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

ITU Regional Forum for Europe –
5G Strategies, Policies and Implementation
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Reinhard.Scholl@itu.int
Telecommunication Standardization Bureau

# 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 is different from AI/ML in, say, image recognition

- Constraints on computing resources in the network
- Noisy and dynamic network environment
- Data
  - Which data is available?
  - Where generated?
  - 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

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

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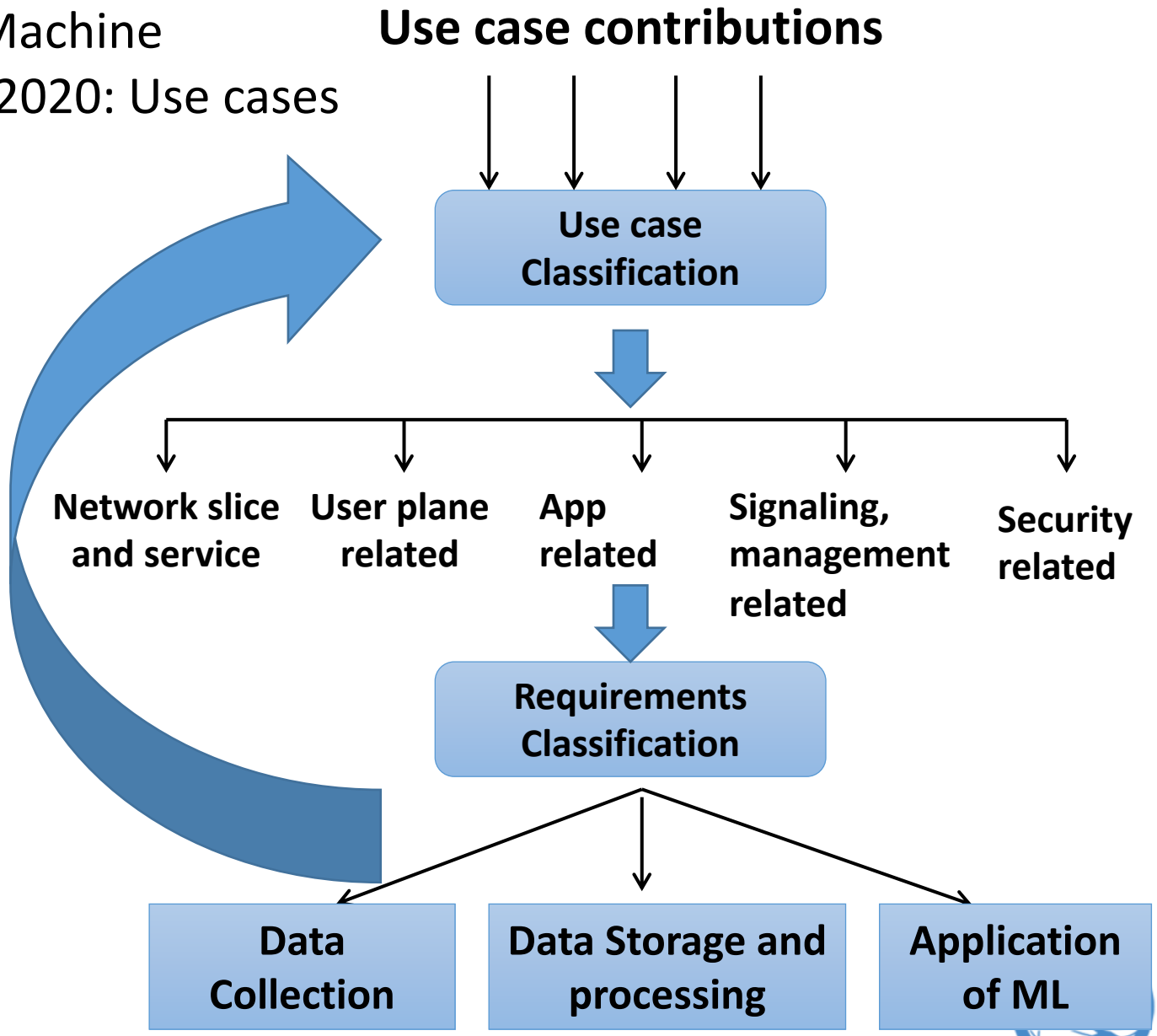
# Use Case analysis for ML in Networks

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

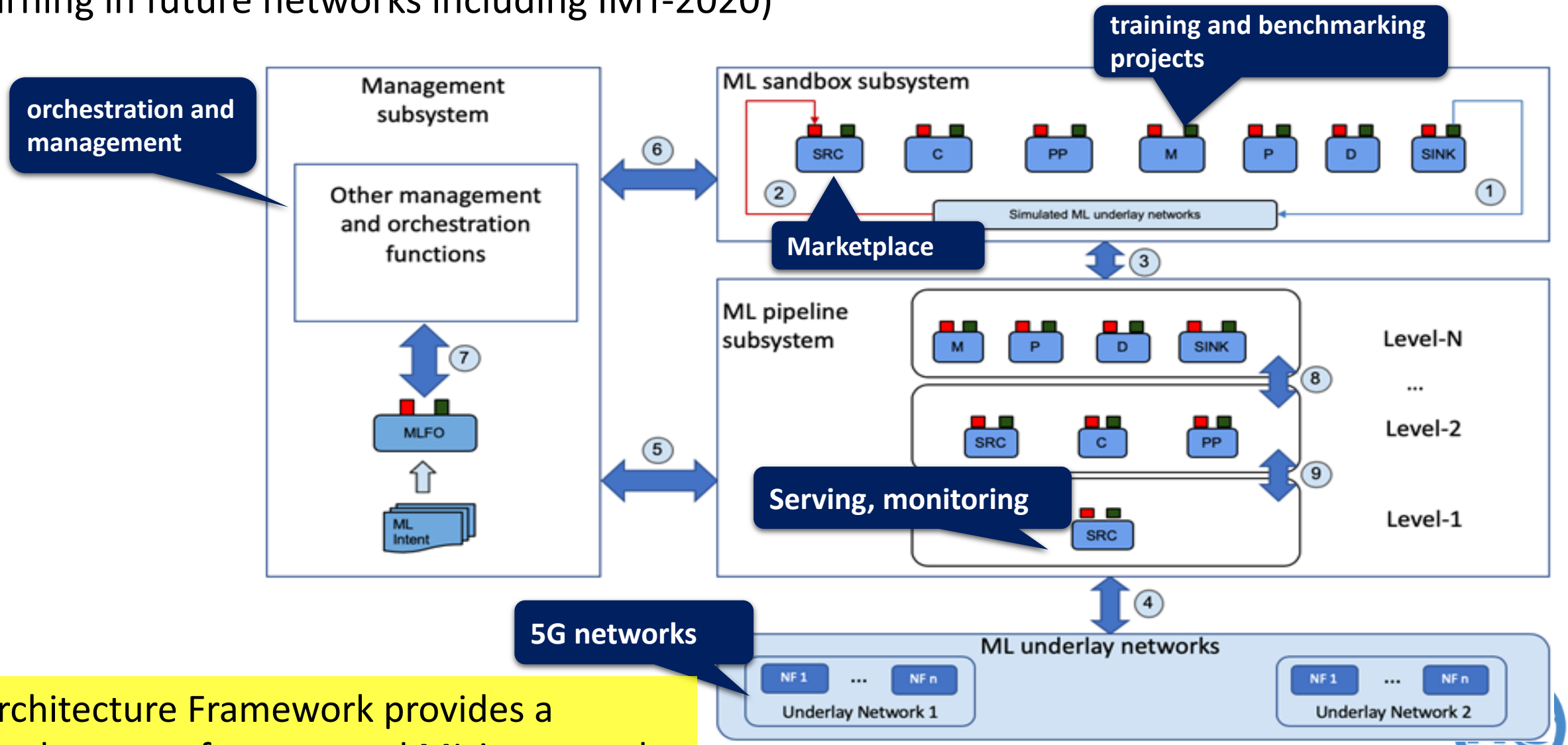
  - Analysed more than 30 use cases
  - Requirements classified as “critical”, “expected”, “added value”.




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

# ITU's Architecture Framework for ML in networks

- 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

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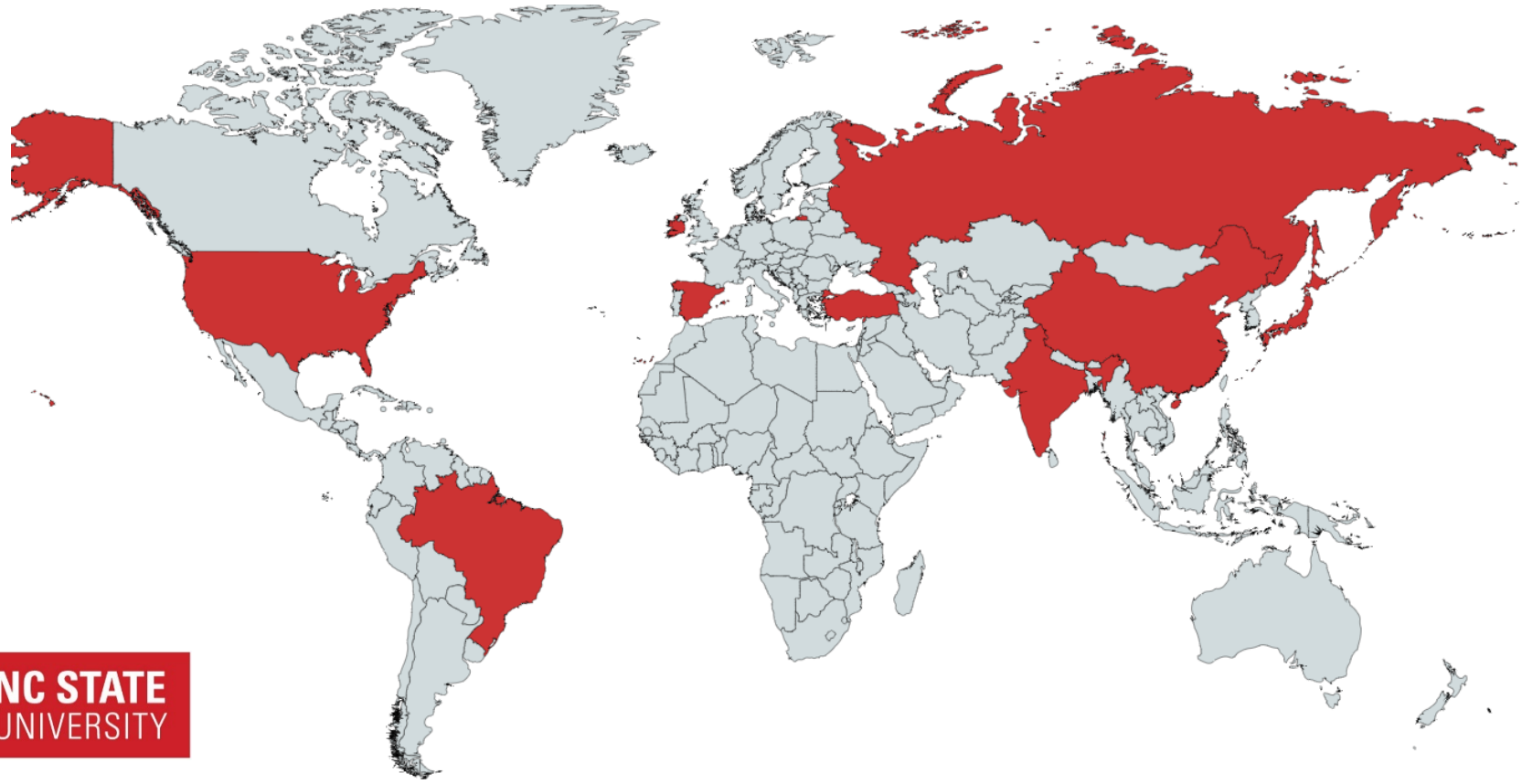
# Hosts of Problem Statements

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)

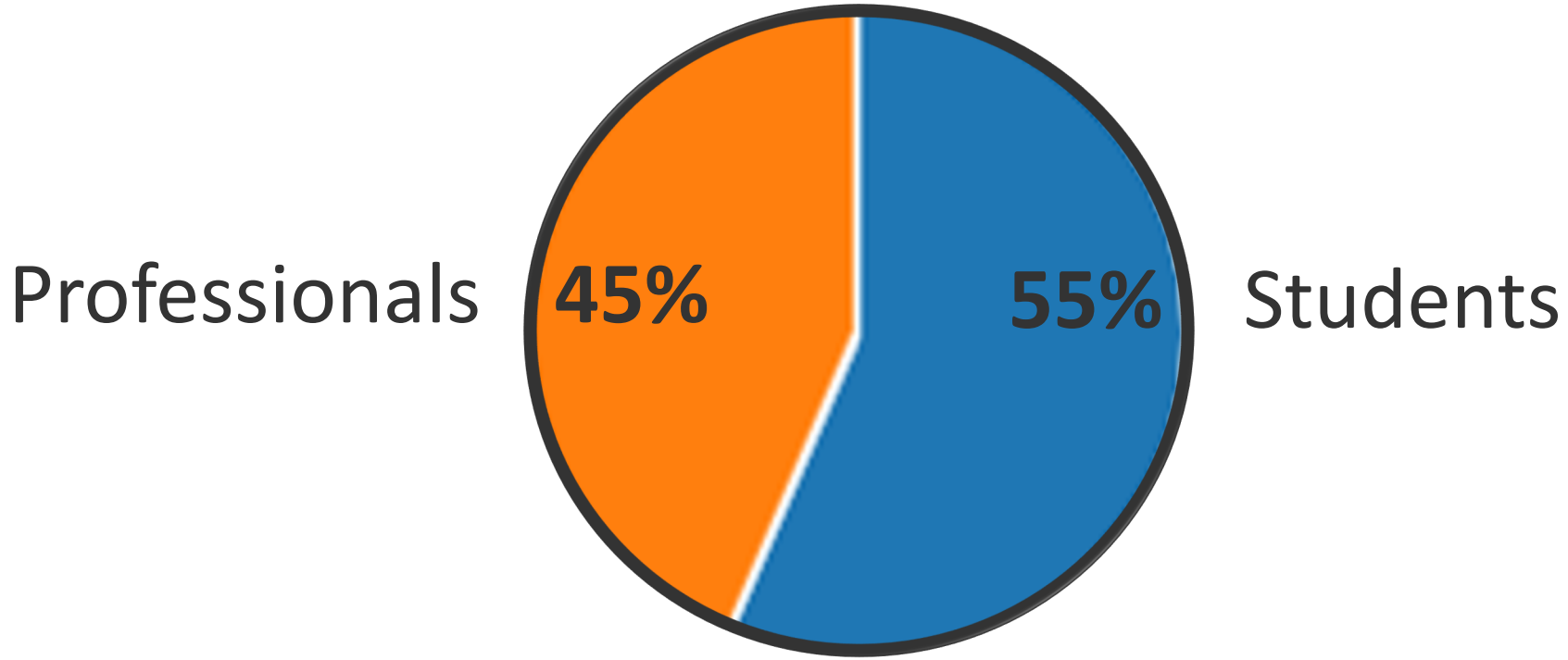
Bronze Sponsors: Cisco Systems and ZTE

## Challenge Promotion

- LF AI Foundation:
- SG Innovate (Singapore):
- Next Generation Mobile Networks Alliance:

# Registrations

> 500 participants from > 60 countries



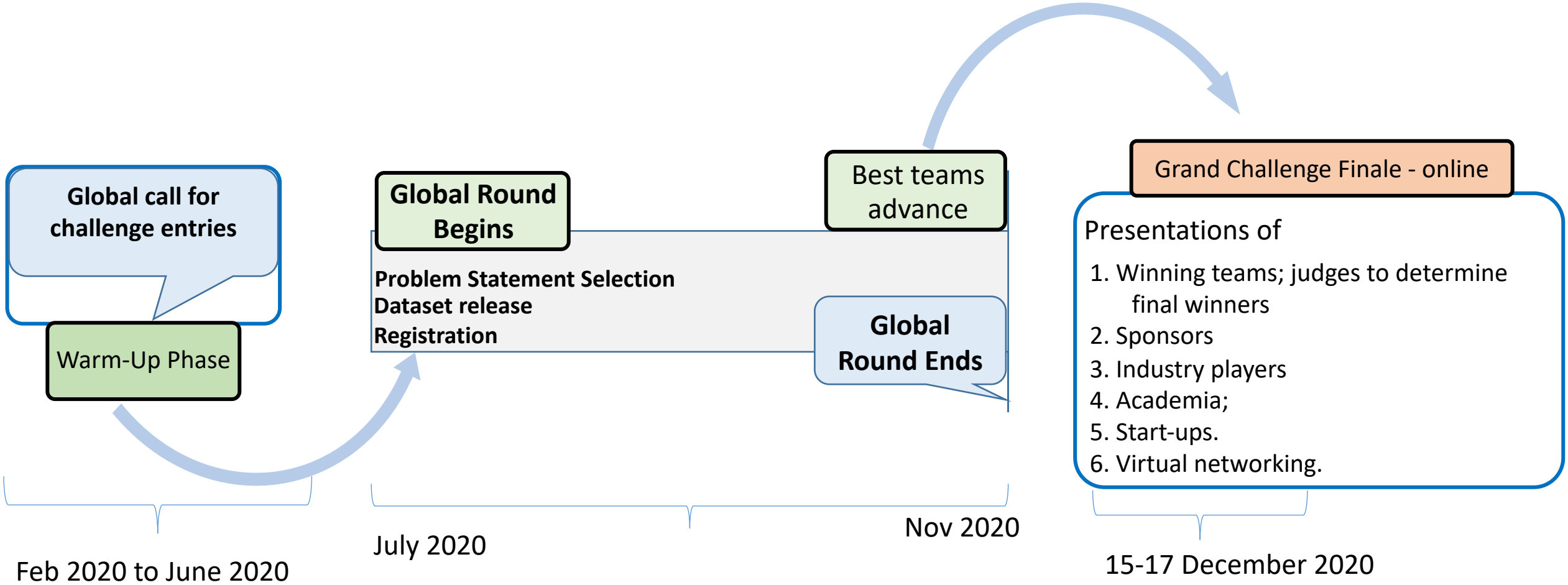
# Technical Tracks and Data

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

Real Data (anonymized) may have access restrictions.

Green: Types of data currently being used in the Challenge

# Timeline




- 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 | Saint Petersburg University (SPbSUT), Russia |

❖ Detailed webinars for each topic are available on the Challenge website

# 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 |

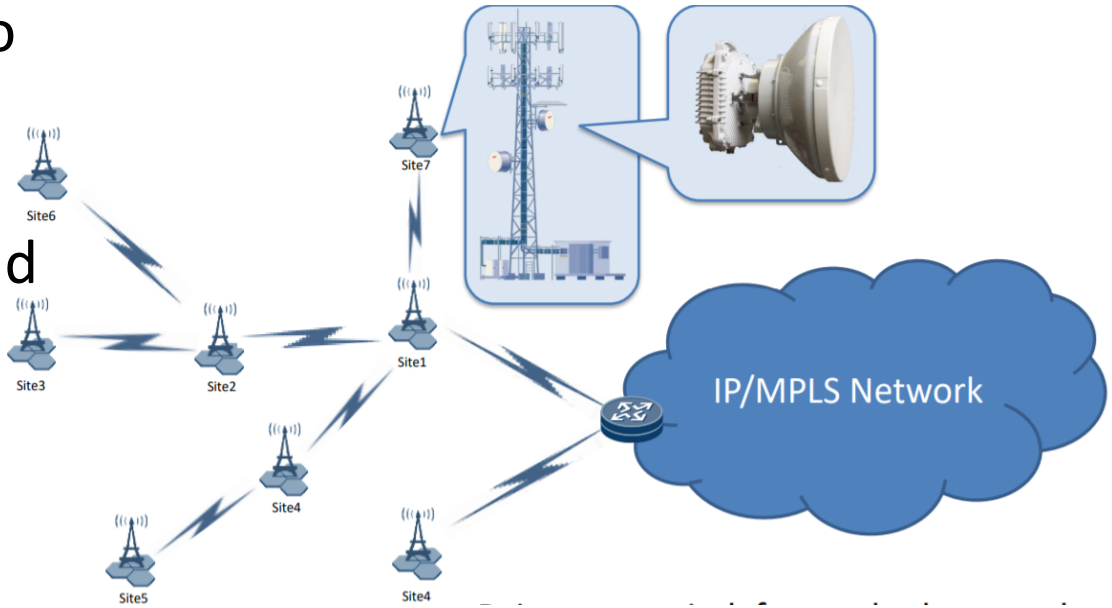
❖Webinars in Chinese language are available for PS-007 in the Challenge website

# An Example of a Problem Statement for ITU AI/ML in 5G Challenge

## Radio Link Failure Prediction Challenge

(Using weather information for radio link failure (RLF) prediction)

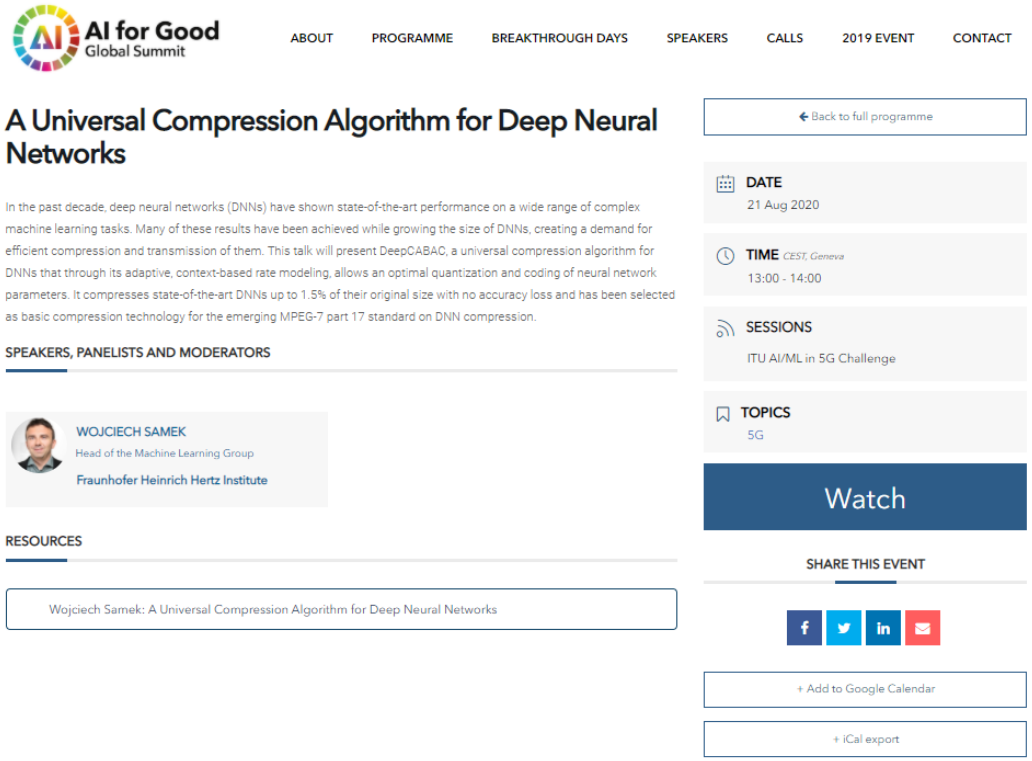
- How does the weather influence the radio signal to and from a base station?
- Participants get weather data and network data and use AI/ML algorithms to find patterns in order to make predictions that would help the engineers to finetune their networks.
- Several other problems statements available on Challenge website: https://www.itu.int/en/ITU-T/AI/challenge/2020/Pages/default.aspx




❖This problem statement uses real network data.

# Webinar Series accompanying ML5G Challenge

- 20 one-hour webinars so far (mid-June – September)
- By year's end: 30+ webinars
- Dedicated issue of ITU NEWS Magazine on ML5G planned for November 2020




# 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: https://www.itu.int/en/ITU-T/AI/challenge/2020

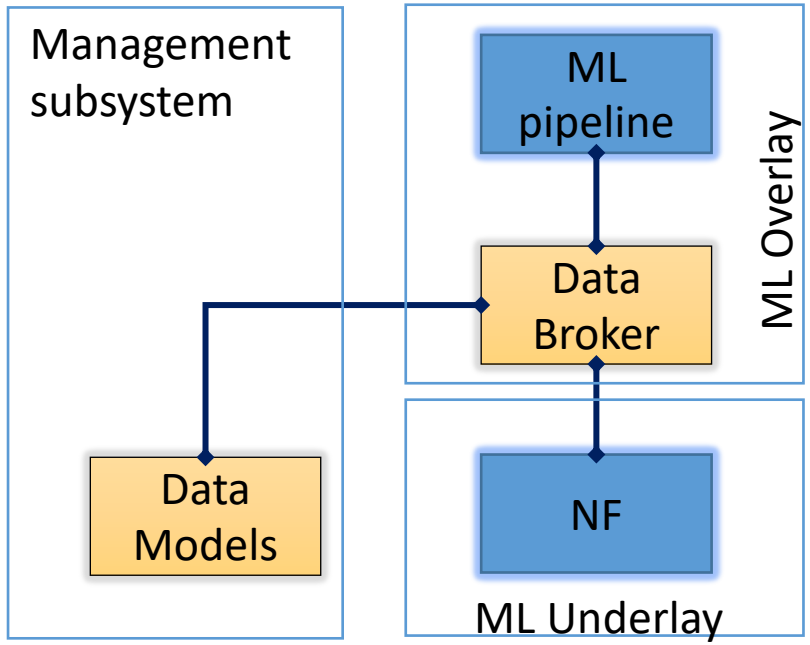
**Contact:** ai5gchallenge@itu.int

# AI/ML in 5G Competition **2021**

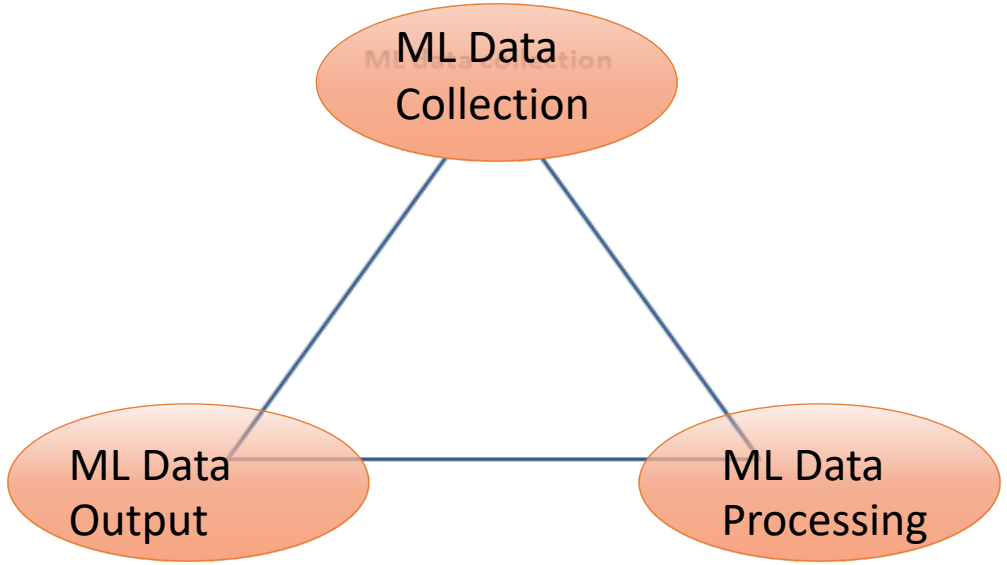
# Backup Slides

# 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



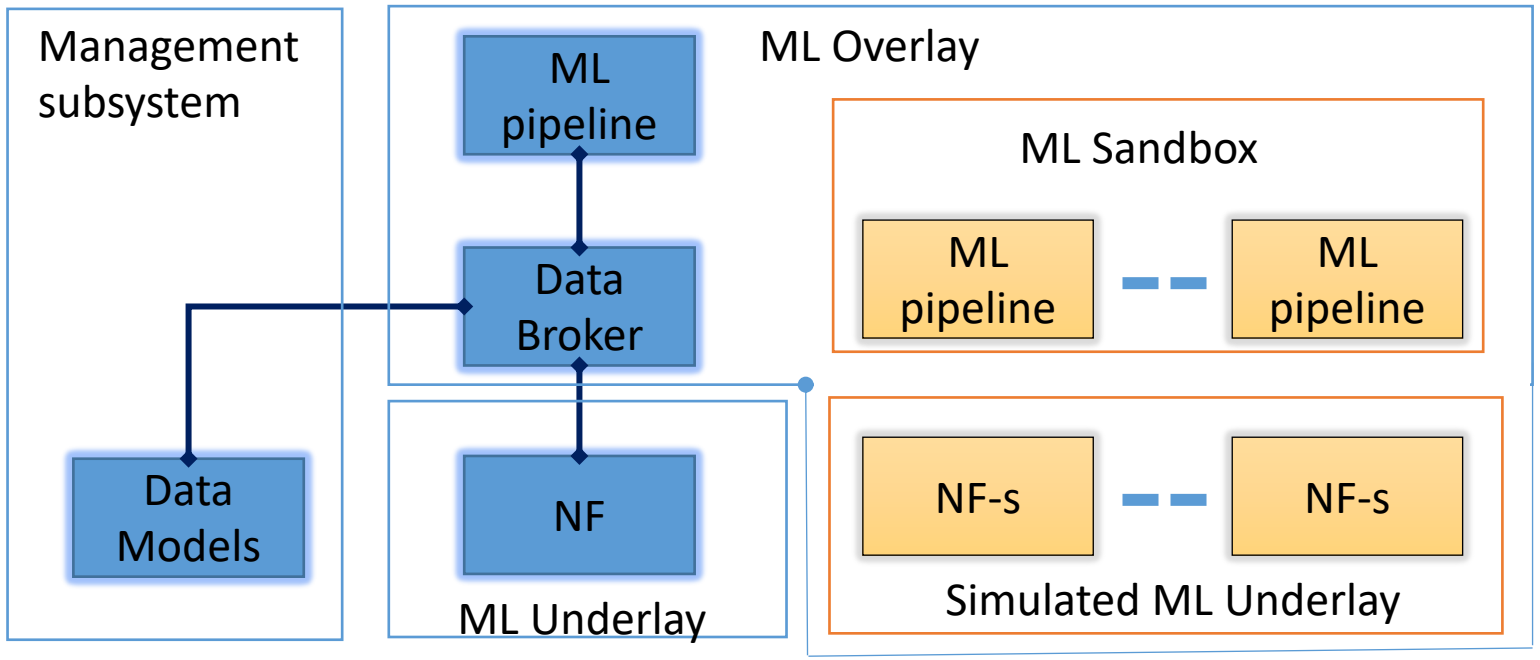

- How to handle the diversity in network data sources?
- How to handle the increased flexibility and agility in future networks?
- How to approach the different kinds of data handling requirements?

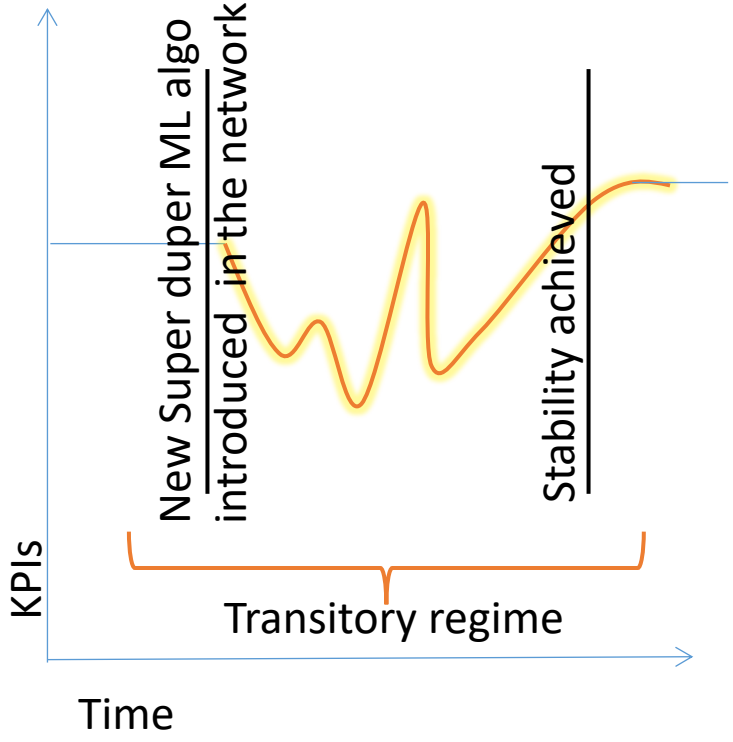



Flexible approach to handle data models for new use cases is important.

# 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)

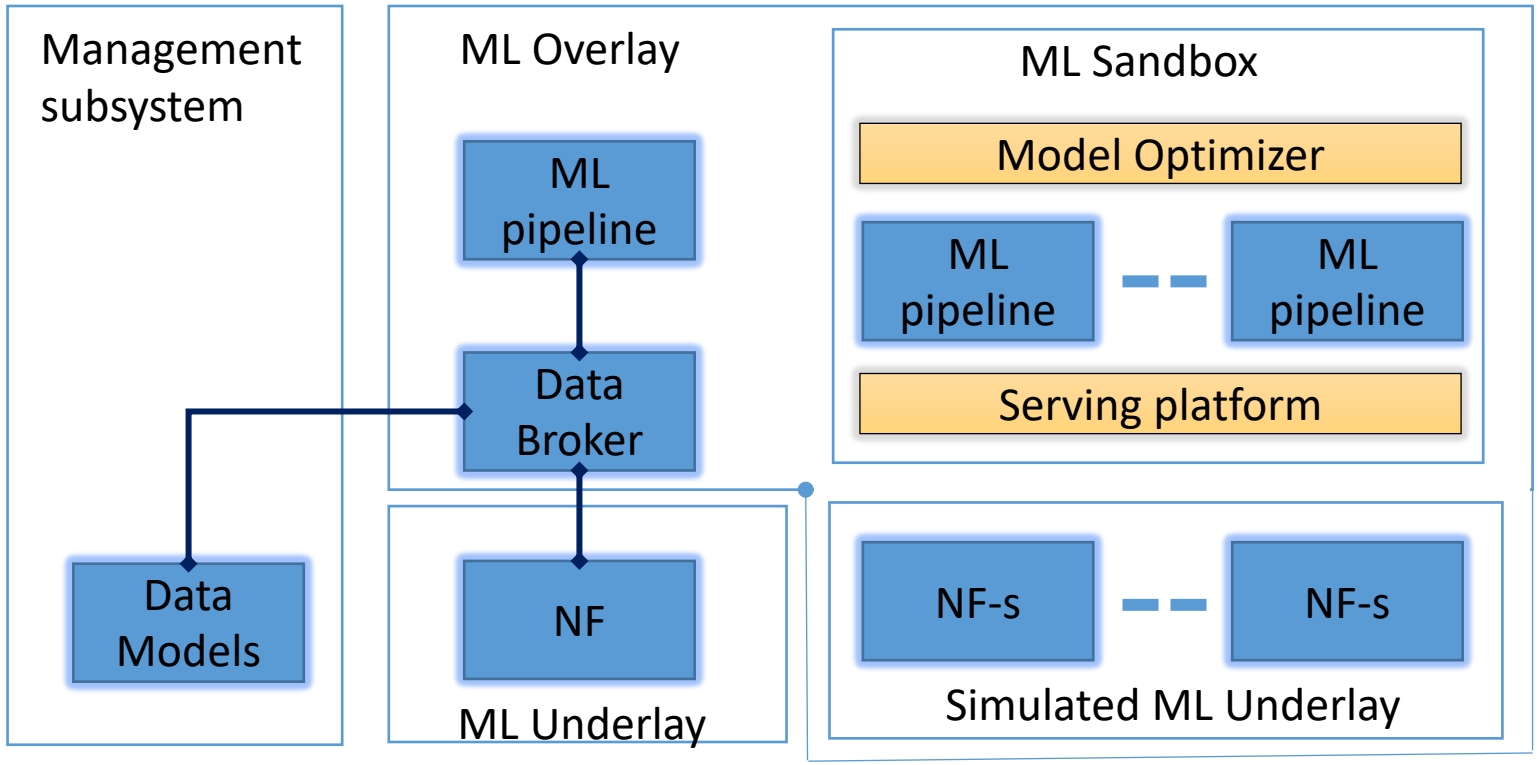



ML sandbox allows experimentation, comparison, benchmarking, testing and evaluation before the Model hits the live network

# 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)

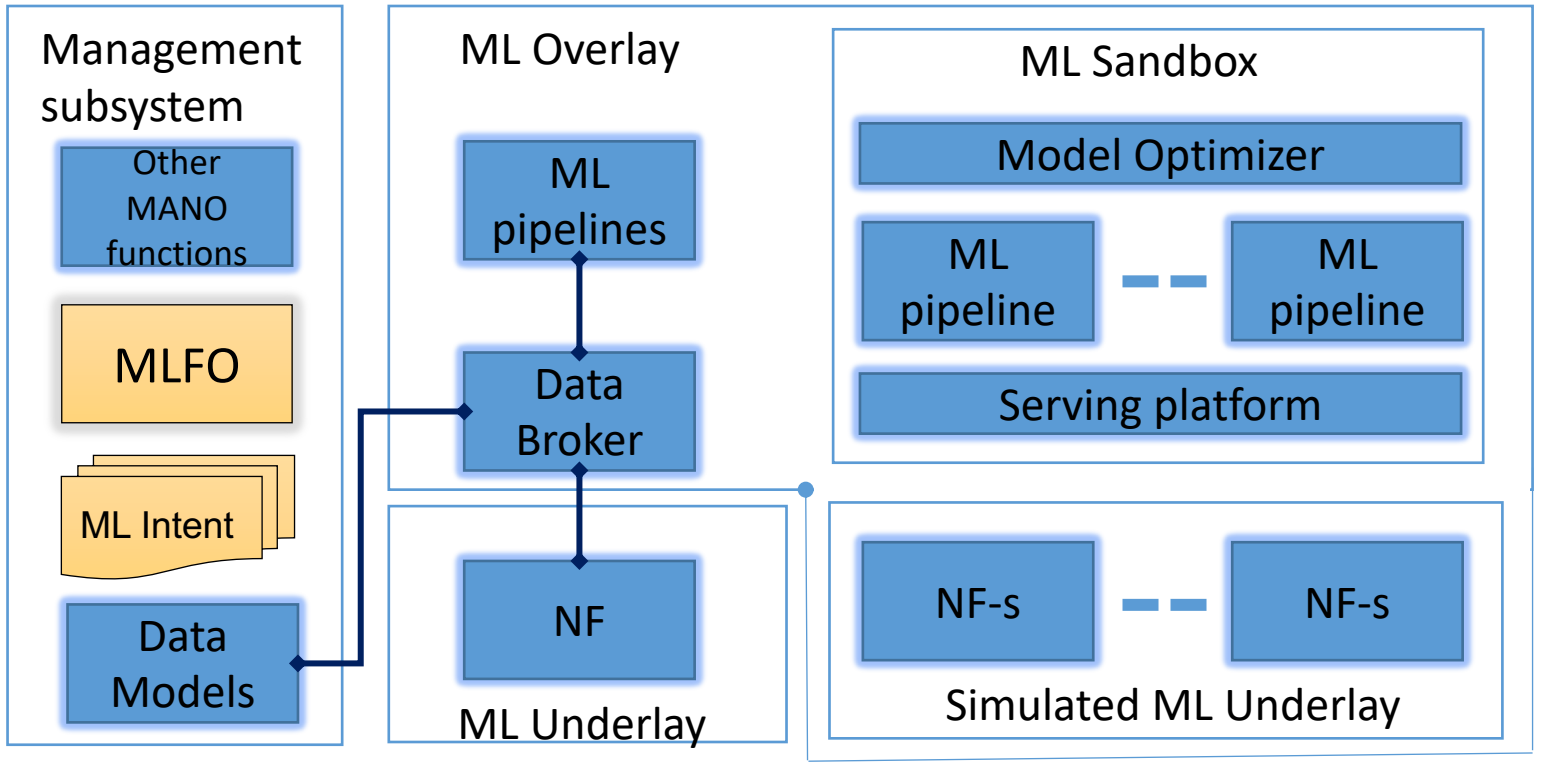


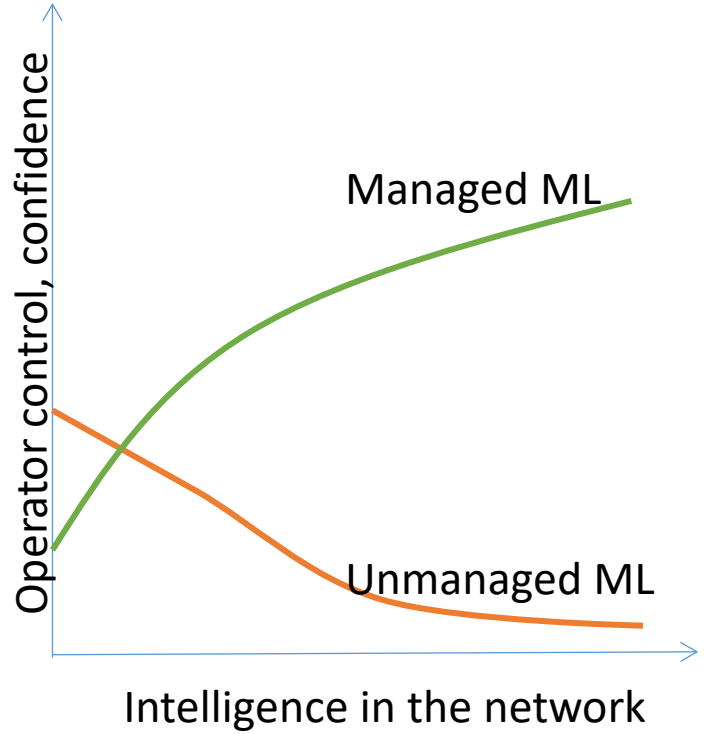

Requirements and architecture for serving ML models in future networks including IMT-2020, including inference optimization, model deployment and model inference.

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

# ITU Toolkit #4: ML Function Orchestrator

- Ongoing work: Requirements, architecture and design for machine learning function orchestrator
- FG ML5G output ML5G-O-038 (status: published)

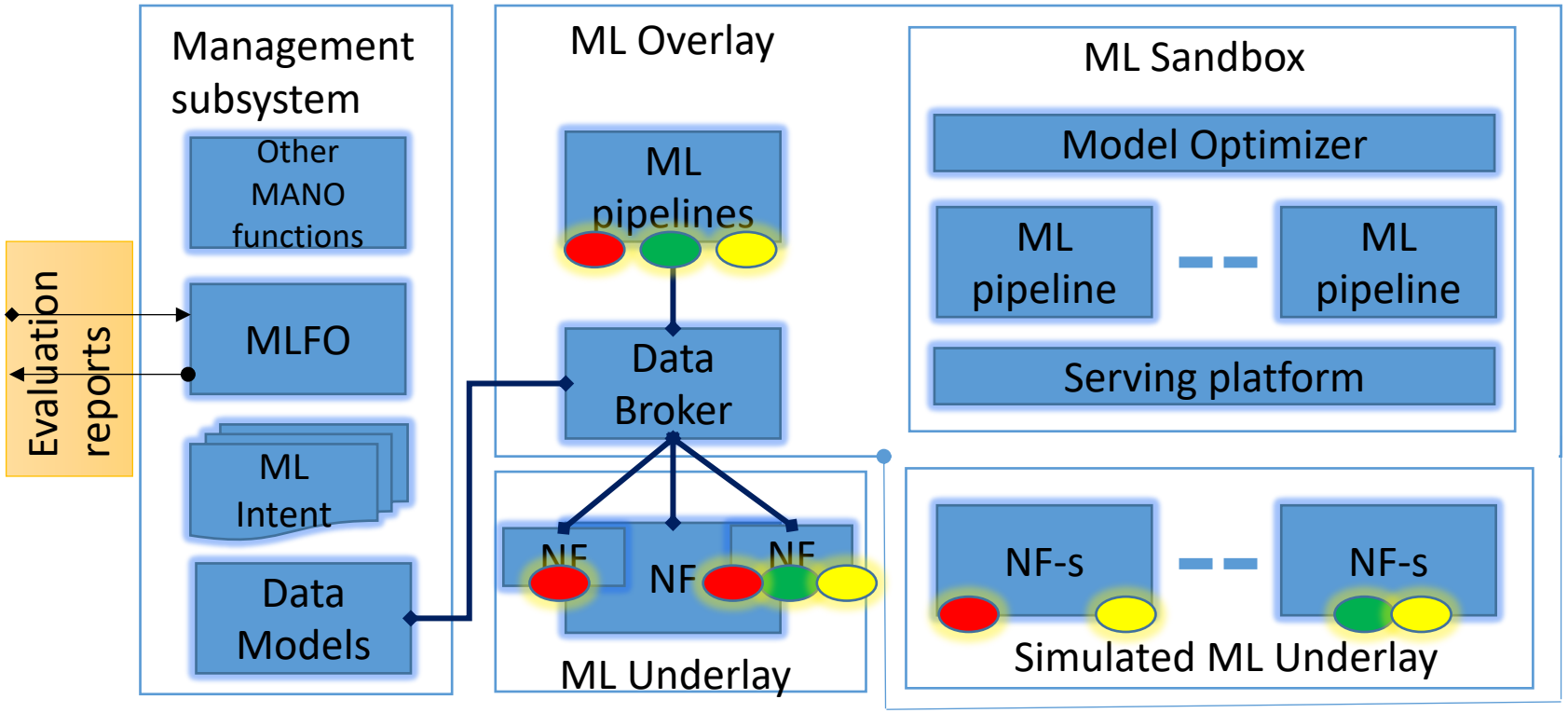



MLFO orchestrates the operation of machine learning pipeline across the network to provide a managed AI/ML integration for the operator

# ITU Toolkit #5: Intelligence Levels

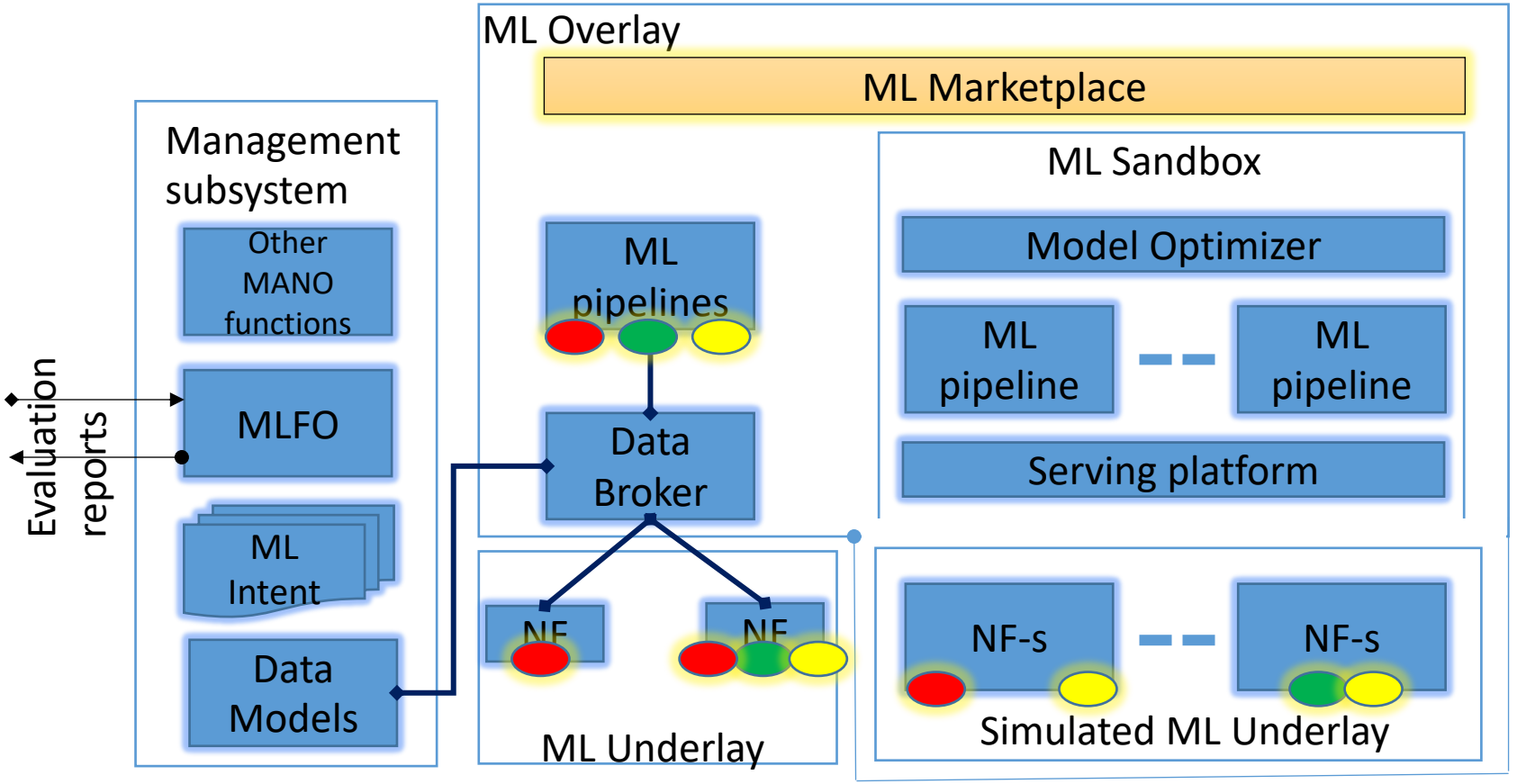
- Published: ITU-T Y.3173 “Framework for evaluating intelligence levels of future networks including IMT-2020”
- https://www.itu.int/rec/T-REC-Y.3173/en

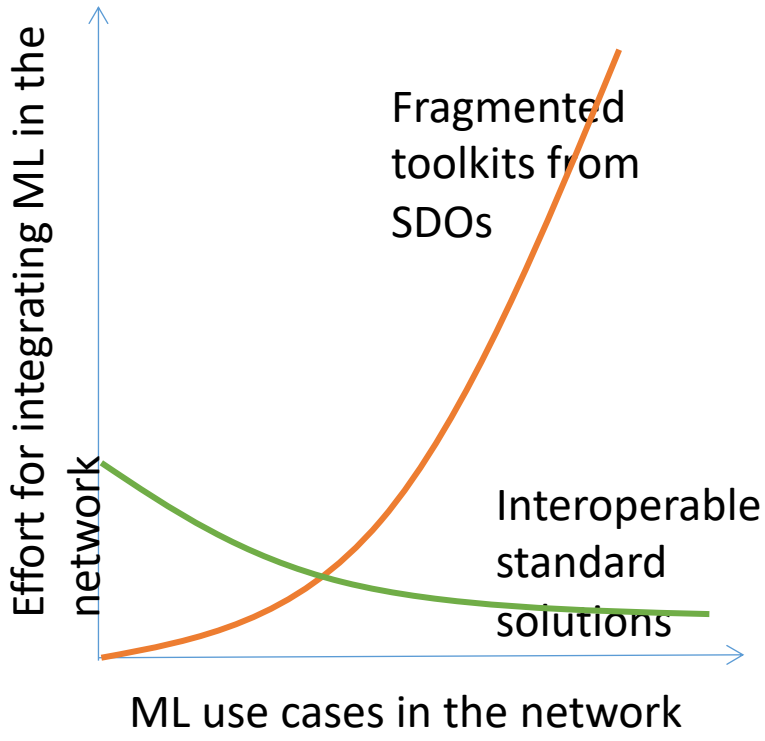



Intelligence levels helps MLFO to interoperate between different ML solutions in the network.

# 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.