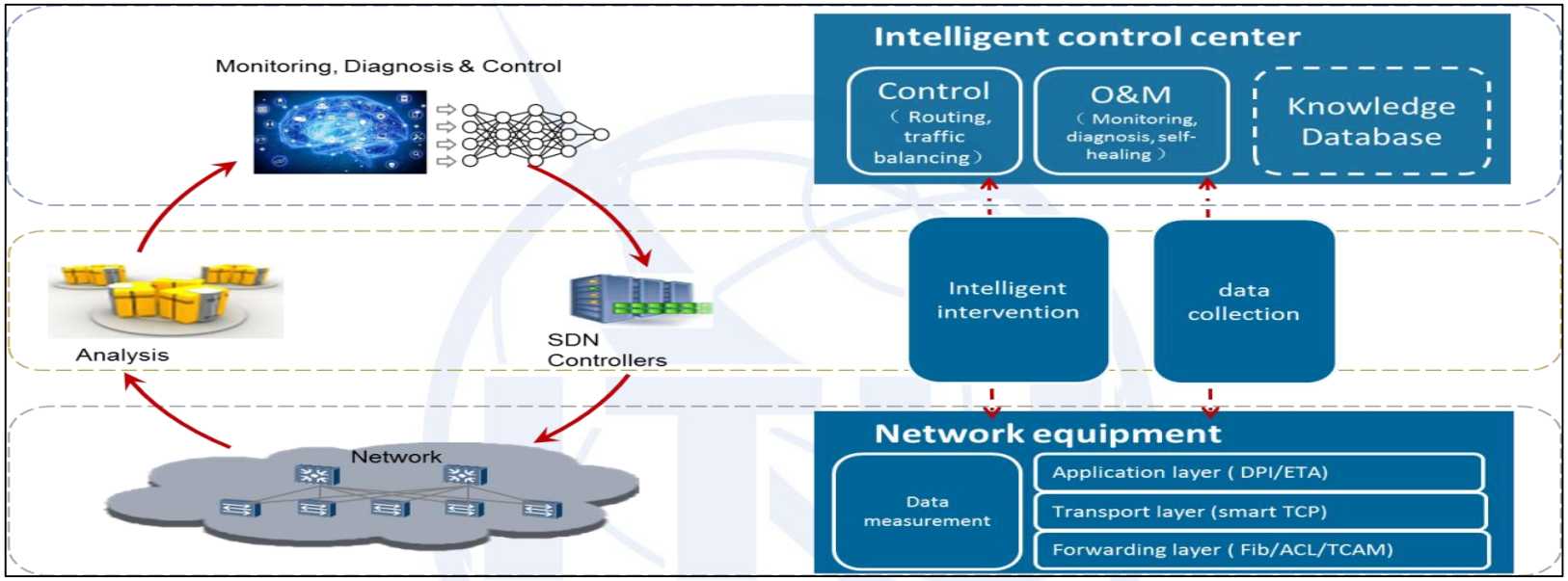


Key network requirements

- *Ultra-low latency*
- *Ultra-low loss*
- *Ultra-high bandwidth*
- *Strict synchronization*
- *Differentiated prioritization levels*
- *Reliable transmission*
- *Security*

Typical use case B: remote robotic surgery

Sub-G1 Use Case examples [from Sub-G1 Summary Report]
Intelligent Operation Network (ION)

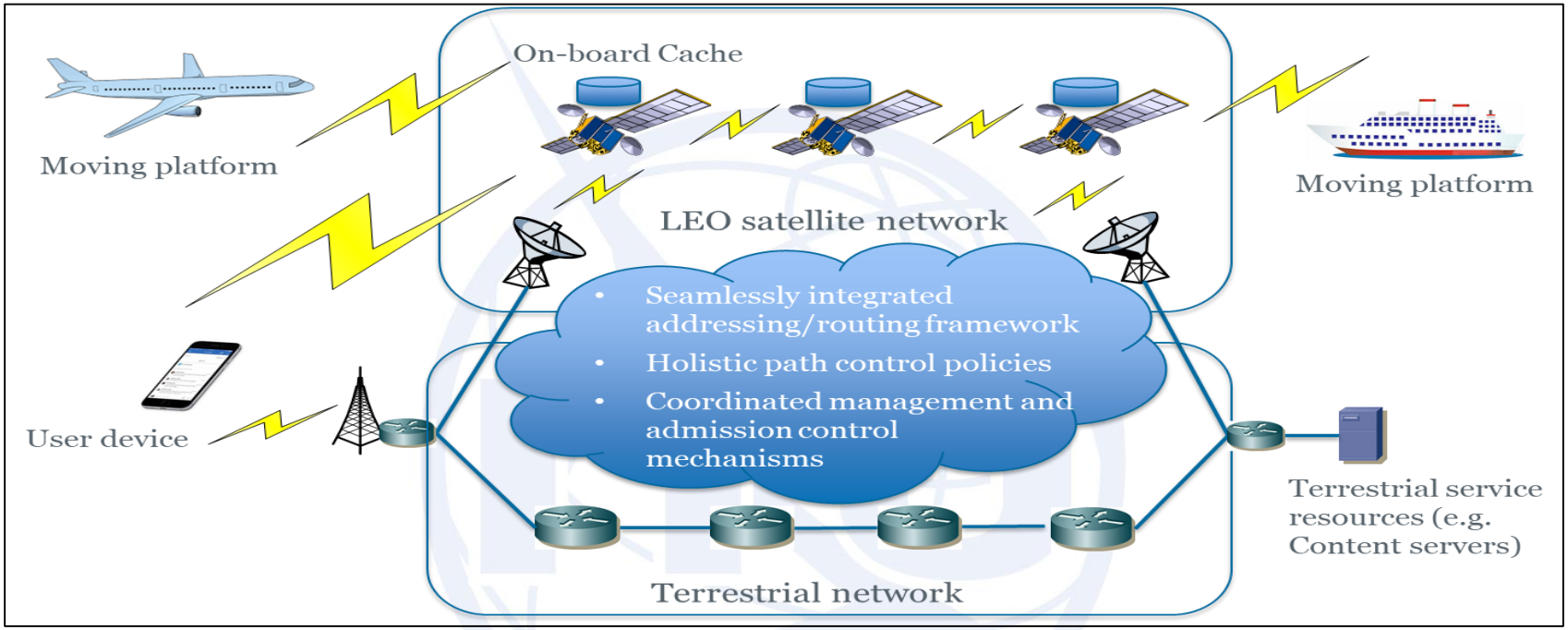


Example framework for fully automated and intelligent closed-loop control for ION-type applications

Key network requirements

- *Intelligent closed-loop control*
- *Instantaneous high-volume data collection for network status*
- *Programmability and softwarization*
- *Low latency event driven response with data prioritization*

Sub-G1 Use Case examples [from Sub-G1 Summary Report]
Space-Terrestrial Integrated Network (STIN)



The trend of satellite and terrestrial Internet integration

Key network requirements

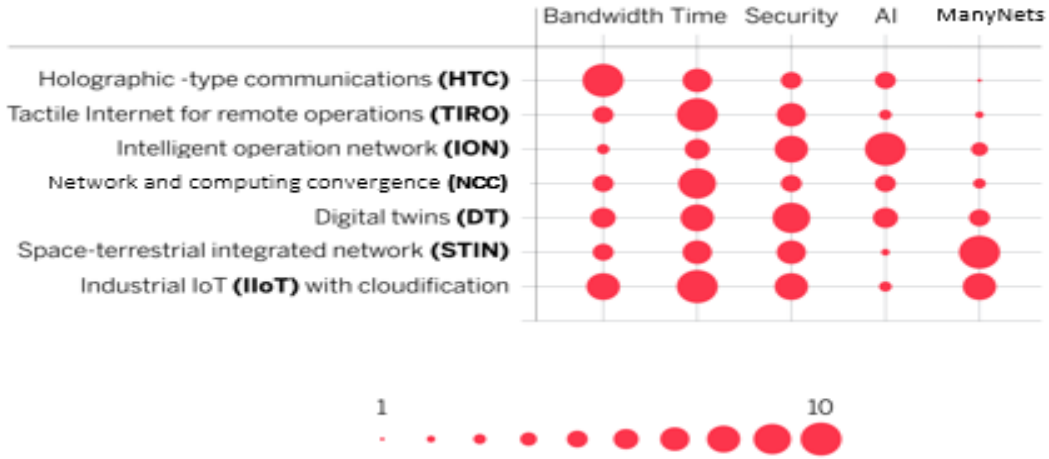
- *New addressing and routing mechanisms*
- *Bandwidth capacity at the satellite side*
- *Admission control by satellites*
- *Edge computing and storage*

Sub-G1 Representative Use Cases (Sub-G1 Summary Report): abstract network requirement dimensions and graphic representation of relative network requirements

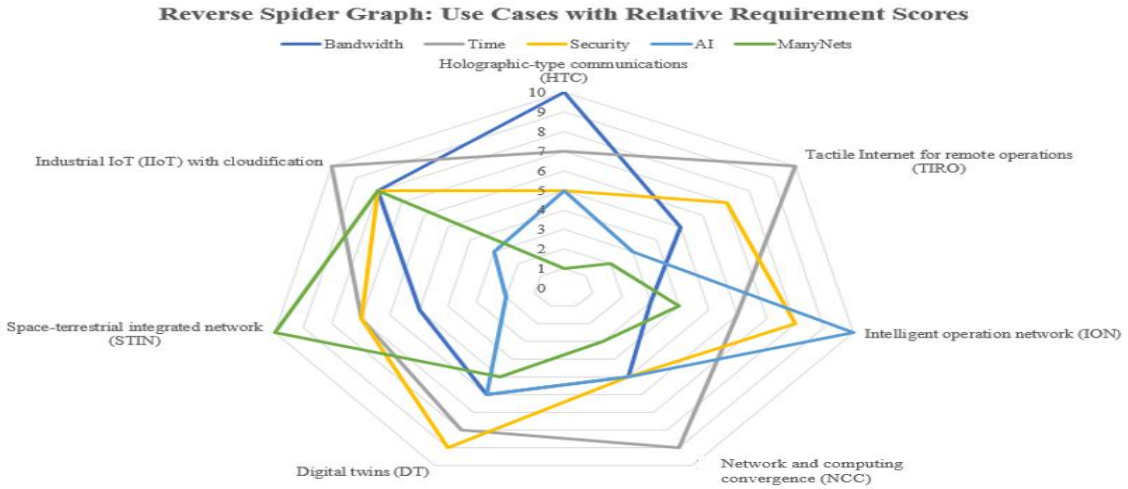
5 ABSTRACT NETWORK REQUIREMENT DIMENSIONS

- **Bandwidth, Time, Security, Artificial Intelligence (AI), ManyNets (*)**
- abstracted over more than 20 network requirement dimensions considered within Sub-G1
- scored according to relative importance of specific network requirement [1 to 3 (low), 4 to 6 (medium), 7 to 9 (high), 10 (extremely high)]

Relative network requirement scores – ball diameter graph



(*) ManyNets: seamless coexistence of heterogeneous network infrastructures



Sub-G2: New Network Services (1/2)

New Network Services [services below - defined in the approved Sub-G2 deliverable - focus on data plane services]

- **In-time and on-time services** -> see next slide
- **Coordinated services** -> see next slide
  - guarantee of delivery of multiple flows in a dependent manner
- **Qualitative communication services**
  - allowing applications to differentiate between different portions of packet payload (chunks) and describe their relative priority to the network [discarding of lower priority packets, if needed, can then reduce congestion and continuity of delivery of critical data to the application, while minimizing the need for retransmission, can be ensured]
- **Compound services** (depending on more than a single constraint)

Compound Services

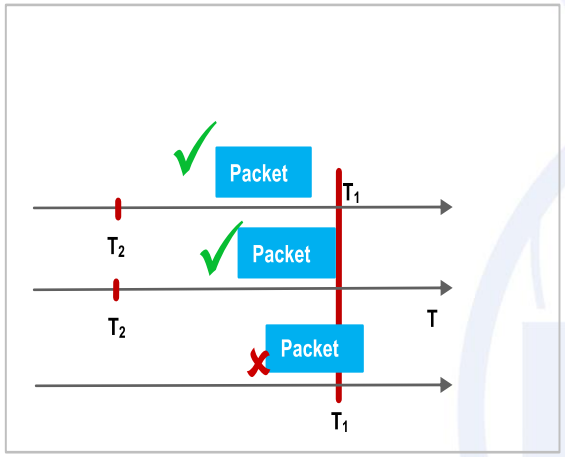
Compound Service	Criteria	Use cases	Time scales*
Qualitative Service	Conditional to network state	High throughput multimedia such as Holographic applications	~ 40 ms
Holographic Type Communications	Coordinated, time dependence and high bandwidth	High bandwidth requirements, different encoding for teleconferencing vs 3D medical imaging	~30 ms
Digital Teleportation	Coordinated, synchronized,	Digital replicated live-environment	~30ms
Tactile communications	Time dependence and reliability (zero packet-loss)	Variable encodings of haptics, optionally high bandwidth requirements, fast responses.	< 10ms

*note: Time scales depend on physical distances between the end points; numbers here represent general guidelines

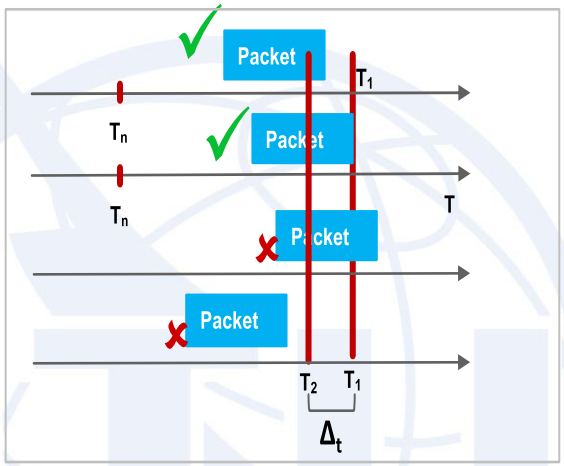
Sub-G2: New Network Services (2/2)

Time Engineered Services

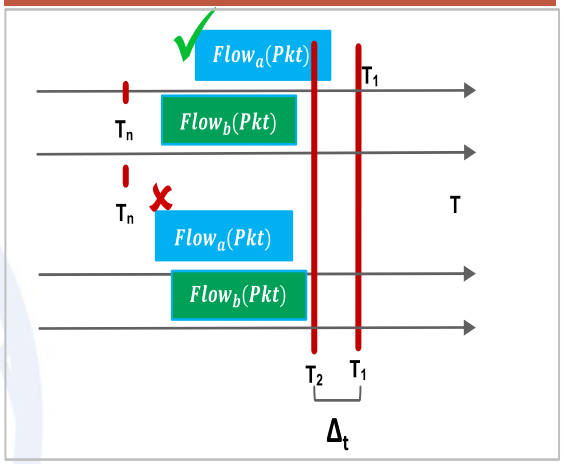
Intime Guarantees



On-time Guarantees



Coordinated Guarantees



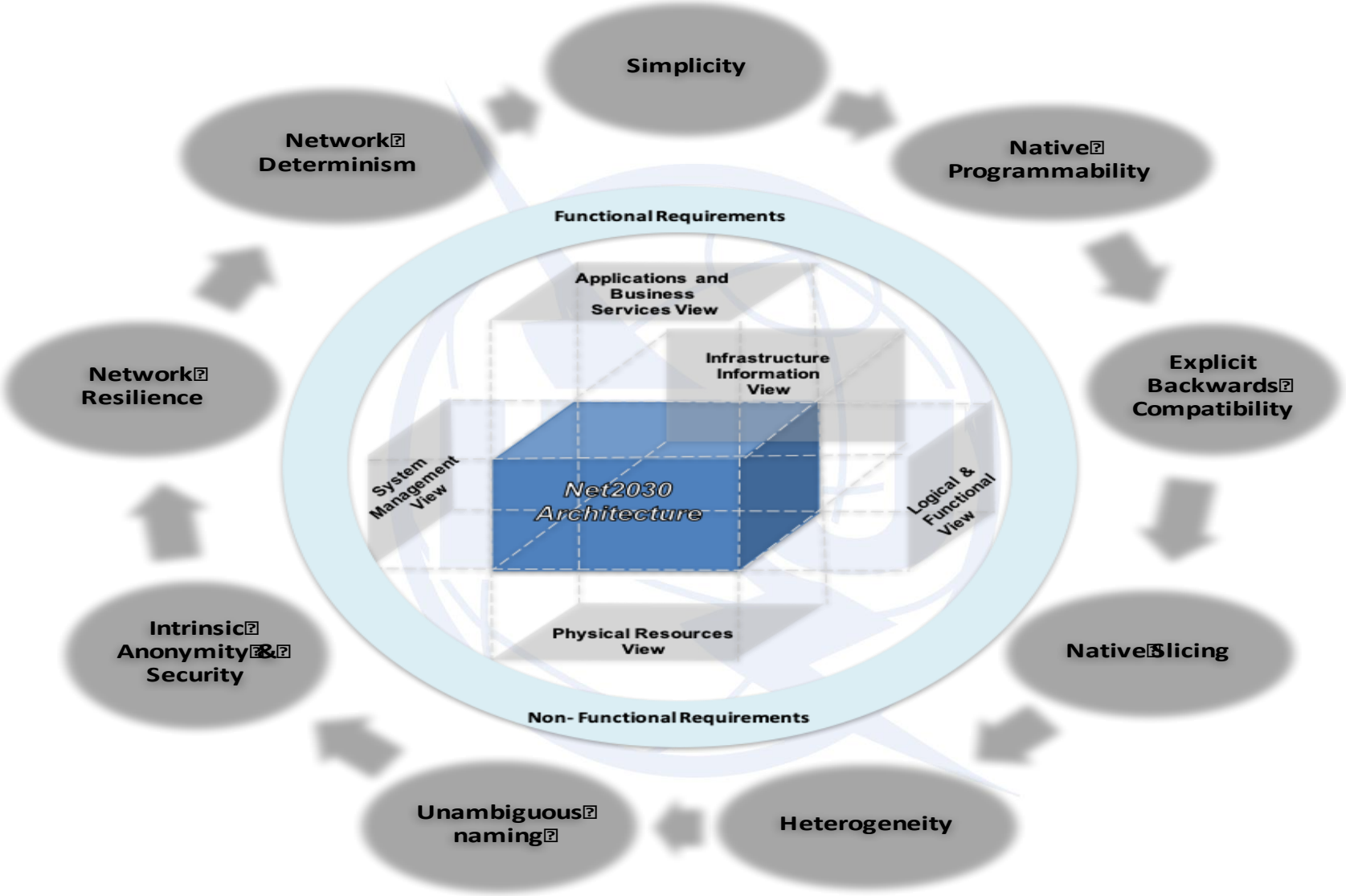
Time Engineered service criteria

Time centric	Criteria	Use cases	Time scales
In-time service	no later than requested time	Manufacturing automation Remote surgery	t ~ 1-10 ms
On-time service	at a requested time	Instantaneous response to emergency situation Synchronized operations such as drone swarms	Δt ~ 1 ms
Coordinated service	Relative time	Multi-sense communication Autonomous Traffic communication	t < 5ms

Coordinated guarantees based services:

- ✓ Source aggregation cooperative transmission service
- ✓ Challenge: time synchronization, resource synchronization, network assurance

Sub-G3 Network 2030 Architecture Framework (1/3)



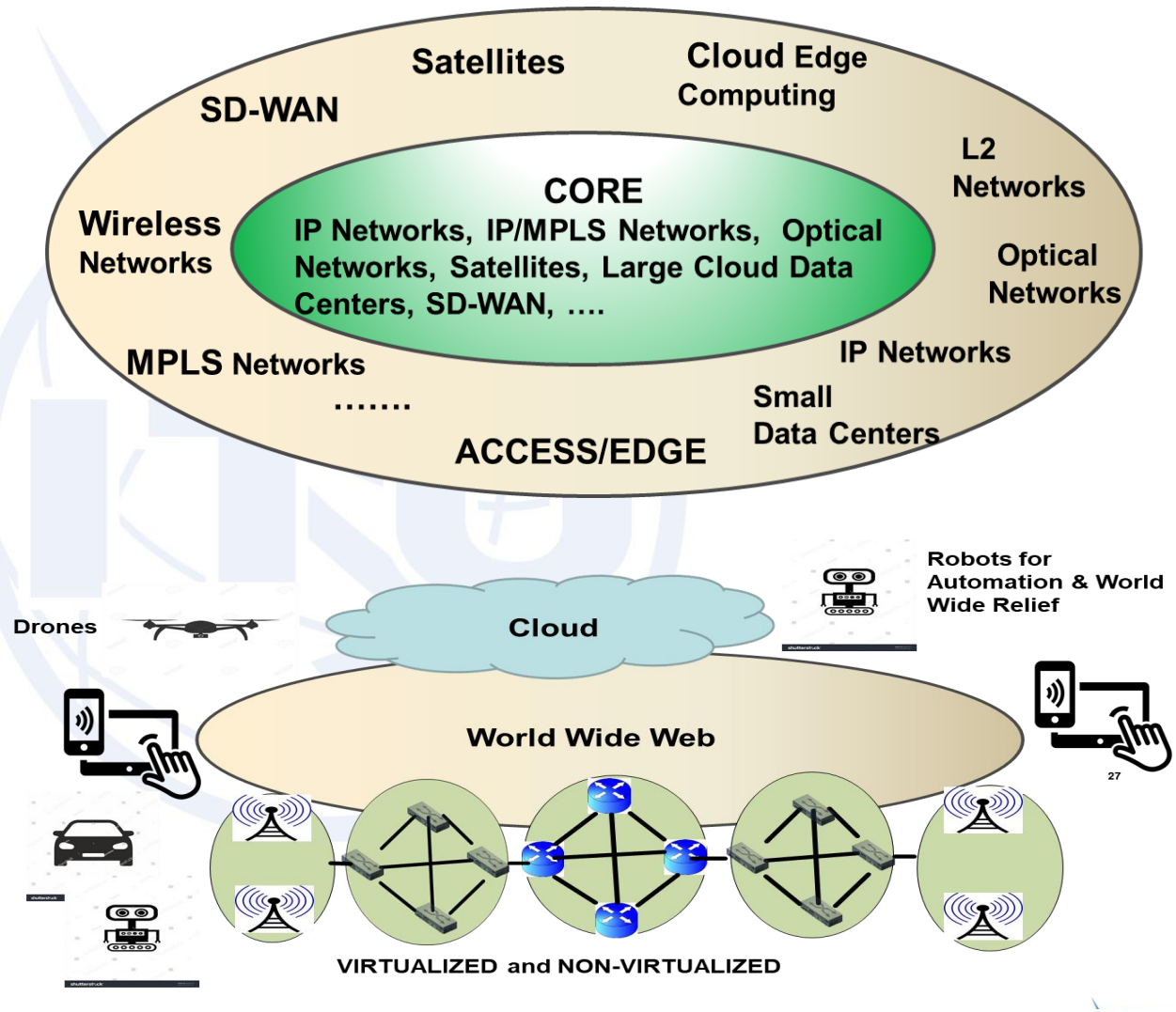
Relationships between Network 2030 principles, requirements and architecture(s)

Extract from Sub-G3 ongoing draft

Sub-G3 Network 2030 Architecture Framework (2/3)

Network 2030 infrastructure is expected to include fixed and wireless networks, cloud and space communications infrastructures

Network 2030 is expected to be used by various devices including robots, self-driven cars, and drones

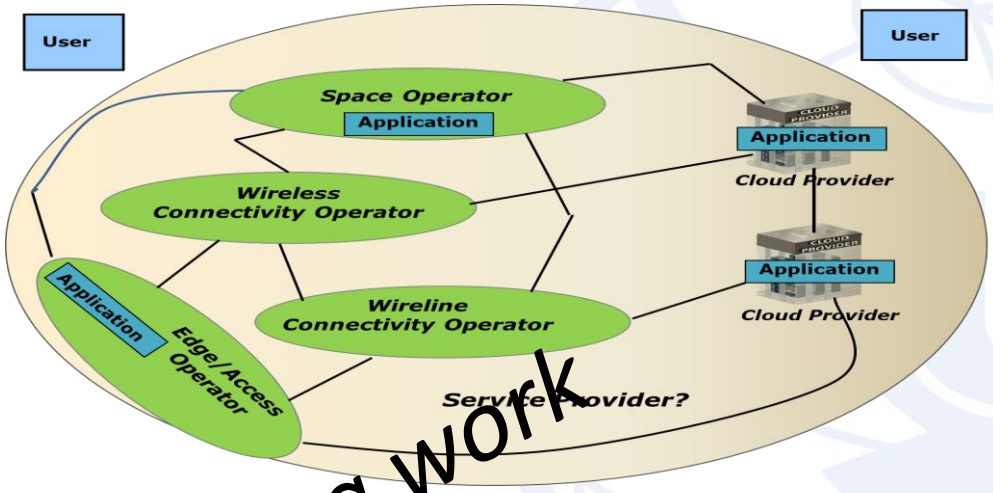


Example of future network infrastructure and end devices

Sub-G3 Network 2030 Architecture Framework (3/3)

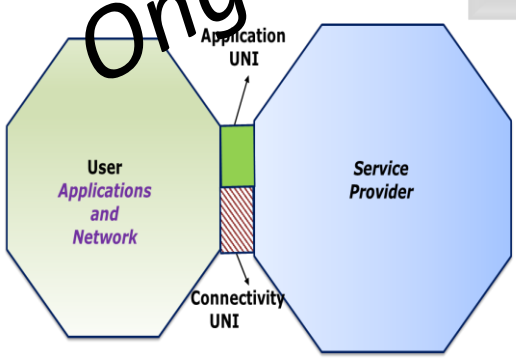
The future integrated network will comprise highly automated and intelligent one or more Operator networks supporting compute, storage, and applications, and connectivity among them, that may be accessed by a user from one or more locations

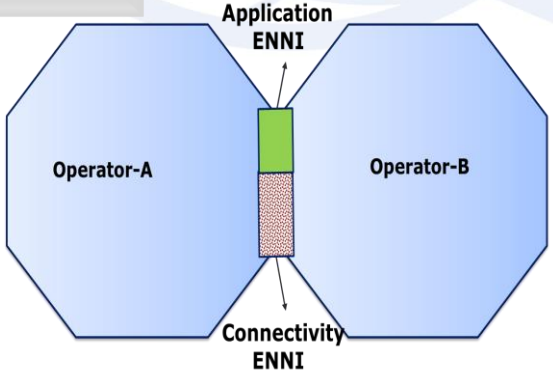
Actors of future integrated network



Ongoing work

Interfaces





Sub-G3 architectural teams:

- Principles
- Addressing
- Security
- Routing
- Mobility
- QoS
- Access Network and Edge Computing
- Network Management and Orchestration
- Space Networking
- Resiliency, reliability and high availability
- *Microservices and Control Plane, Softwarization*

Steps forward

- **Sub-G1**
  - Completion of the use cases for the main Sub-G1 deliverable (in addition to the 7 representative use cases described in approved TR), including clustering, gap analysis and graphical representation
  - Aggregation, consolidation and appropriate formulation of the requirements for all identified use cases
  - To be confirmed: mapping of the requirements to Sub-G2 Networking Services and Sub-G3 Architectural framework dimensions
- **Sub-G2**
  - Development of a gap analysis deliverable based on Sub-G2 deliverable findings (to be coordinated with Sub-G1 gap analysis findings)
- **Sub-G3**
  - Progress of the work of the various Sub-teams (each with focused scope) and integration of different findings in the draft
  - It is expected that in the final document further study be recommended on different aspects of the architecture
- **Cross Sub-Group deliverables**
  - Progress of the deliverables on terminology and on description of demonstrations for Network 2030

Thank you very much for your attention


ITU