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FOCUS GROUP ON MACHINE LEARNING FOR FUTURE NETWORKS INCLUDING 5G

ML5G-0-004

Question(s):	N/A	Geneva, 30 January - 2 February 2018

OUTPUT DOCUMENT

Source:	FG ML5G
Title:	LS/o on the results of the 1st meeting of the ITU-T Focus Group on Machine Learning for Future Networks including 5G (FG ML5G)
Purpose:	For information

LIAISON STATEMENT

For action to:	
For comment to:	
For information to:	ITU-T study groups, ITU-R study groups, IEEE, IETF, Wifi Alliance, ETSI Industry Specification Group ISG ENI, ISG ZSM, ISO/IEC JTC1 SC42, ISO/IEC JTC1 SC 29/ WG11 (MPEG), ISO/IEC JTC1 WG 9 (Big Data), Wireless Broadband Alliance, 3GPP, 5GAA, IEC MSB (Market Strategy Board), ISO TMB (Technical Management Board), 5GIA (Infrastructure Association) and other verticals: Alliance for IoT Innovation, AIIA (Artificial Intelligence Industry Alliance, China), 5GPPP, GSMA, BDVA (Big Data Value Association), IIC (Industrial Internet Consortium), Wireless AI Alliance (China), 5G Americas, Telecom Infra Project, SDNIA (China), AIRI (Korea), ONAP (open source project for network orchestration), Acumos (open source AI platform supporting network), RIKEN Center for Advanced Intelligence Project (AIP, Japan), NGMN
Approval:	**Geneva, 30 January - 2 February 2018**
Deadline:	

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Keywords: ML5G; machine learning, 5G, network architecture, use cases, FG ML5G

Abstract: This document contains information about the first meeting of the ITU-T Focus Group on machine learning for future networks including 5G.

We would like to inform you that ITU-T on Machine Learning for Future Networks including 5G (FG ML5G) held its first meeting in Geneva, 30 January - 2 February 2018, with a workshop taking place on 29 January 2018.

The group was established by ITU-T Study Group 13 at its meeting in Geneva (6-17 November 2017) with these Terms of Reference.

At its first meeting, FG ML5G established three working groups:

- WG1: Use cases, services & requirements (Terms of reference see Annex A of this liaison)
- WG2: Data formats & ML technologies (Terms of reference see Annex B of this liaison).
- WG3: ML-aware network architecture: (Terms of reference see Annex C of this liaison).

FG ML5G has a lifetime of one year from its first meeting. The next meeting of FG ML5G will take 24-27 April 2018, with a workshop on 25 April 2018. The venue for the focus group meeting and the workshop is Xi'an (China).

ITU Focus Groups are open to all interested parties. Membership in ITU is not required. Please join the Focus Group's mailing list, request access to documents and learn more about its priorities on the group's homepage.

We welcome your input to the deliverables and updates on activities related to ML5G, and look forward to collaboration in this area.

Annexes

Annex A: Terms of reference Working Group 1: Use, cases, services and requirements

Annex B: Terms of reference Working Group 2: Data formats and ML technology

Annex C: Terms of reference Working Group 3: ML-aware network architecture

Annex A: Terms of reference Working Group 1: Use, cases, services and requirements

Motivation

Today, lots of ML-based applications and services for future networks including 5G start to appear in the market. In order to prepare effective standard ways to build up ML-based applications and services in the networking area, we need to investigate the way ML-technologies and data are used in them and to derive the core requirements for them.

Scope

The objective of WG1 is to understand the industry needs and to clarify the vision about the whole ecosystem in terms of ML for future networks and 5G. This will be done by collecting use cases from industry and defining the derived requirements. Expected use cases, and without any limitation, can be both on the network infrastructure services and applications services (e.g. self-organized networks, information control networks, networked autonomous driving). The classification of these use cases will then allow deriving a set of requirements. These requirements will drive the work on data formats and ML technologies within WG2 and ML-aware network architectures within WG3.

The activity of the group will also include the exploration of the whole ecosystem and stakeholders of the market involved or impacting the vision and the needs for ML in the future networks and 5G. This can go beyond the classical telecoms operators and would involve new players from vertical industries (e.g. automotive, manufacturing) and their needs. Aspects related to specific standardization gaps based on the observation of the whole standardization environment and in liaison with other SDOs, fora, etc, will be also addressed.

Since the outcome of this working group is crucial to the other working groups, the deliverables should be produced incrementally and quickly. In the beginning we will start from a small number of important use cases and enlarge the target use cases later, and then derive the fundamental requirements from the previous work.

Specific questions to be addressed include:

1. What are the relevant use cases and derived use cases requirements for ML?
2. What are the standardization gaps?
3. What are the liaisons activities?

Tasks include, but are not limited to:

1. Specify important use cases.
2. Derive minimum requirements regarding those use cases to be shared with WG2 and WG3.
3. Analyze technical gaps related to the use cases and its ecosystem

Deliverables

WG1 is to deliver the following documentation:

1. Use cases
2. Ecosystem, terminology and services.
3. Requirements and standardization gap

Relationships

- 3GPP (SA1) outcome
- IEEE

- IETF
- ETSI (ISG ENI, ISG ZSM)
- ONAP (open source project for network orchestration)
- Acumos (open source AI platform supporting network)

Annex B: Terms of reference Working Group 2: Data formats and ML technology

Motivation

Modern communication networks, and in particular mobile networks, generate a huge amount of data. Powerful machine learning (ML) methods can be used to extract and leverage this information for various tasks, however, the lack of a unified data format makes such an analysis a challenging problem. The application of ML technology to communication networks is further complicated by constraints and requirements such as limited computation resources, bandwidth or latency restrictions or distributed data. This working group will investigate data formats and ML technologies which are tailored for such a communications scenario.

Scope

This working group will investigate how to collect, prepare, represent and process data for ML in the context of communication networks. This also includes the study of privacy and security implications on data formats and ML techniques. Furthermore, this working group will integrate the inputs received from the other working groups into its work. These inputs will consist of the potential use cases, including requirements on the ML technology (what to compute, what data do we have, how fast to compute, how reliable and transparent it must be, where to do the computation, how much computational resources do we have) and requirements on the data (what data to we have, can we use all the data centrally, can we trust the data, is the data labeled, where is the data generated), as well as potential network architectures (e.g., distributed, centralized, hybrid). Furthermore, this working group will engage in the categorization of ML algorithms used in communication networks. This includes the categorization of how different ML methods (e.g., neural networks, unsupervised methods, reinforcement learning) fit to different communications problems. Since data is usually distributed in a communication network, this working group will also investigate how current ML technology can be used in or extended to a distributed setting. Topics of interest here are the efficient representation of ML models, efficient at-terminal computation, distributed learning with reduced overhead and other ML topics such as trustworthiness and transparency of the algorithms. Finally, this working group will identify standardization and technology gaps and create liaisons with related activities in other organizations.

Specific questions to be addressed include:

1. How should data be collected, prepared, represented and processed for ML in the context of communication networks?
2. What are the privacy and security implications on data formats and ML?
3. Categorization of ML algorithms in the context of communication networks, i.e., how do different ML methods fit to different communications problems?
4. How can current ML technology be used in a distributed setting (e.g., efficient representation of ML models, efficient at-terminal computation, distributed learning with reduced overhead)?
5. What are the standardization and technology gaps?

Tasks include, but are not limited to:

1. Analysis of ML technology and data formats for communication networks, with special focus on the uses cases of WG1.
2. Providing input to WG3 on data formats and ML technology, and incorporate output from WG3 on ML-aware network architectures.
3. Identification of standardization and technology gaps.
4. Liaisons with other standardization organizations.

Deliverables

1. ML algorithms in communication networks: categorization, terminology & implications
2. Data formats including privacy and security aspects for ML in communication networks
3. Standardization and technology gaps

Annex C: Terms of reference Working Group 3: ML-aware network architecture

Motivation

Future networks such as 5G will be highly complex. We expect that ML is a promising technology to cope with this increased complexity. Moreover, ML technologies can be used to improve the performance of networks with respect to OPEX/CAPEX, and enable new use cases, applications and services such as networked autonomous driving.

Today's network architectures are not suitable for incorporating ML technologies. For example, in the case of operation and maintenance, huge amounts of data must be transferred in order to perform training and prediction tasks. This would require a large amount of network resources (such as computational power, energy, storage etc.). Moreover, currently deployed APIs do not meet the requirements of existing ML technology.

Scope

The WG will study the implications of applying ML technologies to communication networks. In particular, the focus will be on specification and placement of functions, interfaces and resources as a result of the integration of ML technologies. The ultimate objective is to enable efficient use of ML technologies in future networks.

Specific questions to be addressed include:

1. What are the implications of ML (including distributed ML) on network architectures?
2. What are the requirements imposed by ML on network architectures in terms of computational power, energy, storage, interfaces, communication resources (e.g. which interfaces are needed to support ML-based network optimization)?
3. What are the standardization gaps?
4. What are the liaisons activities?

Tasks include, but are not limited to:

1. Analysis of implications of ML (including distributed ML) on network architectures
2. Incorporate output from WG1 on use cases and requirements and WG2 on data formats.
3. Analysis of functions, interfaces, resources imposed by ML on network architecture

4. Gap analysis based on the tasks of different standard organizations

Other topics can also be studied as appropriate, based on contributions.

Deliverables

1. Analysis of communication network architectures from the viewpoint of ML

2. Description of ML-related functions, interfaces and resources for communication network architectures

3. Standardization and technology gaps

Relationships

All network architecture related AI and machine learning Standardization bodies, forums, open source projects:

3GPP

IEEE

IETF

ETSI (ISG ENI, ISG ZSM)

ONAP (open source project for network orchestration)

Acumos (open source AI platform supporting network)