Applying ITU's Artificial Intelligence/Machine Learning Toolset in Communications Networks

Dr Bilel Jamoussi
Chief - Study Groups Department
Telecommunication Standardization Bureau
International Telecommunication Union

Outline

1. **Challenges of applying ML in networks**

2. **ITU's ML Toolkit**

3. **ITU's AI/ML in 5G Competition**

Applying AI/ML in networks

- Networks of the future would be "Intelligent"

- But, what are the unique challenges of applying AI/ML in networks?

  - ❖ Constraints on computing resources in the network

  - ❖ Noisy and dynamic network environment

  - ❖ Which data is available? Where is data generated? Is data labelled? Can data be trusted? What is the quality of the training data?

  - ❖ Availability of domain-specific dataset – limited amount of network (operator) data available

While existing tools for AI/ML work well in, say, image processing …

… they may not work well in networks

There are unique challenges in applying AI/ML in networks. **ITU toolkits** are derived from long experience and domain expertise of our members.
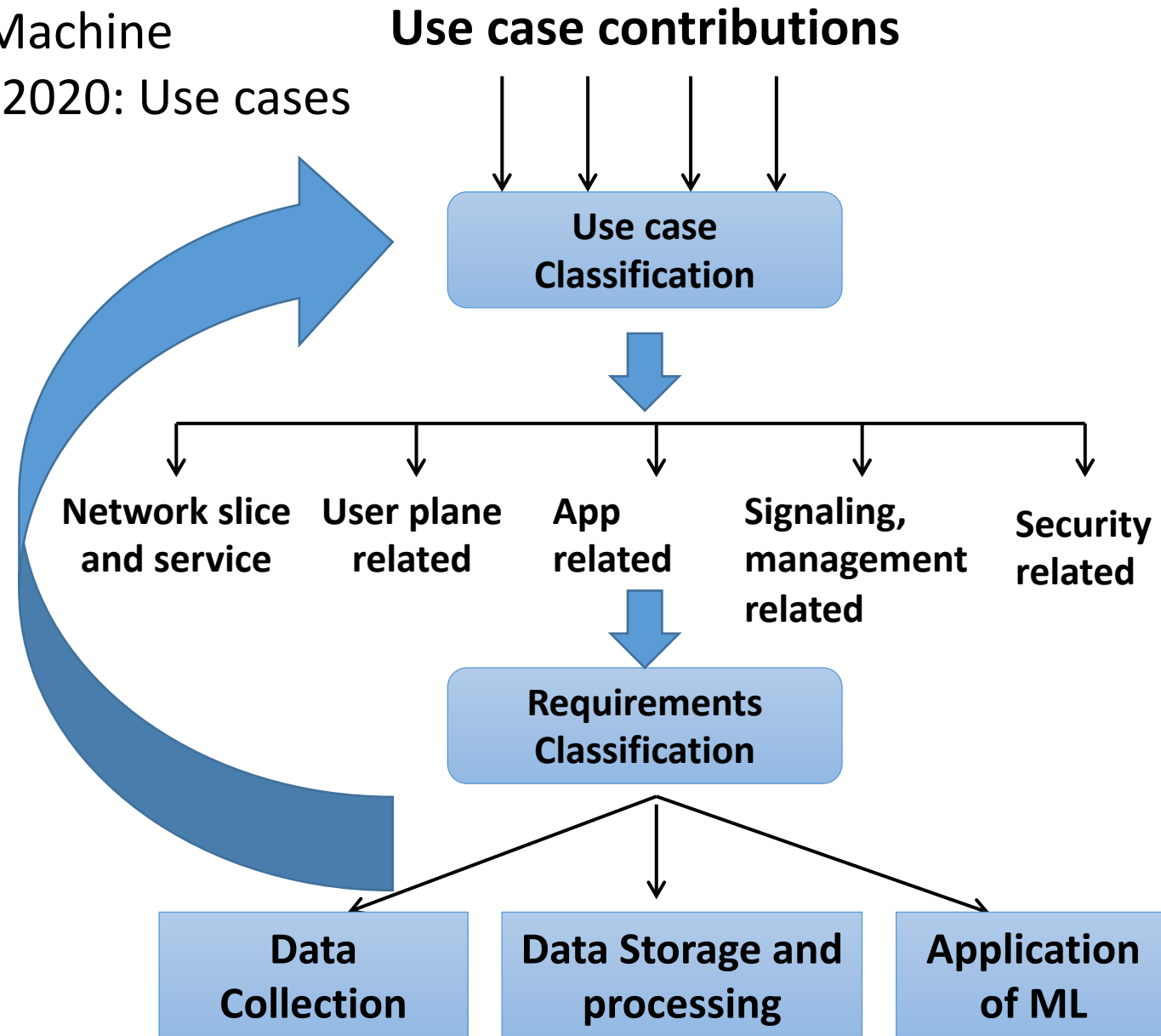
Image from https://www.freeimages.com/

Outline

1. **Challenges of applying ML in networks**

2. **ITU's ML Toolkit**

3. **ITU's AI/ML in 5G Competition**

Use Case analysis for ML in Networks

- Published: ITU-T Y.3170-series Supp 55 – Machine learning in future networks including IMT-2020: Use cases

  - Analysed more than 30 use cases

  - Requirements classified as "critical", "expected", "added value".

Collaborative and continued analysis of use cases is the need of the hour.

Use case contributions

Use case Classification

- Network slice and service
- User plane related
- App related
- Signaling, management related
- Security related

Requirements Classification

- Data Collection
- Data Storage and processing
- Application of ML

- Published by ITU as Y.3172 (Architectural framework for machine learning in future networks including IMT-2020)
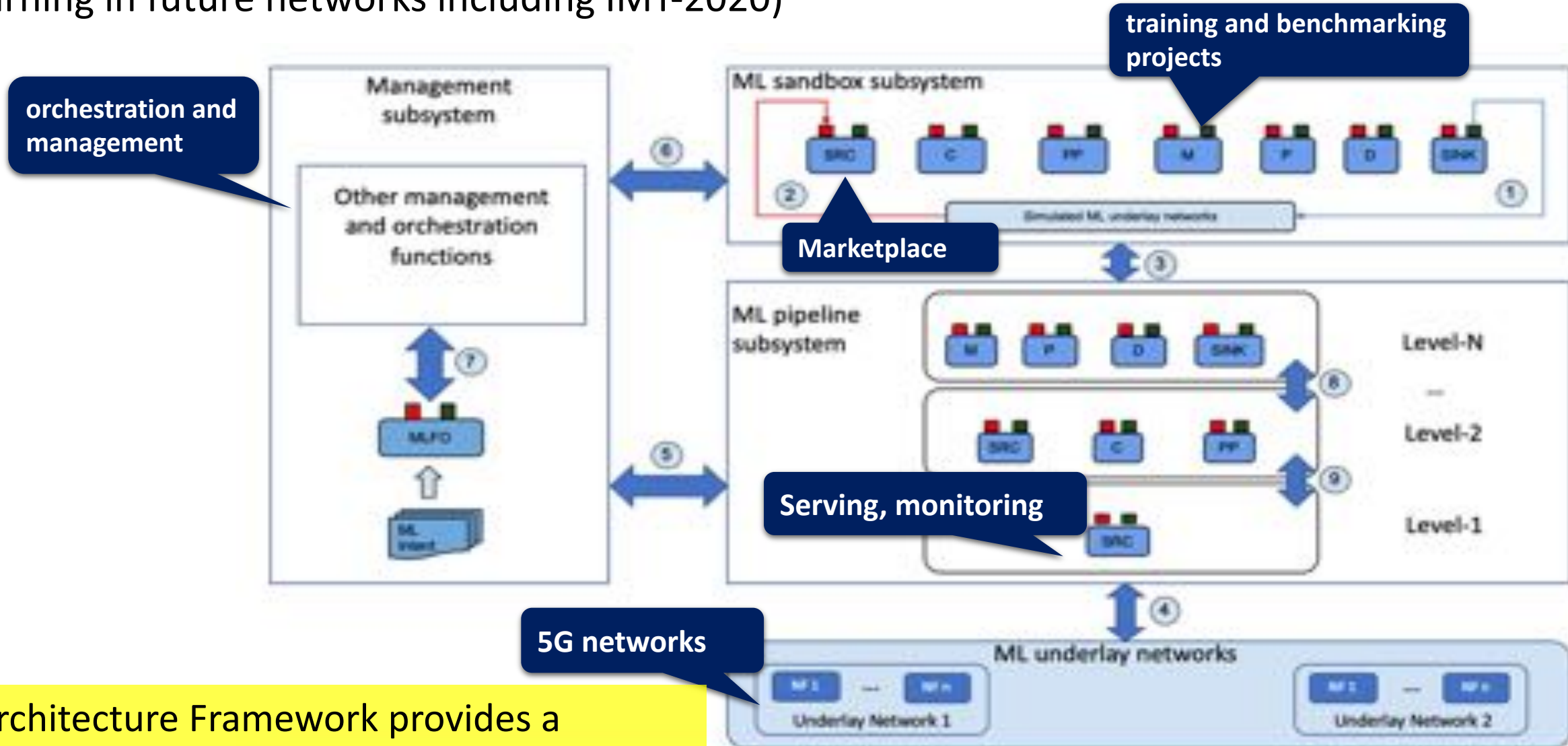

ITU's Architecture Framework provides a common language for managed ML in networks

ITU Toolkit #1: Data Handling

- Published: ITU-T Y.3174 "Framework for data handling to enable machine learning in future networks including IMT-2020"

- https://www.itu.int/rec/T-REC-Y.3174/en
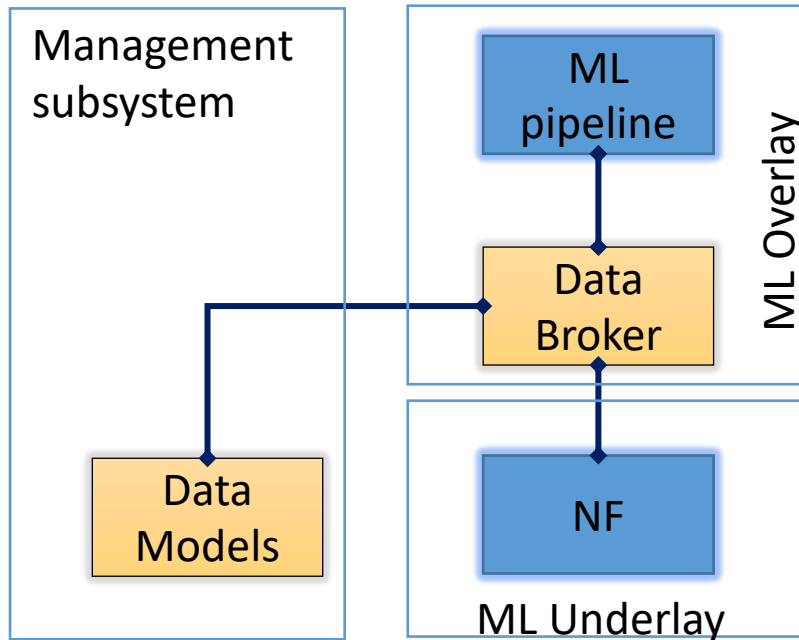
- How to handle the diversity in network data sources?
- How to handle the increased flexibility and agility in future networks?
- How to approach the different kinds of data handling requirements?
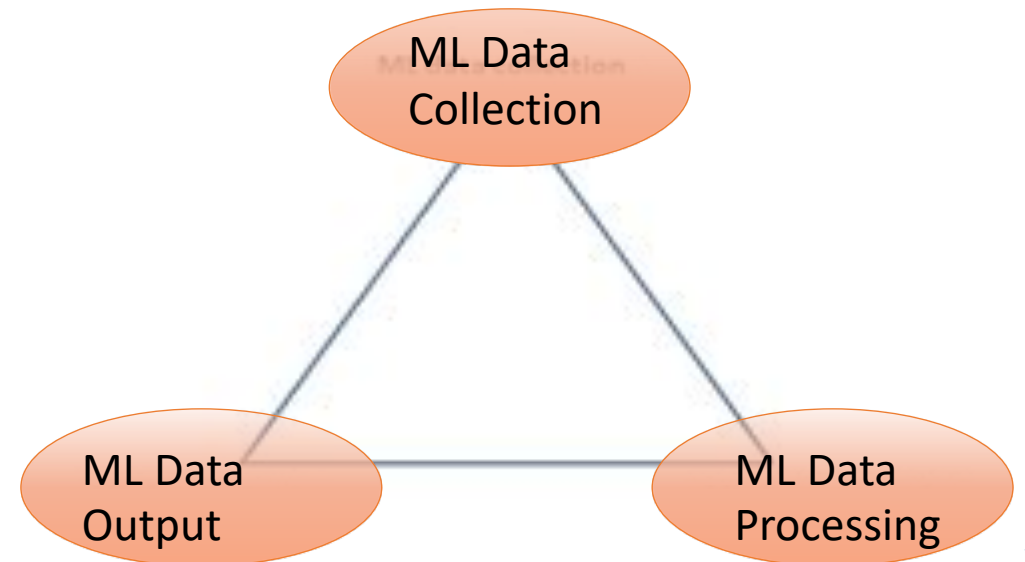
Flexible approach to handle data models for new use cases is important.
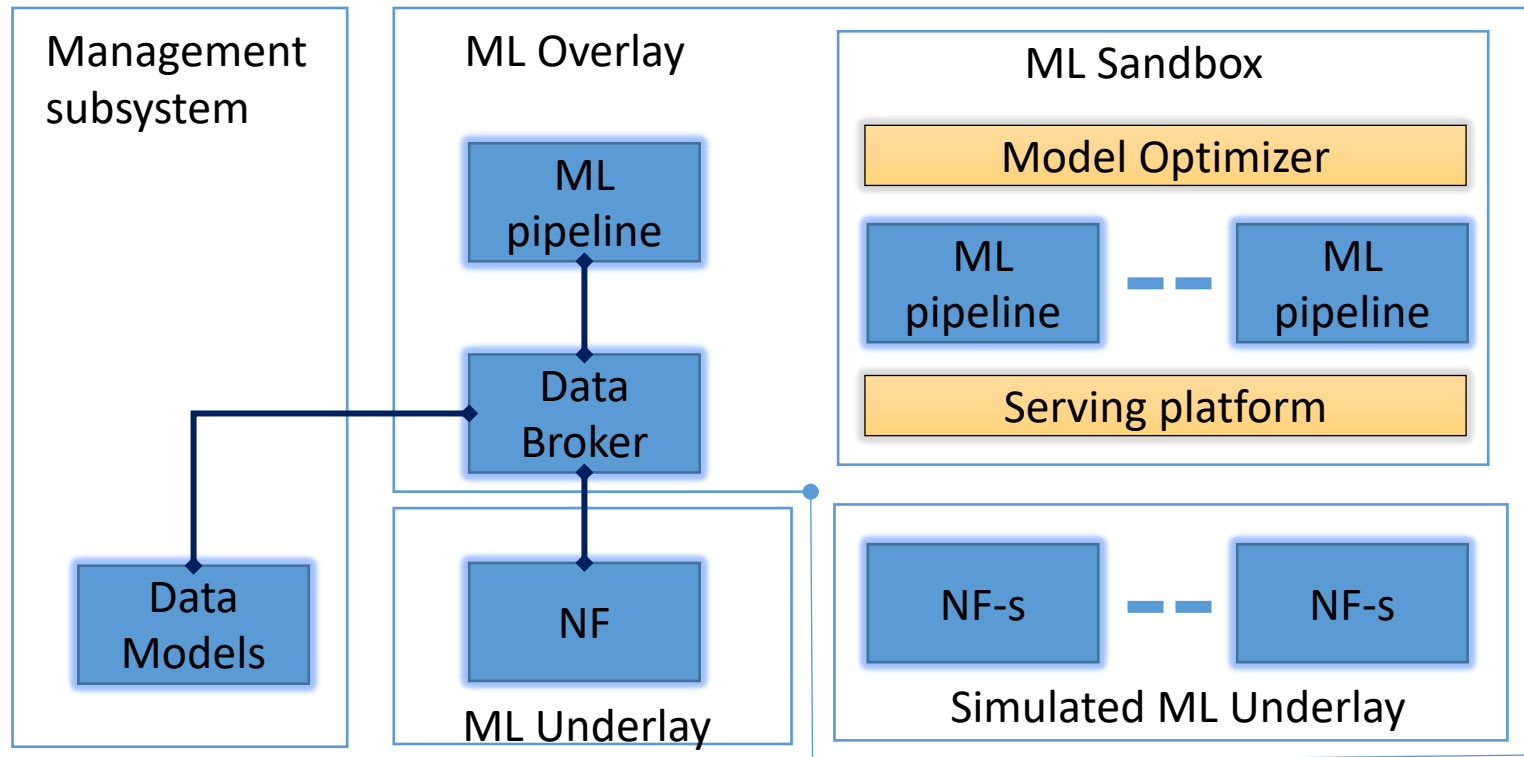
ITU Toolkit #2: ML Sandbox

- Ongoing work: Machine Learning Sandbox for future networks including IMT-2020: requirements and architecture framework
- FG ML5G output ML5G-O-035 (status: published)
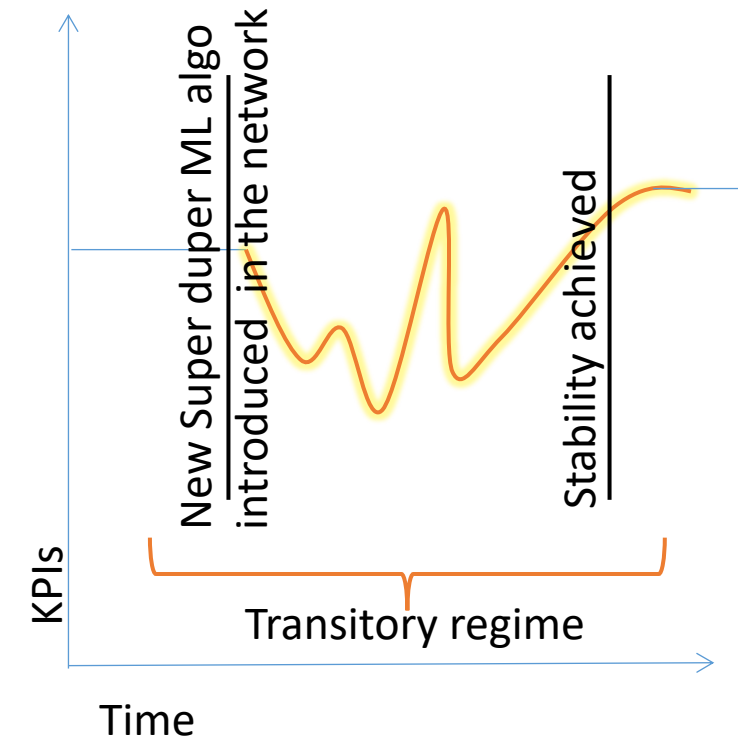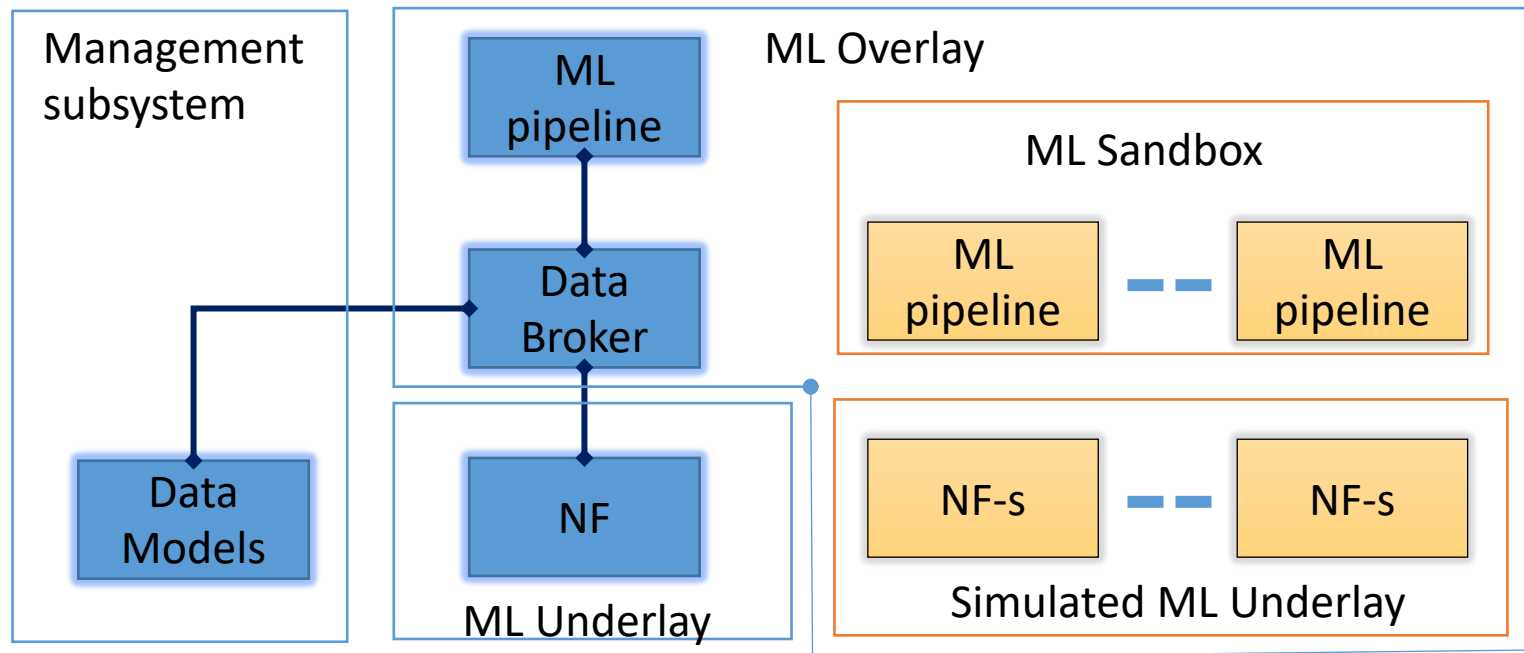
ML sandbox allows experimentation, comparison, benchmarking, testing and evaluation before the Model hits the live network

ITU Toolkit #3: Serving Framework

- Ongoing work: Serving framework for ML models in future networks including IMT-2020
- FG ML5G output [ML5G-O-036](#) (status: published)

Requirements and architecture for serving ML models in future networks including IMT-2020, including inference optimization, model deployment and model inference.

Serving framework provides platform specific optimizations, deployment preferences and inference mechanisms.

- Ongoing work: Requirements, architecture and design for machine learning function orchestrator
- FG ML5G output ML5G-O-038 (status: published)
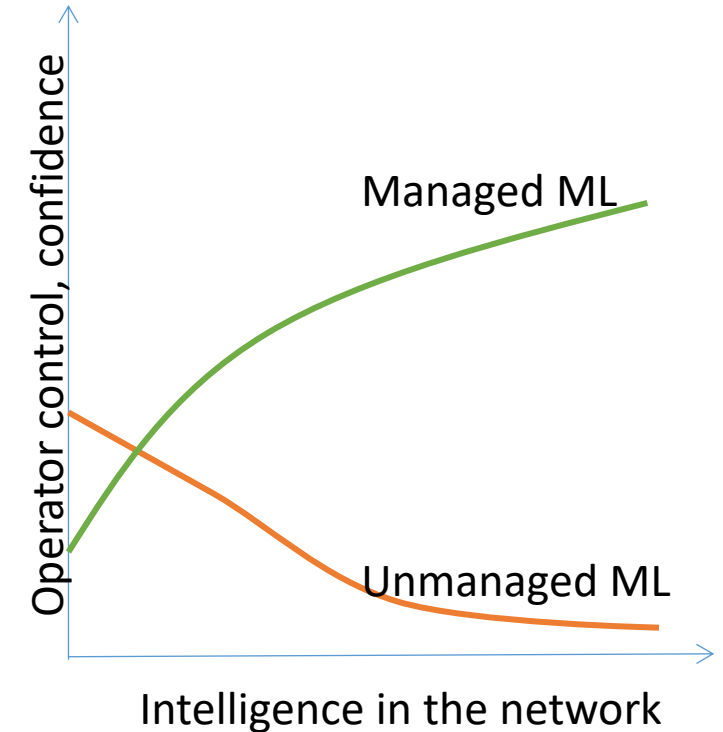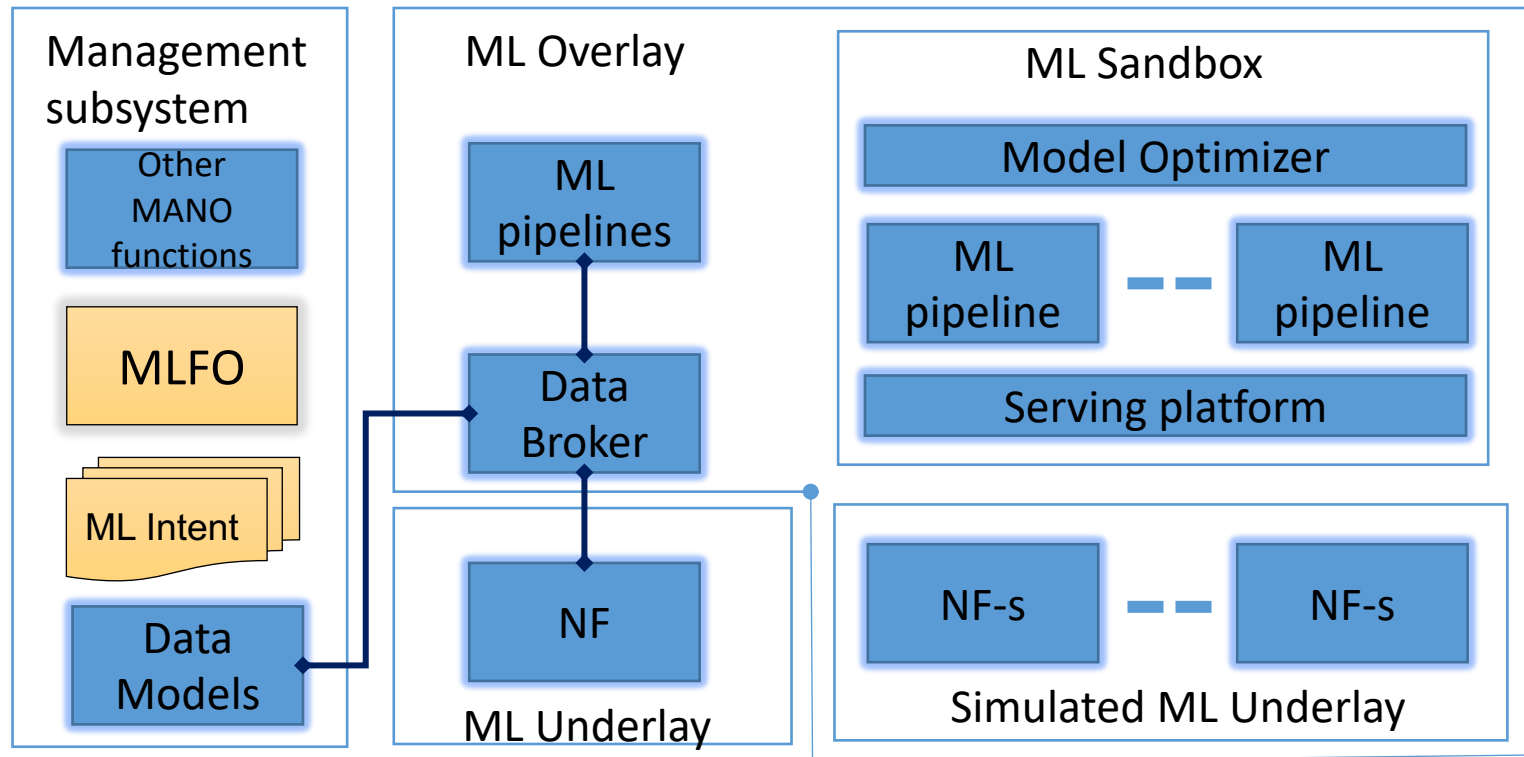
MLFO orchestrates the operation of machine learning pipeline across the network to provide a managed AI/ML integration for the operator

ITU Toolkit #5: Intelligence Levels

- Published: ITU-T Y.3173 "Framework for evaluating intelligence levels of future networks including IMT-2020"
- https://www.itu.int/rec/T-REC-Y.3173/en
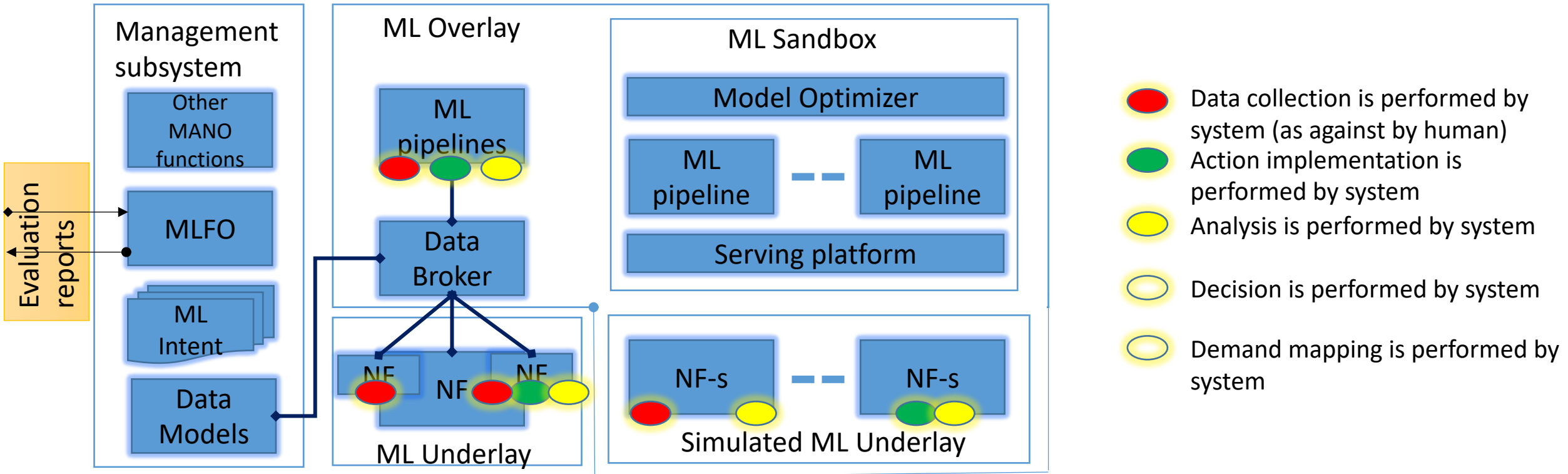
Intelligence levels helps MLFO to interoperate between different ML solutions in the network.

ITU Toolkit #6: ML Marketplace

- ITU-T Y.3176 Draft Recommendation: ML marketplace integration in future networks including IMT-2020 (under ITU review)
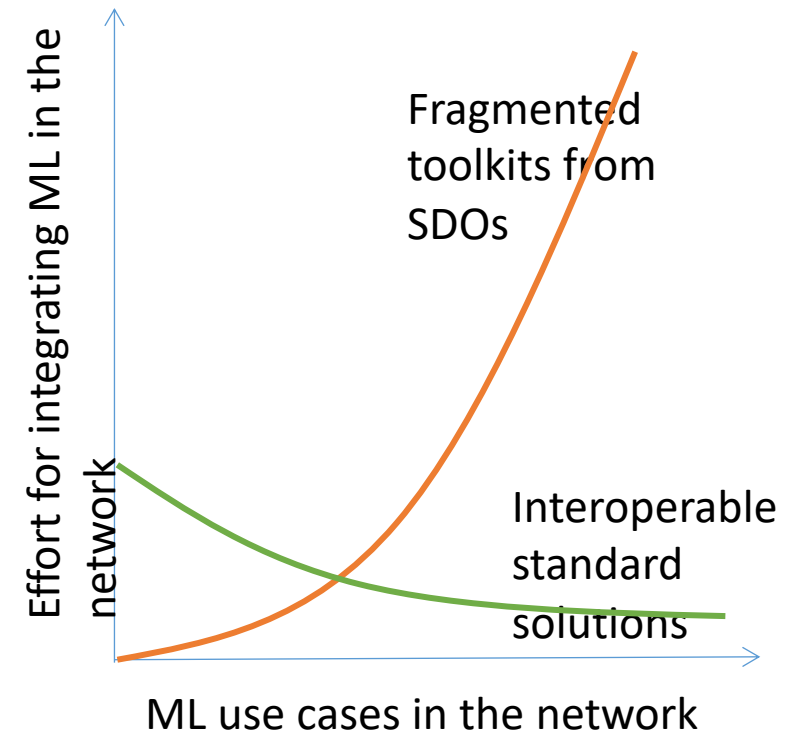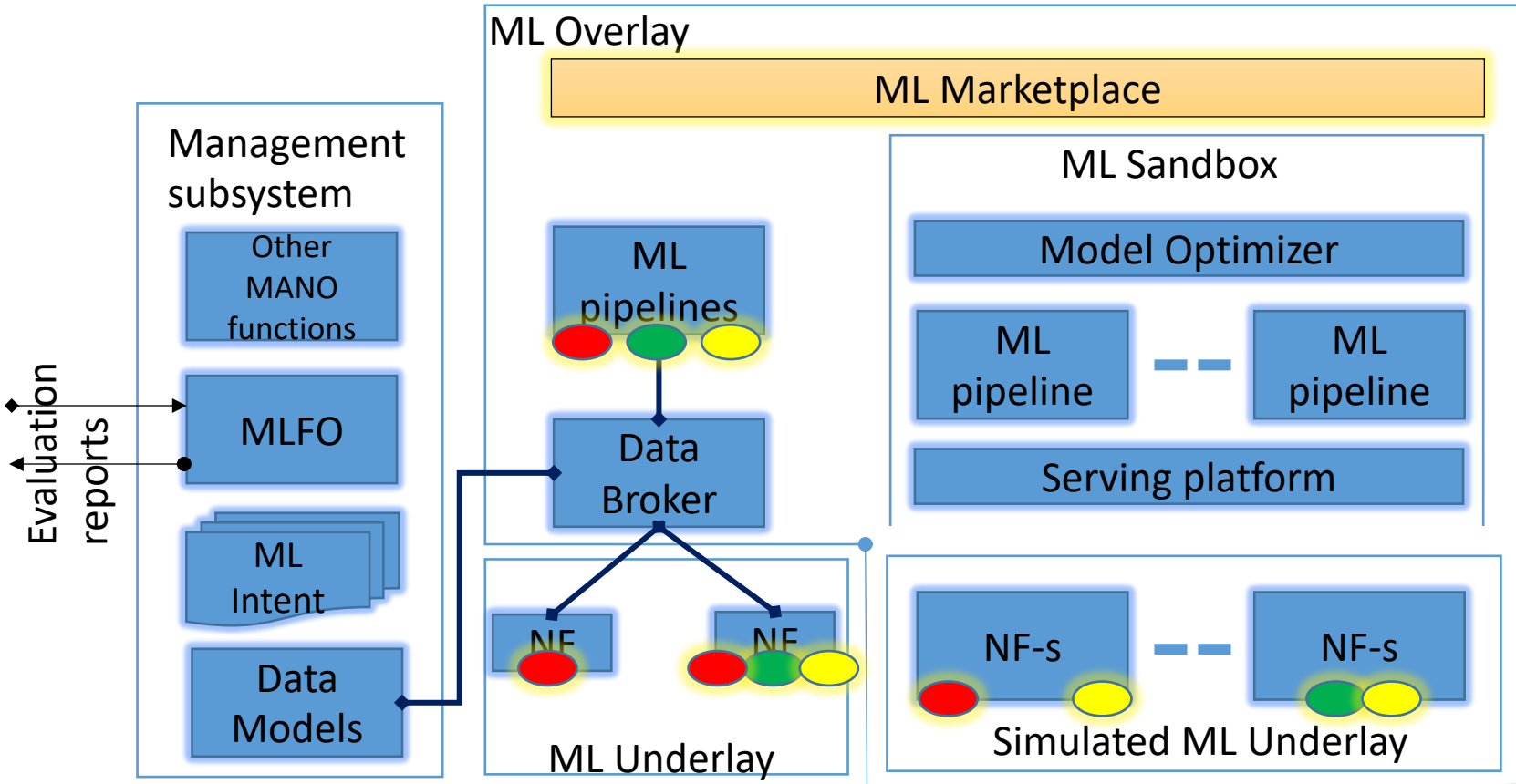
Enables standard mechanisms to exchange ML models and related metadata between the network and ML marketplace.

Outline

1. **Challenges of applying ML in networks**

2. **ITU's ML Toolkit**

3. **ITU's AI/ML in 5G Competition**

Hosts of Problem Statements

1. China
2. Spain 1
3. Spain 2
4. Brazil
5. India
6. Ireland
7. United States of America
8. Japan
9. Turkey
10. Adlik/ZTE
11. Russia

Sponsors and Promotional Partners

Sponsorship

Gold Sponsor: TRA (UAE)

Bronze Sponsors: Cisco Systems and ZTE

Challenge Promotion

❖ LF AI Foundation:

❖ SG Innovate (Singapore):

❖ Next Generation Mobile Networks Alliance:

Technical Tracks and Data

Technical Track	Real Data (Anonymized)	Open Data	Synthetic Data	No Data
Network	✓	✓	✓	
Verticals	✓	✓	✓	
Enablers				✓
Social Good	✓	✓	✓	✓

Note: Real Data (Anonymized) may have access restrictions for use.

Timeline

Global call for challenge entries

Warm-Up Phase

Global Round Begins

Problem Statement Selection
Dataset release
Registration

Best teams advance

Global Round Ends

Grand Challenge Finale - online

Presentations of
1. Winning teams; judges to determine final winners
2. Sponsors
3. Industry players
4. Academia;
5. Start-ups.
6. Virtual networking.

Feb 2020 to June 2020

July 2020

Nov 2020

15-17 December 2020

❖ Prizes total about 20k CHF
❖ Mentoring is provided to students

Problem Statements (1/2)

ID	Title	Author / Host
PS-012	ML5G-PHY -Beam-Selection: Machine Learning Applied to the Physical Layer of Millimeter-Wave MIMO Systems	Universidade Federal do Pará (UFPA), Brazil
PS-013	Improving the capacity of IEEE 802.11 WLANs through Machine Learning	Universitat Pompeu Fabra (UPF), Spain
PS-014	Graph Neural Networking Challenge 2020	Barcelona Neural Networking Center (BNN-UPC), Spain
PS-018	Compression of Deep Learning models	ZTE
PS-019 - 023	5G+AI (Smart Transportation), 5G+ML/AI (Dynamic Spectrum Access), Privacy Preserving AI/ML in 5G networks for healthcare applications	Indian Institute of Technology, Delhi (IIT/Delhi); C-DOT (Centre for Development of Telematics); Hike
PS-024	Demonstration of MLFO capabilities via reference implementations	Letterkenny Institute of Technology (Ireland)
PS-025	ML5G-PHY- Channel Estimation @NCSU: Machine Learning Applied to the Physical Layer of Millimeter-Wave MIMO Systems	North Carolina State University, USA
PS-031 - 032	Network State Estimation by Analyzing Raw Video Data + Analysis on route information failure in IP core networks by NFV-based test environment.	NEC, KDDI, RISING Japan, TTC
PS-036	Using weather info for radio link failure (RLF) prediction	Turkcell, Turkey
PS-038	Traffic recognition and Long-term traffic forecasting based on AI algorithms and metadata for 5G/IMT-2020 and beyond	SPbSUT, Russia

❖ Detailed webinars for each topic are available in the Challenge website
❖ Including webinar in Japanese language for PS-031 - 032

Problem Statements (2/2)

| ID	Title	Author
PS-001	5G+AI+AR (Zhejiang Division)	China Unicom
PS-002	Fault Localization of Loop Network Devices based on MEC Platform (Guangdong Division)	China Unicom
PS-003	Configuration Knowledge Graph Construction of Loop Network Devices based on MEC Architecture (Guangdong Division)	China Unicom
PS-004	Alarm and prevention for public health emergency based on telecom data (Beijing Division)	China Unicom
PS-005	Energy-Saving Prediction of Base Station Cells in Mobile Communication Network (Shanghai Division)	China Unicom
PS-006	Core network KPI index anomaly detection (Shanghai Division)	China Unicom
PS-007	Network topology optimization	China Mobile
PS-008	Out of Service(OOS) Alarm Prediction of 4/5G Network Base Station	China Mobile

❖ Webinars in Chinese language are available for PS-007 in the Challenge website

Radio Link Failure Prediction Challenge
(Using weather information for radio link failure (RLF) prediction)

- How does the weather influence the radio signal to and from a base station?

- Participants get weather data and network data and use AI/ML algorithms to find patterns in order to make predictions that would help the engineers to finetune their networks.

- Several other problems statements available on Challenge website: https://www.itu.int/en/ITU-T/AI/challenge/2020/Pages/default.aspx
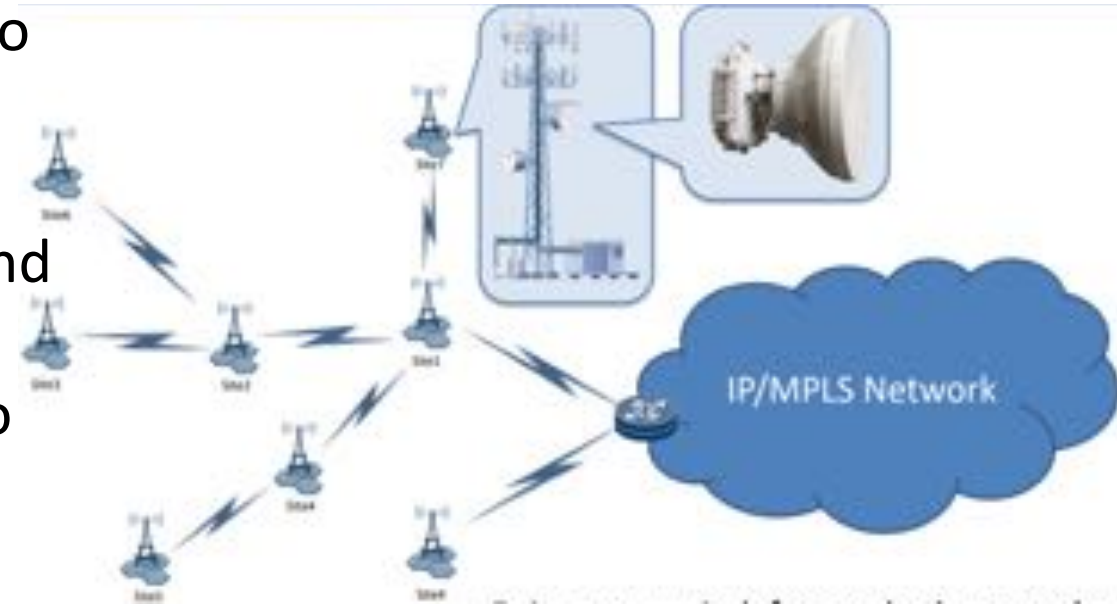
❖This problem statement uses real network data.

ITU AI/ML in 5G Grand Challenge Finale (Final Conference)

15 – 17 December 2020 (12:00 – 16:00 CET)

➢ VIP Speeches

➢ Keynote Speakers

➢ Prize Presentations

➢ Final presentations from participants

➢ Many more…

Registration: https://bit.ly/3kCuBkp

❖Register to take part in the final event.

Interested in participating?

- ITU is committed to developing, in an open forum, and enabling practical toolkits for solving relevant problems in AI/ML in future networks.

- ITU AI/ML in 5G Challenge works with students and professionals to generate innovative solutions in a collaborative manner.

Follow the Slack channel of the ITU Challenge – many exciting initiatives on the way

Follow our webinar series of ML5G talks by respected researchers and professionals

Any Questions?

Email: ai5gchallenge@itu.int