# Session 3: IMT-2020/5G systems - “Machine learning, management and orchestration, operational issues”

Introduction

As highlighted in the opening remarks by the TSB Director, the convergence is the future of telecommunications. Its inclusion into the overall industrial infrastructure, namely by contributing with the high development of horizontal standards to support all and each vertical, is a strategic goal of such convergence. Convergence is where the computing technologies influence the development of the telecommunications and vice a versa. Session 3 elaborates more on this area.

1. *Data processing and management in future networks (Gyu Myoung Lee, KAIST, Korea (Rep. of)*

A vision of converging technologies including AI, IoT, edge computing and blockchain, is fuelled by the availability of copious amounts of data, which can serve as the basis for improved decision-making and overall enhanced performance. This has brought about the idea of data-driven artificial intelligence of things (AIoT). Starting from the driving force of linking AI with Data, the AIoT paradigm has moved forward based on the concept of distributed intelligence with cloud computing being considered an apt choice for controlling the connected things and the data, and promoting collaborative problem-solving based on a decision-making hierarchy. Adopting a similar train of thought as AIoT from the perspective of data sharing, the concept of “internet of blockchains” also envisions the launch of individual and interoperable chains that can enable programmers to innovate and allow for quick value transfers and seamless scalability.

Seeing convergence of computing and telecommunication technologies, the goal is to develop the Trusted Decentralized Data Driven Networking capable to offer Services supported by the Hyper-Connected Distributed Intelligence.

Noting the importance of data protection and privacy preservation, a trusted decentralized data and AI driven infrastructure is sought.

FG ML5G and FG NET2030 results should be use to the maximum efficiency. In addition, a new group on Data and AI-driven networks could also be considered by SG13 along with a new Question under ITU-T SG20 on DPM and AI applications. One of the key questions raised was in relation to decision-making and data management, as more work could be needed to differentiate it from stream of artificial intelligence. The dimension of ethics would also be relevant to the studied within the realm of data management as elaborated on by the deliverables of the Focus Group on Data Processing and Management.

A new direction is towards data-driven networks that is a new approach to support data driven applications.

Contributions driven approach is not much efficient in bringing the new ideas. What are the ways to drive innovations?

Data is becoming a new fuel nowadays. We need to collect, store, share, analyse, process it and make most use of it to adjust network operation. How to support increasing data driven applications? Data driven networks. Another new paradigm is the convergence where computing and networking are integrated in one innetworking computing complemented by the intelligence that comes on top of that.

1. *Considerations for standardization of 5G intelligent operation and management (Yanchuan Wang, China Telecom, China)*

The promise of effective deployment of 5G networks needs to be complemented with intelligent planning in relation to operation and management along with the assurance of providing service quality through multi-layer and multi-domain based on cloud, SDN and NFV networking.

In the past network management was seen as auxiliary support to network operation. In the modern world it gains more and more importance and influence the best network performance. On top of that the energy efficiency comes into the picture. All together this speaks about the collecting the data to power intelligent operation.

On the other hand, data will help understand how to set up slice and better manage resources. Slicing is an important capability to support 5G operation from the SG2 perspective.

ITU may fill in a caveat to lead AI-combined Telecom Operation & Management work to bring together the previous studies convened by now by FG ML5G and SG13 on unified architecture for ML as applied to 5G, TMF on AI service management architecture and maturity assessment model, ETSI with the collection of diverse use cases and 3GPP on Network-level AI applications. All this to contribute to the overall enhanced 5G operation and management unique future standard.

1. *Orchestration aspects: ML for 5G (Vishnu Ram, Consultant, India)*

ITU recently published the high-level architecture framework for machine learning in future networks including 5G. This include MLFO (Machine learning function orchestrator). MLFO complements the NFVO (network function virtualization orchestrator) and the SO (service orchestrators) by managing machine learning functionality in operator network. While this gives a foundation for ML in future networks, further study is needed to develop and exploit the larger concept of orchestrating ML across different standards.

The aim of future standards should be to achieve “invisible intelligence” which does not hinder the user-experience in the network nor the manageability of networks. However, there are significant challenges which ML orchestration has to address before it can achieve this: deriving data from heterogeneous sources, managing policy and security are some of those.

During the discussion, it was highlighted that flexible standards are needed to understand and implement the vision for orchestration of intelligence. A distributed approach (many groups work according to each with focussed expertise), with organic development of solutions (with guidance from each other and FG ML5G) for intelligence orchestration is the need of the hour. Such a collaborative study may not only make networks more intelligent but also gives ITU the opportunity to lead the development of intelligent standards across SDOs.

1. *Future of slicing and ML - Cognitive high-precision slicing (Kiran Makhijani, Futurewei, United States)*

By further adding intelligence to its life-cycle creation and maintenance, one gains cognitive and higher precision slicing. Future sees transition from transport to slice-centric user plane. The network architecture is inherently hierarchical and highly abstracted at the network slice orchestrator. Adding intelligence (ML) will bring automation to manage this complexity. As was pointed out in session 2, slices may need to be stitched, where one slice comes from L2 and another from L3 network. One can think of decentralizing the slice management to better orchestrate the traffic engineering in particular delegating decisions down the hierarchy.

By leveraging the knowledge and insights retrieved from the data, it is prudent to employ machine-learning capabilities such as adaptive boosting to perform cognitive network slice management for dynamic resource optimization and orchestration of networks slicing and improving precision of matching traffic patterns to the service offered by the slice.

Slices for different services may need to coexist over common infrastructure in which case they should not interfere with each other. There is another space to apply ML model to forecast if you can add a new slice along with existing slices without interruption for their operation.

On the standardization front, the strategic direction to be adopted by ITU-T should encompass various aspects including (but not limited to)

* defining network slice user plane capabilities for services and applications described in Network 2030
* distributed routing control for better scalability and gateways for multi-protocol stitching.
* leveraging ML framework Y.3172 for network slices.
* embracing hierarchical Machine learning approaches for cognitive network slices.
* abstraction and anonymization of outcomes of data models at lower level

During the discussion, the need to anonymize data (especially when dealing with personal data) was highlighted. In this regard, there is a need for technical solutions for the usage and exchange of data in keeping with regulations (including GDPR).

Conclusion

As highlighted by presentations in session, a consolidated collaborative platform is sought to be a new approach to use our resources in a right way and work together.