Call for Speakers

Workshop on Machine Learning for 5G and beyond,

17 June 2019,

Geneva, Switzerland, 17 June 2019

Following past standard FG ML5G practice, we are pleased to announce that the next Workshop on Machine Learning for 5G will take place in Geneva, Switzerland, on 17 June 2019 at ITU premises.

We encourage diversity in our program and invite submissions on a wide array of topics that are innovative, engaging, dynamic, and informative in the area of machine learning for 5G and beyond.

To be considered as a speaker, please submit an abstract, title of your talk and short bio by **19 May 2019** to tsbfgml5g@itu.int. Authors of accepted proposals are expected to deliver their talks at the workshop in Geneva. Priority will be given to proposals that are closely related to the work plan of the focus group ML5G-I-126-R7 (attached). As customary, the Workshop will be followed by three days focus group meeting (18-20 June 2019) at the same location. Please consult the Focus group meeting website for more details.

Workshop webpage:
https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20190617/Pages/default.aspx

Looking forward to your submission!

Workshop steering committee

1. Rationale and Scope

Considering the emergence of machine learning as an area of importance and application in telecommunication networks of the future, ITU-T focus group Machine Learning for Future Networks including 5G (FG ML5G) was established by ITU-T Study Group 13 at its meeting in Geneva (6-17 November 2017). The Terms of Reference are here. The lifetime of the focus group was set for one year from the first meeting, which was held in Geneva on 30 January - 2 February 2018, with a workshop taking place on 29 January 2018. The lifetime is extensible if necessary by decision of the parent group (see ITU-T A7, clause 2.2).

FG ML5G discussed various use cases and methods for data handling for machine learning in 5G. The Technical Specification "Unified architecture for machine learning in 5G and future networks" has been sent to ITU-T Study Group 13 for further action: FG ML5G requests that ITU-T SG13 consider progressing and consenting this Technical Specification as ITU-T Recommendation in the meeting in March 2019. The use case deliverable and other deliverables are planned to be finalised by FG ML5G in its final meeting in Shenzhen, China on 5-8 March 2019. Liaisons have been exchanged with other ITU-T study groups and with other standards bodies to get a clearer picture of the adjoint areas of work.

FG ML5G sent a request on 19 February 2019 to ITU-T SG13 that FG ML5G be continued until WTSA-2020 (World Telecommunication Standardization Assembly), to take place in the 4th quarter of 2020.
If continued, the work of FG ML5G would have the objectives and deliverables as outlined below, based on these guiding principles:

- Broaden the use cases to include new domains, e.g. Precision farming, nomadic networks, campus networks, customer experience and behaviour driven network optimization. Extend or prove the design principles and current architecture in the context of such new domains, especially to solve specific problems, e.g. automated planning, deployment and configuration. Collaborate on open guidelines, tool sets and framework needed for such new use cases, while keeping the deployment options flexible.

- Develop ML-aided and ML-enabled networking functionalities

- Produce influence and impact for the work done so far, through its adoption by various SDOs and entities. Reuse the ITU-T Recommendation on the architecture for machine learning in 5G and future networks as a common language across the underlying technologies to enable corresponding machine learning use cases. E.g. targeted solutions which addresses specific "pain-points" for integrators and operators.

- Niche differentiation and continuation of gap analysis from other SDOs or forums. Potential collaboration with other UN bodies e.g. FAO (Food and Agricultural Organization of the United Nations) or industry bodies which provide relevant use cases, corresponding data characteristics and deployment models, address the needs of communication networks and

verticals, reusing the ML pipeline architecture as foundation, allows parallel evolution of optimization algorithms and communication technologies by defining clear interfaces. By focusing on specific aspects (e.g. planning|deployment|configuration) of certain possible deployments (e.g. Connected-Agriculture, campus networks, ML at the edge), but developing generic solutions and standard architectures, we aim to solve practical problems and develop inter-operable standards in the process, provide a mechanism (ML Function orchestration) to separate out the ML use case, functionality management from the resource management at the underlay.

The focus group would play a role in providing a platform to further study and advance the various ML approaches for future networks including 5G.

2. Objectives of the FG ML5G

The objectives include:

- Adoption: To help ITU-T study groups and entities with adoption of inter-operable ML overlay in future networks including architecture, interfaces, protocols, security and protection of information; this includes:
    - Gap-analysis: To study, review and survey existing technologies, platforms and features (e.g. with respect to specific deployment scenarios like connected-farming, nomadic networks or Industrie 4.0, study the characteristics of source, sink, applicable models to solve specific problems like self-organizing, optimization, configuration, healing, so that for these specific deployments, ML overlay can be applied in a standard manner).
    - To propose mechanisms for reuse of ML pipeline, come up with guideline for adoption customized for technologies, while keeping in mind the essence of commonality within the FG work of ML pipeline.
    - (E.g. while the deployment scenarios differ, develop the solutions standard, which can be applied in the operator world, especially in the context of small cells like in 5G. The deployment scenarios would give us a valuable proof and adoption points for such standard solutions for, say, ML-based self-operation of networks).
    - To define technology specific interfaces (for source and sink) where applicable.
    - In a future network, we expect more and more disintegration and commodization of network components. Such network components could be used for multiple deployment scenarios by integrating them (using intelligence), but this will need specific capability/configuration exposure functions. By defining specific APIs and interfaces where applicable, we enable futuristic ML-based operation of networks.

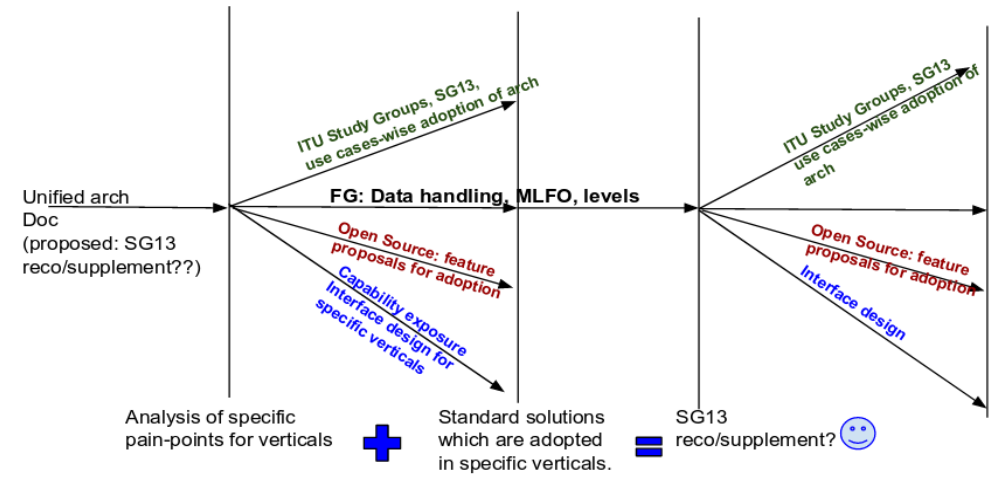

Fig 1: work split and impact

- Conformance of ML functionalities, datasets, in the network.
- To create an environment for development and deployment of ML services on future networks. Standards and interoperability form the key to achieving this. This includes:
    - To develop enablers for rapid adoption of ML services and their evolution independent of underlying technologies. E.g. standard mechanisms for 3rd parties to develop ML services, standard mechanisms for NOP to evaluate the ML Intelligence level.
    - To enable an environment of model-vendors/NOP/integrators/verticals using the ML pipeline overlay. E.g. Standard chaining mechanisms between verticals, NOP NF, Transport SDN nodes for achieving E2E ML use case like RCA (Root Cause Analysis).

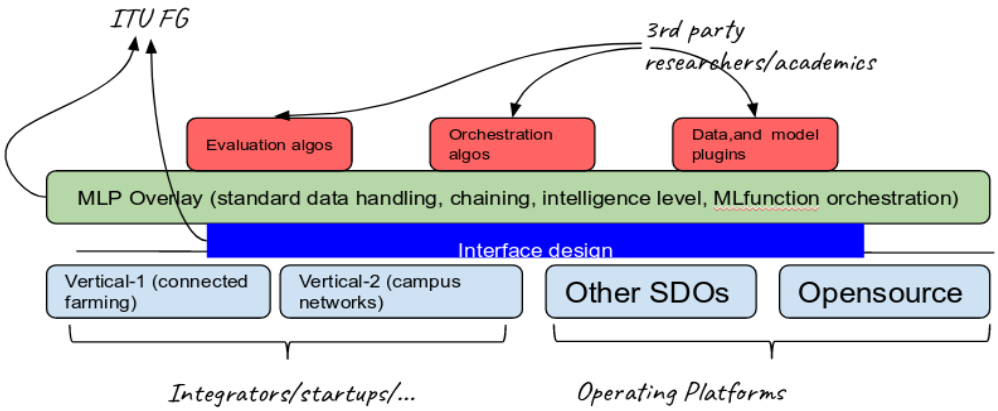

Fig 2: Ecosystem

    - To enable a smooth selection of ML mechanisms or models based on the use case /specification.
- Cross-domain approach: heterogeneous networks, platforms and solutions of future networks demand a cross-domain approach for optimal benefits from ML. This includes:

- Study and develop inter-domain, standard interface (by ITU) between ML mechanisms hosted in various domains.

- Futuristic ML: characteristics and management of ML services has to be in tune with future networks, e.g. Automation and monitoring: ML cannot come in between end-user, NOP and experience. These include:
  - Study the need for orchestration mechanisms for ML in future networks.
  - Interfaces between Platform, Infra, Software, and ML
  - Study the monitoring mechanism of ML on the network for impacts on E2E service.
  - Study the impact of future service composition and deployment on ML (e.g. chaining).
  - Enable ML mechanisms which are technology-agnostic but "opportunistically-aware": e.g. Resource status, scaling decisions, accelerator availability, compression. Evolve from current centralized and best-effort ML mechanisms (where training data is collected in batch, pre-processed and fed to a black box ML solution) to approaches which can cope with channel and network dynamics and limited data generated at the edge.
- Evaluation: intelligence levels which are currently discussed under the network and service terminologies should be broadened to include more aspects of future networks. These include:
  - Considering that NS (Network Slice) providers may play an important role in future networks, study the evaluation of supporting capabilities of the NS (Network Slice) from the ML mechanism itself.
  - E.g. query, update and management of ML at slice level, separate from its core functionality (but related to ML use case that it expects/supports).
  - Evolution of NS in the intelligence scale may be studies, e.g. NS may expose unstructured/new data based on its evolution.
  - Study the capability discovery/evaluation/evolution/mutation of NS with respect to ML use cases.
  - Consideration of technical requirements based on operator guidelines.

3. Specific Tasks and Deliverables

- Deployment and application scenarios (WG1):
  - Gap-analysis: Study and identify ML related gap-analysis for use cases and deployment scenarios, including general-purpose and domain-specific applications such as precision farming, C-V2X, smart factory, smart and connected community collaborating with system integrators and domain experts in any specified domain.
  - Identification of ML-aided and ML-enabled networking functionalities
  - Identification of networking and computing entities, interfaces, and data flow (collaborating with WG2) to accomplish these networking functionalities
  - Identification of requirements of ML-enabled services and applications utilizing the network, and their potential impacts for the evolution of future networks

- **Data management for ML (WG2)**
    - Propose ITU-T Recommendation for data flow and model management framework: Study data formats, data collection, transfer, storage, pre-processing, and post-processing mechanisms, and constraints (including privacy, security, and time requirements) both for collected and synthesized data
    - Study of reference ML methodologies: Realizing ML algorithms as an implementation issue out of the scope of technical specifications, online ML, offline ML, and cooperative and/or collaborative ML mechanisms will be explored and exploited to achieve target networking functionalities based on the datasets for benchmarking, while the develop ML network architecture in WG 3 can accommodate all ML methodologies.
    - Study data sharing framework for operator-hosted datasets which can be used by 3rd party models. We will also take into account privacy requirements.

- ML-aware network architecture (WG3)
    - **Propose Network Architecture Recommendation**: to allow inter-operability of networking and computing entities, harmonization of networking and computing resources for ML operation and network operation. It may include studying
        - interfaces between network orchestrator and MLFO
        - requirements on mapping intent of an ML application using a meta-language
        - ML-aided/enabled network architecture
    - **Recommendation for intelligence levels**: Develop standard mechanism for evaluating intelligence across the domains or services.
    - **Propose ITU-T Recommendations/Supplements** on the following areas:
        - general-purpose and domain-specific scenario deployments
        - open source compatibility
    - **Market place integration**: 3rd party vendors may provide models in the “market place”, telecom vendors may build ML supporting capabilities in the NF (Network functions).
    - **Study of Sandbox framework** for integration of training, monitoring, testing and update of ML services

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