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## ITU Global Challenge on AI/ML in 5G networks

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### 1. Executive Summary

Artificial Intelligence (AI) will be the dominant technology of the future and will impact every corner of society. In particular, AI will shape how communication networks, a lifeline of our society, will be run. Many companies in the information and communication business are exploring how to make best use of AI. ITU has been at the forefront of exploring how to make best use of AI/ML (machine learning) in future networks including 5G networks<sup>1</sup>.

The time is right to bring together the technical community and stakeholders to brainstorm, innovate and solve relevant problems in 5G using AI/ML. Building on its previous work, ITU is looking for partners and sponsors to conduct a global AI/ML challenge on the theme “How to apply ITU’s ML architecture in 5G networks”. Participants will select use cases [e.g. [ITU-T Supplement 55](#)] and apply ML techniques to such use cases in 5G networks. The challenge will span over a nine months period in 2020. See clause 9 below for understanding the different roles for various entities in this challenge.

The challenge would have multiple tracks (e.g. Students-track, Secure-track, ML@Edge-track, Enablers-track, Social-good-track, and Verticals-track). Different security levels to access training and testing data would be offered to accommodate privacy issues: a secure-track would make sure isolated, segregated sandboxes and best-practices are in place for secure data handling. The ML@Edge-track and the Enablers-track will make sure that the end-to-end 5G solutions are covered and not just the ML models. The Verticals-track allows the combo of verticals (e.g. Manufacturing, automotive) and 5G to exploit the green-field opportunities for AI/ML applications. A separate track for solutions is aimed to provide socially relevant applications (“AI for Good”) in 5G using AI/ML. Preliminary results; could be showcased or pitched during the “AI for Good Global Summit” in Geneva, 4-8 May 2020 (<https://aiforgood.itu.int/>). See clause 4 for detailed description of the tracks.

<sup>1</sup> 1. Recommendation ITU-T Y.3172 “Architectural framework for machine learning in future networks including IMT-2020”

2. Recommendation ITU-T Y.3173 “Framework for evaluating intelligence level of future networks including IMT-2020”

3. Recommendation ITU-T Y.3174 “Framework for data handling to enable machine learning in future networks including IMT-2020”

4. Supplement 55 to ITU-T Y.3170-series “Machine learning in future networks including IMT-2020: use cases”

A unique feature of this challenge would be that mentoring will be offered to participants from the students track.

Participants in the global challenge would gain hands-on experience related to AI/ML and concepts related to future networks. Another key value-add would be alignment of open source with standards – application of standard based ML mechanisms in 5G would be encouraged in open source as part of this challenge. The best solutions will battle it out during a global conference in the host country. ITU would offer the host-nominated participants a tailored two-week onsite course twice in 2020 to enhance their skill sets in this domain.

The challenge will consist of two rounds: the first round is conducted in regions/countries. The best projects in each region will advance to the second (global) round. The best projects of the second round will be invited to a global conference – to be conducted in the host country – to determine the final winners.

The global conference which coincides with the prize-giving ceremony will put the host country at the centre of the AI/ML challenge. This will provide an opportunity for the host country to engage with the best minds in AI/ML in this domain. A hackathon collocated with the conference will boost the innovation levels of the host ecosystem. Dovetailing of the winning ideas and follow-ups will make sure that the impact to the host is long-lasting.

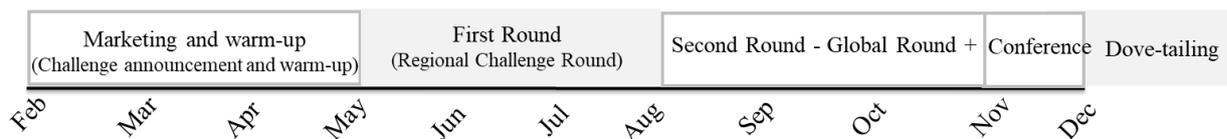
## 2. Timeline

The challenge will be announced in February 2020. The actual challenge would run for a total of nine months and include two rounds.

The final winners will be announced at the global conference gala ceremony by official delegates of the host country.

A post-conference brainstorming including host delegates to dovetail the solutions, findings and innovations to various areas of the host country would follow.

The timeline of the global challenge is outlined below;



## 3. Demand

There will be strong demand by network operators to master the application of ML in networks. Neither today's nor the up-and-coming 5G networks are designed to make best use of ML. However, every company in the networking business is investigating the introduction of ML in order to optimize network operations, increase energy efficiency and curtail the costs of operating a network. ML will enhance network management and orchestration and make predictions to optimize network operations and maintenance. This optimization is becoming increasingly challenging and important as networks gain in complexity to support the coexistence of a diverse range of services. Network operators aim to fuel ML models with data collected from multiple technologies and at different levels of the network. They are calling for deployment mechanisms able to 'future-proof' their investments in ML. They also need interfaces to transfer data and trained ML models across ML functionalities at multiple levels of the network.

#### 4. Detailed Description

A global challenge will be held by ITU to apply Artificial Intelligence (AI) or Machine Learning (ML) techniques to solve relevant problems in 5G networks. The challenge is open to participants from member countries of ITU and will have multiple tracks: Students-track, Secure-track, ML@Edge-track, Enablers-track, Social-good-track, and Verticals-track.

NOTE- regional partners may tune the tracks according to local requirements and sensitivities.

The details of each track are described below:

<b>Track name</b>	<b>Description</b>
Students-track	<p>Participants in this track would be students from various universities around the world. They can register and form teams comprising of 1-4 members. They need to be registered students at any university in a member country of ITU at the time of registering for the challenge. Experts from ITU will mentor students on problems, providing guidance, and good practices for participation in this challenge.</p> <p>This track allows students across the world to network and compete with each other.</p>
Secure-track	<p>For most industry stakeholders like network operators and vendors, network data is sensitive and cannot be shared on an open platform. However, this type of dataset is important for inference using ML in 5G networks.</p> <p>The secure-track will provide isolated, segregated sandboxes and best-practices for secure data handling. Different security levels to access training and testing data would be offered to accommodate privacy issues.</p> <p>Thus, this track will allow the design and implementation of ML models using data from operators by experts from network operators, ML researchers, and data scientists (with talented multi-disciplinary researchers from academia).</p>
ML@Edge-track	<p>This track is designed considering the importance of distributed, edge computing based AI/ML solutions that require low latency, high reliability, and fast decision-making. When AI/ML is used for use cases such as detection and prediction, it is expected that inference will be done in near real-time, in a distributed architecture.</p> <p>In this track therefore, participants will build, train and deploy ML models for edge devices (to develop efficient machine learning algorithms that can run on severely resource-constrained edge and endpoint devices). Problem statements and data sets will be geared towards the challenges of distributed ML in the edge e.g. optimization techniques, distribution mechanisms, federated learning mechanisms etc.</p>
Enablers-track	<p>ML models alone are not sufficient to integrate intelligence in future networks. Training, evaluation, deployment, inference, and application of ML output in the network requires enabling technologies and tools in the network. An end-to-end solution may therefore comprise of an ML model, a set of APIs, data, metadata and other resources to realize the full capabilities of the models in a network.</p>

	In this track, participants will design and implement toolsets that can help in an end-to end implementation of ML model deployment in a real network. These toolsets consist of APIs, metadata, and other software such as Adlik, Acumos, ONAP, O-RAN OSC.
Verticals-track	<p>5G network will enable a new era of mobile Internet of Everything. This will facilitate the evolution of business models and is expected to create economic value. The integration of 5G with other technologies will transform business models and industry applications.</p> <p>In this track, participants will apply ML/AI in 5G networks to other verticals such as manufacturing, education, health, public safety, transportation/automotive, finance, government, retail, agriculture, energy, smart cities, and media and entertainment. This track allows the combo of verticals and 5G to exploit the green-field opportunities for AI/ML applications. The key drivers of implementing 5G within these industries are the potential revenue growth opportunities for mobile operators and new business models.</p>
Social-good-track	<p>One of the flagship events of ITU in collaboration with other UN bodies is The AI for Good summit. It aims to bring forward Artificial Intelligence research topics that contribute towards more global problems, in particular through the Sustainable Development Goals (SDGs). This is done in order to find practical applications of AI and support strategies to improve the quality and sustainability of life on our planet. The summit continues to formulate strategies to ensure trusted, safe and inclusive development of AI technologies and equitable access to their benefits.</p> <p>In this track, participants/teams will identify and solve problems whose solutions are aimed to provide socially relevant applications (“AI for Good”) in 5G using AI/ML. Some examples of the solutions are advancing education, healthcare and wellbeing, social and economic equality, space research, and smart and safe mobility. Selected teams will be invited to participate in the AI for Good Summit in May 2020.</p>

The salient features of this challenge are the following:

- **Include:** A worldwide call for participation will be sent out to all ITU members and partners. Participation is open to all interested parties.  
NOTE- For the students track (clause 9), participation is open only to students who are registered at any university at the time of registration to the challenge.
- **Energize:** Multiple levels of competitions are planned, to build up excitement and engagement. Over a period of nine months, the teams will compete first on a regional basis. The winners of this round will move to the global round and the best from there will compete for the global prize to the tune of USD 50’000 during the conference in the host country.
- **Solve:** Participants will be able to solve real world problems (including those with social relevance), based on standardized technologies developed for ML in 5G networks. Teams will be required to enable, create, train and/or deploy ML models (such that participants will acquire hands on experience in AI/ML) in areas relevant to 5G.

- **Collaborate:** Wherever applicable, outcomes of the global challenge will be encouraged to be shared in open forum as an open source project. This will enable industry stakeholders and member states to access the outcomes of this competition and collaborate with teams in their domains (Collaborating is a good way to win too! Scores may be awarded for teams which enable solutions for other participants). This also aims to fulfill one of the important goals of encouraging (ITU) standard based open source implementations.
- **Support:** ITU will support the participants with resources needed for the challenge including access to published documents, standards and guidance.
- **Hack:** A separate hackathon may be available for students selected for the conference, with host-selected themes. Mentoring may be extended to include this hackathon.
- **Learn:** ITU will provide a mentoring program to host-nominated participants and those in the students-track of the AI/ML challenge in order to enhance their skills and understanding of applicant of AI/ML in 5G.
- **Win:** winners from each regional round will advance to the global round. Winners from the global round will be invited for the conference where the final winners would be announced. Criteria for selecting winners from each round and in the conference and the prize money will be published by the Challenge Management Team.

## 5. Conference

To mark the conclusion of the challenge, a global conference will be organized in the country of the host. The aim of this conference is many-fold:

- **Climax:** the conference will mark the end of the nine-month period of preparation and competition by the participants. The best proposals from regional rounds will advance to the global round, from where conference entries may be chosen, making sure that the conference will be attended by the crème de la crème.
- **Spotlight:** Demonstration and presentations from participating teams who have passed through the regional challenges.
- **Edu-fun:** Lectures, presentations and tutorials from ITU/UN experts and partner organizations covering all aspects of technology. It will bring together teams, mentors, sponsors, and partners to share knowledge and experience during the competition. Hackathon session for students will lead to interesting solutions to practical problems.
- **On-track:** Multi-track sessions to cover various domains e.g. verticals, networks, ML methods.
- **Work:** Workshops specifically for students to collaboratively solve problems.

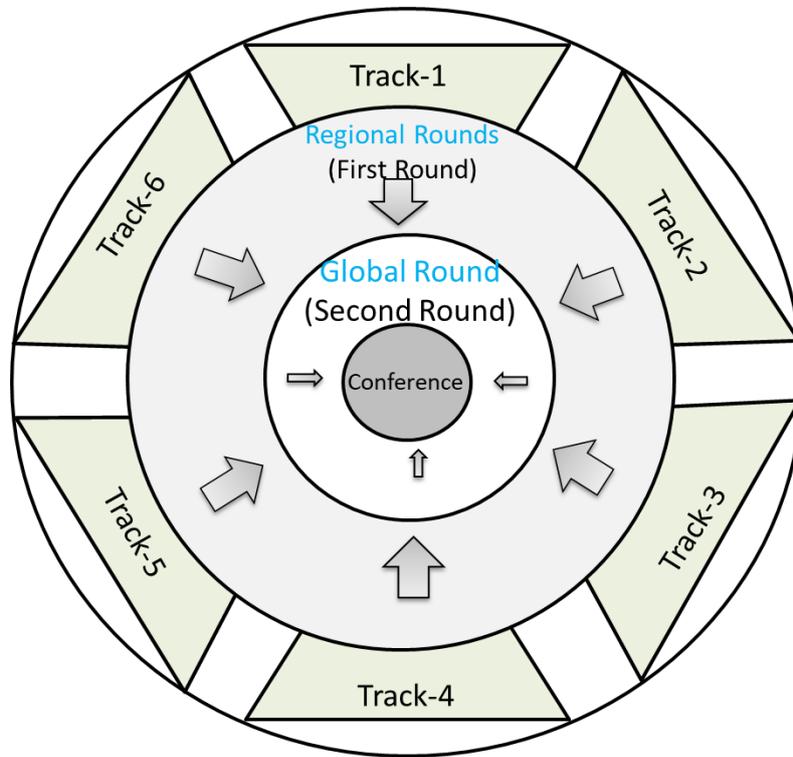


Figure: The format of the challenge

## 6. Data privacy policy

Use case description (according to Supplement 55 to ITU-T Y.3170-series “Machine learning in future networks including IMT-2020: use cases”) will be scrutinised according to policies and regulations. Data may be pre-processed and provided only using pre-published APIs, and may be secured using login/token. Data handling APIs (according to ITU-T Y.3174) will be provided based on the use case and filtered based on organization policies. Data anonymization may be applied according to policies and regulations. Non-disclosure agreement (NDA) may be included in the terms of participation. Challenge may be local, where applicable, according to policies and regulations, but the results of the challenge, without including local user data, may be presented in the form of a competition paper. API access to data shall be monitored and licensed based on agreement. Some test data set may be private and will not be disclosed.

In addition, the “Secure-track” of the challenge allows participants to isolate their data into private sandboxes (see ITU-T Y.3172). Access to this data may be restricted on role-basis and need-basis. Secure data-handling techniques (see ITU-T Y.3174) would be put in place for the “secure-track”.

## 7. Resources

Following resources may be set up by the Challenge Management Team (CMT) for smooth operation of this initiative.

NOTE- this will be setup in collaboration with all entities mentioned in clause 9.

- Mentor panel: a panel of mentors from ITU experts, this would have representation from all regions.
- Links to software: Adlik, ONAP, O-RAN OSC Resources, Acumos (based on partner support).

- Cloud Credits (Google, Amazon etc): sponsored by the platinum, gold or silver sponsors.
- Tool sets and APIs from partners: setup by sponsors.
- Challenge Website: ITU to provide
- Datasets:
  - hosted in contest platforms : provided by sponsors, partners and collaborators.
  - open datasets from Kaggle, AICrowd, OpenML
  - Simulated datasets from collaborators.

## 8. Output format

The challenge participants may produce the following as output:

- Demo video (short, can be uploaded to the challenge website)
- Demonstration explaining the concept and solution using AI/ML in 5G.
- Brief paper explaining the problem and solution, with a section explaining the relationship to standards e.g. ITU-T Y.3172, Y.3173, Y.3174, Q.5001 and partner resources.

In the case that the output will be shared as open source, the following deliverables from participants will be proposed;

- Final version of the code;
- Reproducibility: we recommend participants to create a docker image which contains all dependencies and environments required for the algorithm to run;
- ReadMe file which contains description of the algorithm;
- Minimum system configuration required to run the algorithm;
- Details of any Data used to train the model (metadata);

## 9. Roles for various entities in the Challenge

The ITU Global Challenge comprises of different entities. The potential roles for various entities are described below:

NOTE- it is possible for one entity to assume different roles simultaneously (unless there is a conflict of interest).

Role name	Description
Host (Platinum sponsor)	<p>This entity hosts the conference at the end of the challenge. Conference is explained in clause 5 above.</p> <p>The host will be the platinum sponsor for the challenge – sponsoring the conference as well as the global round of the challenge.</p> <p>NOTE- ITU may design the website for global round and conference and other promotional material in coordination with CMT and the host.</p> <p>NOTE- sponsorship from the host may cover part of the travel and lodging for the participants of the conference.</p>
Gold sponsor	<p>This entity sponsors one or more tracks in the regional rounds and/or global round. There could be many Gold sponsors in</p>

	<p>various regions based on the nature of the regional rounds and interest of the regional partners.</p> <p>NOTE- sponsorship from the gold sponsor may cover part of the travel and lodging for the participants of the conference.</p>
Silver sponsor	<p>This entity sponsors prizes in individual tracks, e.g. \$\$ for the best entry in use of AI/ML for network management. There could be many silver sponsors in various regions based on the nature of the regional rounds and interest of the regional partners.</p>
Regional partner	<p>This is an umbrella body (in some cases an organization - such as a Regulator, SDO, etc) which coordinates and runs the regional round.</p> <p>The regional partner will arrange sponsorship, resources and coordinate with local entities on problem statements, datasets, and how to run the challenge within the ITU timeline. The partner will setup a local management committee with local entities such as operators, vendors, companies and universities in the country.</p> <p>Regional partners may bring the existing challenges run by various entities in the region into the fold of ITU AI challenge while keeping in mind the focus of AI/ML in 5G.</p> <p>Regional partners may use local languages and practices for the regional rounds. Language of communication with the challenge management team, for the global round and the conference may be English.</p> <p>Regional partners may design the website for regional round in local language and other promotional material in coordination with CMT.</p> <p>Regional partner will host the data sets securely (within the region, in compliance with local laws and regulations for data handling and privacy) in coordination with local collaborators.</p>
Collaborator	<p>This is an organization (such as a network operator, vendor, or platform provider, companies, universities, etc) that will provide problem statements, datasets, platform to run the challenge, sponsorship, computing resources, experts etc to run the challenge.</p> <p>Collaborator can be a regional entity or global organization. In case the collaborator is a regional entity, it can work with the regional partner (discussed above).</p> <p>If the collaborator is a global body, then it can work with ITU for channelizing its membership towards various regional rounds and the global round.</p>
Participants	<p>These are individuals and companies that will participate in the ITU global challenge, providing solutions to problem sets of the challenge. The participants will register to the local challenge, choose problems depending on their interests, and provide solutions based on criteria set by the regional partner. Best teams or participants from the regions/local challenge will compete in the global round of the challenge.</p>
Challenge Management Team member (CMT)	<p>These are individuals and companies that would help to organize all aspects of the challenge including problem statements, tracks, data sets, partners, logo guidelines etc. The members of this team may be regional or global. This team will</p>

	<p>meet regularly over ITU Zoom bridge and discuss the progress of regional or global rounds. ITU will coordinate and arrange such meetings.</p> <p>CMT will design an IP policy for the challenge, including regional, global rounds and the conference in coordination with the regional partners and the host.</p> <p>The judges panel for selection of candidates from each round will be setup by the CMT (in coordination with the regional partners where applicable).</p> <p>NOTE- in case of synchronization between global and regional rounds, for problem statement and/or data, CMT will discuss and decide it e.g. mapping of regional problem statements or rounds to global round.</p> <p>NOTE- Coordination for global round will be done by CMT in alignment with regional partners. E.g. a uniform selection criteria may be defined for global round which is agnostic and unbiased towards specific details of the problem or data sets.</p> <p>NOTE- CMT may discuss the use of data sets for the global round.</p>
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## 10. Benefits for partners and collaborators

Partner organizations e.g. network operators in specific regions, may enable data and conduct regional stages of the global challenge. The ITU Global Challenge offers the partners the following:

- It provides a logical, global target for the regional challenge. This association may result in sustained interest in the regional stage due to branding, publicity and continuity to the global stage.
- Collaborative feedback from the global challenge for partners: learnings from the global and regional stages may be looped back into the partner organizations for further advancements in technology.
- Publish the results in ITU journal (subject to acceptance).

## 11. Benefits for participants

- **Shape the future:** Opportunity to define, provide inputs and shape the technologies related to AI/ML and 5G networks.
- **Create your network:** Network with ITU experts and peers.
- **Be practical:** Platform to gain hands-on experience related to AI/ML and concepts related to future networks.
- **Be known:** gain global recognition in the form of prizes, appreciation and publications of the results in ITU journal (subject to acceptance).
- **Implement your dreams:** receive support for implementing their use cases and technology ideas using software and access to platforms, e.g. cloud credits and licenses.
- **Be Social:** Solutions targeted to solving socially relevant issues may be selected for presentation and demonstration in AI for Good Global Summit 4-8 May 2020.

## 12. Special Benefits for the host

- Focussed on-site mentoring for host-nominated participants (two weeks mentoring sessions twice in 2020, conducted by ITU experts).
- Mentoring for post-processing and publishing the results in publications and standards contributions.
- Workshop presentation slots for host experts.
- Co-branding of the ITU Global Challenge and publicity.
- Dovetailing and channelling the curated output to the host organization in the form of skills, presentations, standards, open-source, and academic and industry partnerships.
- Some of the committee and panel positions for the global challenge shall be reserved for host experts.

## 13. Special Benefits for the sponsors:

- Workshop presentation slots.
- Co-branding of the challenge and publicity for specific category (based on the domain e.g. Automotive may be sponsored by a player in that industry).
- Funnelling of innovative approaches to specific problems of interest in their areas or domains.

## 14. Prize money

The first team will be awarded \$10,000 in cash (and/or computing equipment) plus a certificate, the second team awarded \$7,000 in cash (and/or computing equipment) plus a certificate, and the third team awarded \$5,000 in cash (and/or computing equipment) plus a certificate. The 4<sup>th</sup> – 10<sup>th</sup> placed teams will receive a consolation prize of \$1000 per team and participation certificates. There will be other consolation prizes for participants who will participate in the final round.

## 15. Important Dates

- 3<sup>rd</sup> February 2020 Open
  - March 2 - April 24, 2020 submission
  - May 1, 2020, notification for projects (regional rounds)
  - 4-8 May 2020 AI for social good track
  - July 24- Final submission
  - July 31- regional winners
  - October 30, global project submission deadline
  - Beginning of November: Conference and global AI/ML competition winners
-