14TH ITU ACADEMIC CONFERENCE

ITU KALEIDOSCOPE ACCRA 2022

WRAP-UP SESSION

7-9 December 2022
Accra, Ghana

Mostafa Hashem SHERIF
Kaleidoscope Steering Committee Member and TPC Chair

ITU KALEIDOSCOPE ACCRA2022

14TH ITU ACADEMIC CONFERENCE

ITU KALEIDOSCOPE ACCRA 2022

S1.1 Integrated network control architecture for terrestrial and non-terrestrial network convergence in beyond 5G systems
Presented by Ved P. Kafle (National Institute of Information and Communications Technology, Japan)

S1.2 Towards computing and network convergence: QoE-oriented service anycast based on SRv6
Zicheng Wang (Inspur Communications Technology Co., Ltd, China)

S1.3 Towards a more flexible networking landscape
David Lou (Huawei Technologies Duesseldorf GmbH, Germany)

7-9 December 2022
Accra, Ghana

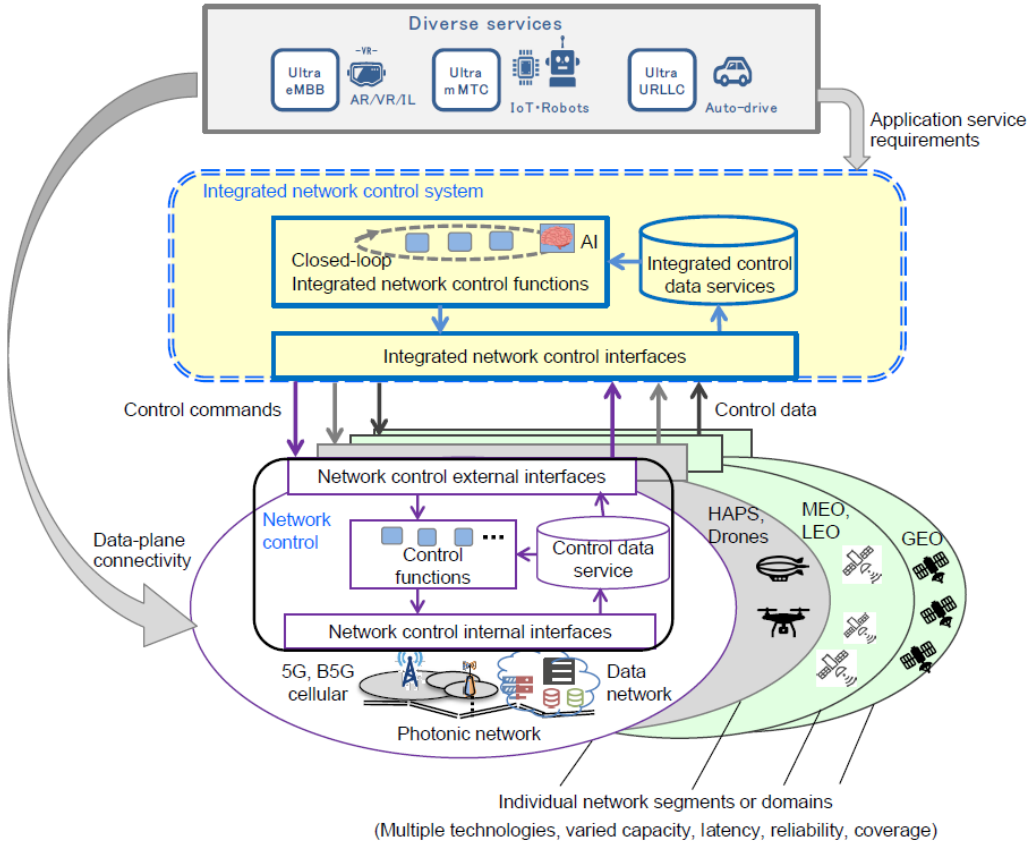
Eva Ibarrola
University of the Basque Country UPV-EHU

Session 1 – Presenters **ONLINE**
Some perspectives on future networks

ITU KALEIDOSCOPE ACCRA2022

Integrated network control architecture for terrestrial and non-terrestrial network convergence in beyond 5G systems

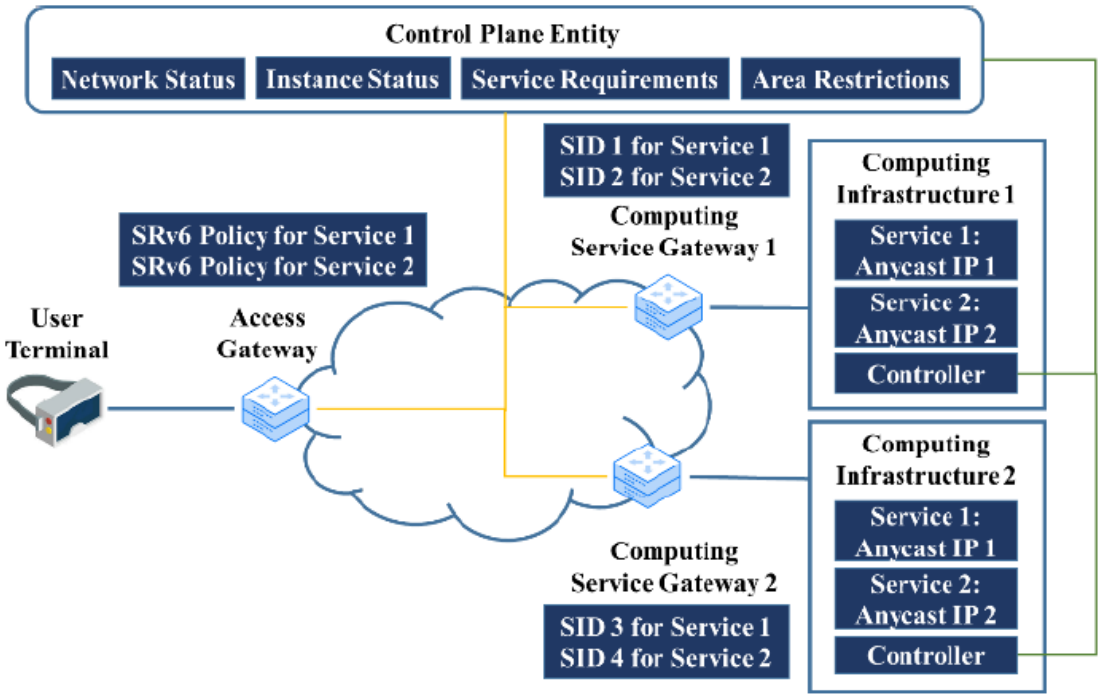
- **The convergence of Terrestrial Networks** (TNs) **and Non-Terrestrial Networks** (NTNs) **is essential** to seamlessly cover urban and rural areas, mountains and desserts, as well as sea and air.
- The paper presents **a preliminary design of integrated network control architecture for TN and NTN convergence:**
  - The integrated control system can **accommodate several control functions** enabling end-to-end network control and monitoring for offering reliable services in any place at anytime.
  - Some of the most important features of the integrated network control architecture are introduced.
- **Related ITU SG-13 standardization activities** and also to other SDOs (3GPP &ETSI) activities.



ITU KALEIDOSCOPE ACCRA2022

Towards computing and network convergence: QoE-oriented service anycast based on SRv6

- The authors present **the challenges of supporting Extended reality (XR) type business applications** and **the technical requirements** for load balancing of computing services through the network control plane.
- **An overlay service anycast system is proposed based on a Segment Routing over IPv6:**
  - To support service resource discovery
  - QoE-oriented service instance selection
  - Seamless mobility and service continuity



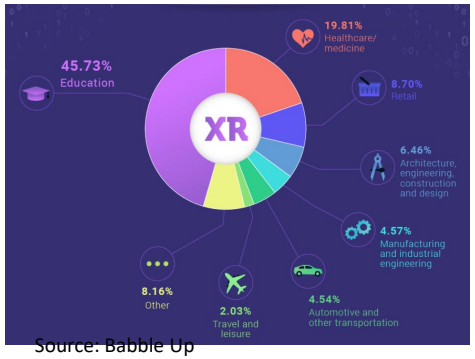
ITU KALEIDOSCOPE ACCRA2022

Towards a more flexible networking landscape

- In this paper **the need of enhancing future networks with more flexibility** is analyzed.
- The **four areas** that may achieve that objective are explored:
  - **Network configuration and adaptability**
  - **Cloud native networking**
  - **Network softwarization**
  - **Network addressing**
- Based on the analysis they plan to develop specific solutions for each of the explored areas.

Table 1 – SoTA and challenges summary

Area	State-of-the-Art	Research Challenges
Network configuration and adaptability	Long-lived configurations, centralization, OpenFlow, P4	Automation: decentralized management, light-weight telemetry High-level programmability: intent decomposition, configuration consistency
Cloud-native networking	Communication and computation treated separately	Efficient resource management algorithms (joint optimization), multi-provider resource federation
Network softwarization	SDN, NFV	Network operating system, abstractions, APIs, common functionalities
Network addressing	Fixed address length and semantics	Elastic addressing scheme, semantically-enhanced addresses and routing mechanisms



Source: Babble Up

Conclusions/Recommendations


Source: Einfochips

- The three papers of Session 1 discuss **key issues with respect to future networks convergence**.
- **Much effort needed** to integrate and optimize future terrestrial and non terrestrial networks.
- One of the **main challenges** facing the definition of the future networks integrated architecture is to support new applications as extended reality. Further research is certainly needed to support:
  - End-to-end network control and monitoring
  - Load balancing of computing services
  - More flexibility to overcome important limitations of the current networking landscape and fulfill emerging user needs and application requirements
  - End-to-end network resource sharing
- To consolidate the achieved results it is essential to **introduce them to the ongoing standardization** activities:
  - ITU SG-13 standardization activities and also to other SDOs (3GPP &ETSI)

Thank you!

14TH ITU ACADEMIC CONFERENCE

ITU KALEIDOSCOPE ACCRA 2022

S2.1 A framework for the design, implementation and evaluation of a multi-variant Augmented Reality application*
Sophie Westfahl (University of Applied Sciences Neu-Ulm, Germany)

S2.2 Enhancing user experience in pedestrian navigation based on Augmented Reality and landmark recognition*
Dhananjay Kumar (Anna University, MIT Campus, Chennai, India)

S2.3 The knowledge graph as the interoperability foundation for an Augmented Reality application: The case at the Dutch Land Registry*
Alexandra Rowland and **Erwin J.A. Folmer** (University of Twente & Kadaster, The Netherlands)

7-9 December 2022
Accra, Ghana

Prof. Quist-Aphetsi Kester
Ghana Communications Technology University

Session 2:
Augmented reality systems: design and implementation

ITU KALEIDOSCOPE ACCRA2022

A framework for the design, implementation and evaluation of a multi-variant Augmented Reality application*

- The proposed framework is built around: i) a development process that describes the different steps for the design of a model-based AR application and its implementation with Unity and Vuforia model targets; and ii) a multilayer orchestration model that describes the different interactions between a user and a server layer.
- The proposed framework is successfully implemented, and its performance analyzed using both quantitative and qualitative evaluation based on the Brooke's System Usability Scale

Enhancing user experience in pedestrian navigation based on Augmented Reality and landmark recognition*

- In this paper, we design and develop a marker-less augmented reality-based pedestrian navigation system which can handle navigation even in the absence of GPS as well as improve user experience by providing a novel landmark recognition feature, which allows users to identify nearby buildings or streets during navigation. To mitigate the absence of a GPS signal, a user localization method utilizing a step count-based distance estimator is proposed.

- The performance comparison with existing state of the art techniques and devices shows locational accuracy of 2.5 meters on average and a step count detection accuracy increase of nearly 0.5% with a latency of 70 milliseconds in an urban environment. The proposed solution is intended to be used as a mobile application on smartphones and has a potential to contribute to the smart city-related standardization activities of ITU-T Study Group 16.

The knowledge graph as the interoperability foundation for an Augmented Reality application: The case at the Dutch Land Registry*

- The concept of the knowledge graph supports insight to a given context through the provision of standards-based mechanisms for accessing open and interoperable data. In doing so, the graph uses the power of the web to integrate data from distributed data sources and make this data available to end users in a transparent, flexible and application-independent manner, either by simply displaying data in the browser based on a dereference unique resource identifier or in an application built using the knowledge graph as the source. With the latter approach, the knowledge graph remains independent of the applications making use of it as a data source, where the connection between the graph and the application is achieved through interfaces which are completely based on open standards, most commonly through the use of a SPARQL endpoint.
- Indeed, chatbot applications often make use of the knowledge graph in this way but this paper aims to present the potential for Augmented Reality (AR) applications to be similarly built using knowledge graphs. By presenting this potential, this paper will argue that AR applications exemplify the potential opportunities that fully open, interoperable and standardsbased approaches to data publication, such as the development of knowledge graphs, have and, therefore, will become key drivers within the organization in the investment of the further development of the concept of the knowledge graph in the future and improved accessibility of data for end users.

Conclusions/Recommendations

- Possible works and improvements

Thank you!

14TH ITU ACADEMIC CONFERENCE

ITU KALEIDOSCOPE ACCRA 2022

S3.2 Research and Standardization Requirements for 5G Network Peak Control Technology in Video Transmission

Zhiji Deng, Zhejiang Provincial Key Laboratory of Harmonized Application of Vision & Transmission, China and Zhejiang Dahua Technology Co. Ltd, China, and Xiangyu Qu, Zhejiang Dahua Technology Co. Ltd, China

S3.3 A Comparative Analysis of Augmented Reality Frameworks Aimed at Diverse Computing Applications

Mfundo A. Maneli, University of the Western Cape, South Africa

7-9 December 2022
Accra, Ghana

Dhananjay Kumar
Affiliation: Department of Information Technology, Anna University, Chennai, India

Session #3
Session title: Services in future networks

ITU KALEIDOSCOPE ACCRA2022

Research and Standardization Requirements for 5G Network Peak Control Technology in Video Transmission

- The severe fluctuation of network peaks in 5G video surveillance scenarios is largely caused by the
  - Collision of I-frames during multi-channel video transmission.
- Network peak control in 5G video transmission scenarios can
  - effectively smooth multiple channels, and
- For concurrent transmission of multi-channel videos in 5G networks, network peak control technology is a requirement.

A Comparative Analysis of Augmented Reality Frameworks Aimed at Diverse Computing Applications

- Compared augmented reality frameworks (ARKit and ARCore) based on AR measurements
- Experiments on two mobile operating systems: Android and iOS to calculate average accuracy
  - Four-distance measure criteria
  - Six devices used amongst the frameworks
- The ARKit was found more accurate and reliable based on experimental results.

Conclusions/Recommendations

- The study and formulation of standards related to Asset Administration Shell (AAS) standardization can help enabling technology to implement digital twins for Industry 4.0
- The mechanism for the network peak control for concurrent transmission of multi-channel videos in 5G networks helps in enhancing bandwidth utilization.
- The accuracy of augmented reality frameworks on smartphones can be evaluated based on measurements of AR objects.

Thank you!