First meeting of the ITU-T FG ML5G 26/3/2018, Abidjan, Cote D'ivore

BY ENGR CHARLES CHIKE ASADU

ICT/INNOVATION CENTRE, UNIVERSITY OF NIGERIA, NSUKKA

Chike.asadu@unn.edu.ng

chikecasadu@yahoo.com

+234 7061262244

CONTENT

1. INTRODUCTION
2. ISSUES FOR ML
3. Objectives of the FG-ML5G
4. Specific Tasks and Deliverables
5. Relationships
6. First meeting of FG-ML5G
7. First meeting documents
8. Meeting results
9. Working group structure
10. Future Plan of FG-ML5G

INTRODUCTION

Further to the agreement by ITU-T Study Group 13 at its meeting in Geneva (6-17 November 2017), the ITU-T Focus Group on Machine Learning for Future Networks including 5G (FG-ML5G) was establishment, Under the chairmanship of Mr Slawomir Stanczak (Fraunhofer HHI, Germany),

The first meeting was chaired by Mr Slawomir Stanczak (Fraunhofer Heinrich Hertz Institute), assisted by vice-chairmen Mr Charles Chike Asadu (University of Nigeria), Mr Seongbok Baik (KT, Republic of Korea), Mr Viliam Sarian (NIIR, Russian Federation) and Ms Mingjun Sun (CAICT, People's Republic of China). On 1 February, the focus group appointed a further focus group vice-chairman, Mr Salih Ergut (Turkcell).

- The task of the Focus Group is to draft technical reports and specifications for machine learning (ML) for future networks, including interfaces, network architectures, protocols, algorithms and data formats.
- "The Focus Group's key objective is to identify relevant gaps in the standardization in order to improve interoperability, reliability and modularity of ML for 5G", states Stanczak.

INTRODUCTION

- Participation in FG-ML5G is free of charge and open to all relevant parties such as ML and networking technology experts from network operators, technology vendors, and academia. Anyone interested in updates and announcements related to this group is invited to subscribe to the FG-ML5G mailing list. Details on how to subscribe can be found at: www.itu.int/en/ITU-T/focusgroups/ml5g.
- 4 The group will operate under the procedures set out in Recommendation ITU-T A.7 and within the agreed Terms of Reference.
- The FG-ML5G may establish sub-groups if needed
- The Focus Group lifetime is set for one year from the first meeting but extensible if necessary by decision of the parent group

ISSUES FOR ML

The areas of machine learning (ML) and communication technology are converging. The design and management of networks and communication components can be significantly enhanced when combined with advanced ML methods. In particular, fixed and mobile networks generate a huge amount of data at the network infrastructure level and at the user/customer level, which contain a wealth of useful information such as location information, mobility and call patterns. To improve network performance and enhance user experience, new ML methods for big data analytics in communication networks can extract relevant information from the network data while taking into account limited communication resources, and then leverage this knowledge for autonomic network control and management as well as service provisioning.

ISSUES FOR ML

Considering the growing complexity of SDN/NFV and IMT2020/5G networks and beyond, ML may be well applicable for automatic network orchestration and network management. ML also impacts information and communication technology (ICT) in areas related to security or protection of personal information. Regulations in ICT may require that the learning algorithms do not provide personally identifiable information (PII). Hence, ML algorithms that also work under uncertainty and incompleteness are of increasing interest in ICT. These aspects are relevant when considering formats that deliver data to ML algorithms.

ISSUES FOR ML

- The standardization of interfaces, processes and data formats is of high importance in communications, because it increases the reliability, interoperability and modularity of a system and its respective components. Standardized formats may be needed to specify how to train, adapt, compress and exchange individual ML algorithms, as well as to ensure that multiple ML algorithms correctly interact with each other and that certain security or protection of personal information requirements are fulfilled.
- Furthermore, it can be expected that a large number of new ICT applications would emerge, if the complexity of state-of-the-art ML algorithms, especially deep neural networks, can be reduced to a level which allows their use in computationally/energy limited environments.
- This Focus Group would play a role in providing a platform to study and advance the various ML approaches for future networks including 5G.

Objectives of the FG-ML5G

The objective of the Focus Group is to conduct an analysis of ML for future networks in order to identify relevant gaps and issues in standardization activities related to this topic. Such analysis includes an overview on related activities by other SDOs and groups.

Furthermore, it includes technical aspects such as use cases, possible requirements, architectures and others.

The Focus Group also serves as an open platform for experts representing ITU members and non-members to quickly move forward studies on ML related to future networks including 5G.

Objectives of the FG-ML5G

More precisely, the objectives include:

- To help adoption of ML in future networks including architecture, interfaces, use cases, protocols, algorithms, data formats, interoperability, performance, evaluation, security and protection of personal information;
- To study, review and survey existing technologies, platforms, guidelines and standards for ML in future networks;
- To recognize and highlight the various perspectives for the future of networks and computing systems involving ML;
- To identify aspects enabling safe and trusted use of ML frameworks;
- To review and study how to train, adapt, compress and exchange ML algorithms in future networks, and how multiple algorithms interact with each other;

Objectives of the FG-ML5G

- To identify possible requirements of ML applied to future networks taking into account a variety of fixed and mobile communication stacks, and to promote the development of new ML methods that will be able to meet these requirements;
- To identify possible requirements on network functionality, interfaces and capabilities to use ML;
- To identify challenges in the standardization activities for ML in communications;
- To produce a gap analysis of ML in order to identify the relevant scope of ITU-T recommendations on these topics and develop a roadmap for ML;
- To establish liaisons and relationships with other organizations which could contribute to the standardization activities for ML.

Specific Tasks and Deliverables

- To provide terminology and taxonomy for ML in the context of future networks, as well as a guideline on the approaches, tools, applications and platforms related to this topic;
- To gather information on initiatives pertaining to ML for future networks and to identify existing standards, ML methods, best practises and challenges for the adoption of ML in future networks;
- To describe the ML ecosystem for future networks and the roles and activities related to different stakeholders in this ecosystem;
- To analyse possible requirements on ML applied to future networks;
- To draft technical reports and specifications for ML for future networks, including interfaces, network architectures, protocols, algorithms and data formats;
- To analyse the impact of the adaption of ML for future networks (e.g. autonomic network control and management);

Specific Tasks and Deliverables

- To send the final deliverables to ITU-T Study Group 13 at least four calendar weeks before the parent group's next meeting in accordance with Recommendation ITU-T A.7;
- To analyse the standardization gaps related to ML for future networks and develop a future standardization roadmap, taking into consideration the activities currently undertaken by the various standards developing organizations (SDOs) and forums;
- To develop a list of standards bodies, forums, consortia and other entities dealing with aspects of ML and liaise with organizations, which could contribute to the standardization activities on ML;
- To organise thematic workshops and forums on ML for future networks, which will bring together all stakeholders, and promote the FG activities and encourage both ITU members and non-ITU members to join its work

Relationships with other bodies

This Focus Group will work closely with SG13 through co-located meetings when possible. It will establish and maintain a collaboration arrangement with ITU-R WP5D by several means (for instance, liaison statements). Furthermore, the FG-ML5G will collaborate (as required) with other relevant groups and entities, in accordance with Recommendation ITU-T A.7. These include municipalities, non-governmental organizations (NGOs), policy makers, SDOs, industry forums and consortia, companies, academic institutions, research institutions and other relevant organizations

First meeting of FG-ML5G

The first meeting of FG-ML5G was held at ITU headquarters, Geneva, Switzerland from 30 January to 2 February 2018.

The objectives of the first meeting include:

- Discussion on machine learning for 5G networks: Requirements, expectations, challenges, research gaps and standardization needs;
- Agreement on the precise scope and objectives of the focus group;
- Agreement on the group's structure, expected deliverables, responsibilities, timeline; and
- Review of written contributions and initial development of deliverables.

A workshop on Machine Learning for 5G and beyond was also held the day before the first meeting of the FG-ML5G, on 29 of January 2018, at the same location.

First meeting of FG-ML5G

The meeting was chaired by Mr Slawomir Stanczak (Fraunhofer Heinrich Hertz Institute), assisted by vice-chairmen Mr Charles Chike Asadu (University of Nigeria), Mr Seongbok Baik (KT, Republic of Korea), Mr Viliam Sarian (NIIR, Russian Federation) and Ms Mingjun Sun (CAICT, People's Republic of China). On 1 February, the focus group appointed a further focus group vice-chairman, Mr Salih Ergut (Turkcell).

First meeting of FG-ML5G

CHAIRMANS SPEECH

- The chairman presented a keynote address available as I-023.

On IPR call

- The Secretariat explained the ITU IPR policy (I-002),while the chairman read out the IPR call. Vodafone pointed out the patents listed in their contribution as in I-003.

- There were no contributions from Africa

First meeting of FG-ML5G Documents

	Title	Doc. number	Submitter
1	Suggestions for contribution direction in FG-ML5G	I-020	KT Corporation
2	CTO Meeting Communiqué, 24 September 2017, Busan, Republic of Korea	I-018	TSB
3	ENI-Experiential Networked Intelligence	I-005	ETSI
4	Data Formats and Specifications for Efficient Machine Learning in Communications	I-013	Fraunhofer HHI
5	Information Model and Data Formats for Policy Based Network Management	I-015	Nicos AG (document not presented)
6	European Financial Transparency Gateway / Energy distribution with the use of smart contracts / Smart contracts for data accountability and provenance tracking	I-011	Universitat Pompeu Fabra
7	Proposed a new study item on "Use cases of Machine Learning on Future Network Optimization (MLNO)"	I-010	ZTE Corporation, China Academy of Information and Communications Technology

First meeting of FG-ML5G Documents

8	Proposed hierarchy chart of potential work items for the focus group	I-017	China Academy of Information and Communication Technology
9	Machine Learning and 5G	I-012	Telecom Italia Mobile (document not presented)
10	Machine Learning in 5G Self Organizing Networks	I-019	TU Berlin / Telekom Innovation Labs (presented at workshop)
11	Proposal of adding a new subject on "requirements of intelligent 5G network service deployment and network	I-007	China Telecom

First meeting of FG-ML5G Documents

12	Intelligent Telecommunication Network Maintenance and Optimization Based on Machine Learning：Function Requirements and Application Scenarios	I-016	China Mobile Group Design Institute Co., Ltd
13	ML applications in networking field	I-021	KT Corporation
14	Proposed a new work item on "Reference Architecture of Machine Learning on Future Network Operation and Maintenance(MLNOM)"	I-009	ZTE Corporation, China Academy of Information and Communications Technology
15	The Evolution of Communication Networks. Beyond 5G	I-003 I-004	Vodafone
16	Security Orchestration of a Machine Learning 5G Deployment	I-006	Forward-Looking Threat Research (FTR) (document not presented)
17	Collaboration with IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems	I-014	NEC Corporation Japan
18	Root Cause Analysis of Network Alarm	I-008	China Unicom

Results of First meeting of FG-ML5G

- Communication networks have not been designed to cope with big data analytics and ML. Therefore future networks need to be designed and operated to do so. To analyse the impact of ML on communication networks which are bound by constraints on communication resources and operate in a noisy and dynamic environment is the main task of the focus group.
- The focus group needs to stay focused. The focus group is not about research or artificial intelligence but about data formats, functional network architectures and ML in the context of future networks and 5G.
- Use cases from industry will need to drive the requirements on data formats and ML technologies.
- Data is everything, but the lack of a unified data format and constraints on computing resources, bandwidth, latency etc. make the use of ML challenging. This is in particular true for mobile networks such as 5G. Further questions are what data is available, whether data can be trusted, whether data is labelled, and where data is generated. Privacy and security implications on data formats and ML techniques further complicate matters.

Results of First meeting of FG-ML5G

- Working groups will interact and cross-fertilize each other.
- The focus group needs to move quickly and fast. Working groups will hold regular conference calls / e-meetings to prepare face-to-face meetings and to progress work.
- For the second meeting of the focus group, the first working group (WG1) will derive and prepare use requirements for too important use cases. The requirements will provide a basis for further discussions during the second focus group meeting

Working group structure of FG-ML5G

The meeting established the following working groups:

- WG1: Use cases, services & requirements. Chairman Mr Seongbok Baik, KT; co-chairman Mr Mostafa Essa, Vodafone.
- WG2: Data formats & ML technologies. Chairman Mr Wojciech Samek, Fraunhofer Heinrich Hertz Institute.
- WG3: ML-aware network architecture: Chairman Mr Wei Meng, ZTE.

Working group structure of FG-ML5G

Terms of reference for Working Group 1:

- **Use cases, services and requirements**

Motivation:

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

Working group structure of FG-ML5G

SCOPE OF WG1

- 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.

Working group structure of FG-ML5G

SCOPE OF WG 1 cont.

- 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.

Working group structure of FG-ML5G

Specific questions to be addressed WG 1 include:

- What are the relevant use cases and derived use cases requirements for ML?
- What are the standardization gaps?
- What are the liaisons activities?

Tasks include, but are not limited to:

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

Working group structure of FG-ML5G

Deliverables of WG1:

- WG1 is to deliver the following documentation:
- Use cases
- Ecosystem, terminology and services.
- Requirements and standardization gap

Relationships of WG1:

- 3GPP (SA1) outcome
- IEEE
- IETF
- ETSI (ISG ENI, ISG ZSM)
- ONAP (open source project for network orchestration)
- Acumos (open source AI platform supporting network)

Working group structure of FG-ML5G

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.

Working group structure of FG-ML5G

Scope WG2

- This working group will investigate how to collect, prepare, represent and process data for ML in the context of communication networks, including the study of privacy and security implications on data formats and ML techniques.
- It 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).
- It will engage in the categorization of ML algorithms used in communication networks such as the categorization of how different ML methods (e.g., neural networks, unsupervised methods, reinforcement learning) fit to different communications problems and 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 and will identify standardization and technology gaps and create liaisons with related activities in other organizations.

Working group structure of FG-ML5G

Specific questions to be addressed by WG2 include:

- How should data be collected, prepared, represented and processed for ML in the context of communication networks?
- What are the privacy and security implications on data formats and ML?
- Categorization of ML algorithms in the context of communication networks, i.e., how do different ML methods fit to different communications problems?
- 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)?
- What are the standardization and technology gaps?

Working group structure of FG-ML5G

Tasks for WG2 include, but are not limited to:

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

Deliverables:

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

Working group structure of FG-ML5G

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.

Working group structure of FG-ML5G

Scope of WG3:

- 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:

- What are the implications of ML (including distributed ML) on network architectures?
- 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)?
- What are the standardization gaps?
- What are the liaisons activities?

Working group structure of FG-ML5G

Tasks of WG3 include, but are not limited to:

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

Working group structure of FG-ML5G

Relationships of WG3 include:

- 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)

Future Plan of FG-ML5G

Following the kind invitation of the China Academy of Information and Communications Technology (CAICT), the government of the Xi'an high-tech district and ZTE, the 2nd meeting of FG ML5G will take place on Tuesday 24, Thursday 26 and Friday 27 April 2018. A workshop will take place on Wednesday 25 April 2018. The venue for the focus group meeting and the workshop is Xi'an (China).

Africans are therefore requested to attend this second meeting which is taking place in an industrial set-up of China

Future Plan of FG-ML5G

MEAN WHILE, THE RESPECTIVE WG's HAVE SCHEDULED E-MEETINGS THAT WILL LAST TILL MID APRIL 2018.

AFRICANS ARE THEREFORE REQUESTED TO CONTRIBUTE AND PARTICIPATE IN THESE E-MEETINGS

THANKS FOR YOUR KIND ATTENTION

ENGR CHARLES CHIKE ASADU

ICT/INNOVATION CENTRE, UNIVERSITY OF NIGERIA, NSUKKA

Chike.asadu@unn.edu.ng

chikecasadu@yahoo.com

+234 7061262244