

Opportunities in Autonomous Networks

WWRF CV WG Session 1

19 Jan 2021

Vishnu.n@ieee.org

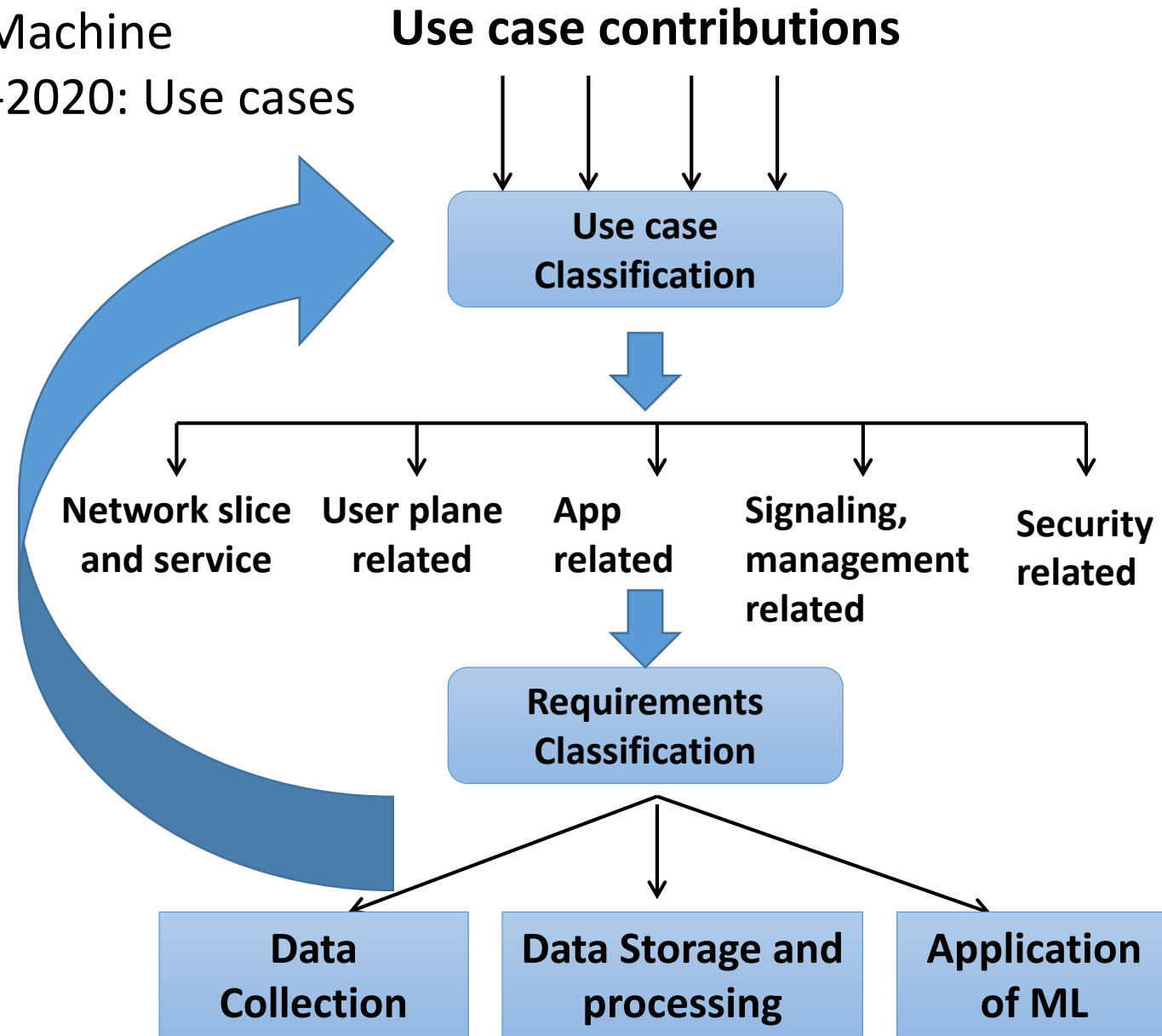
Agenda

- AI/ML in networks
- Autonomous Networks
- Opportunities for collaboration

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

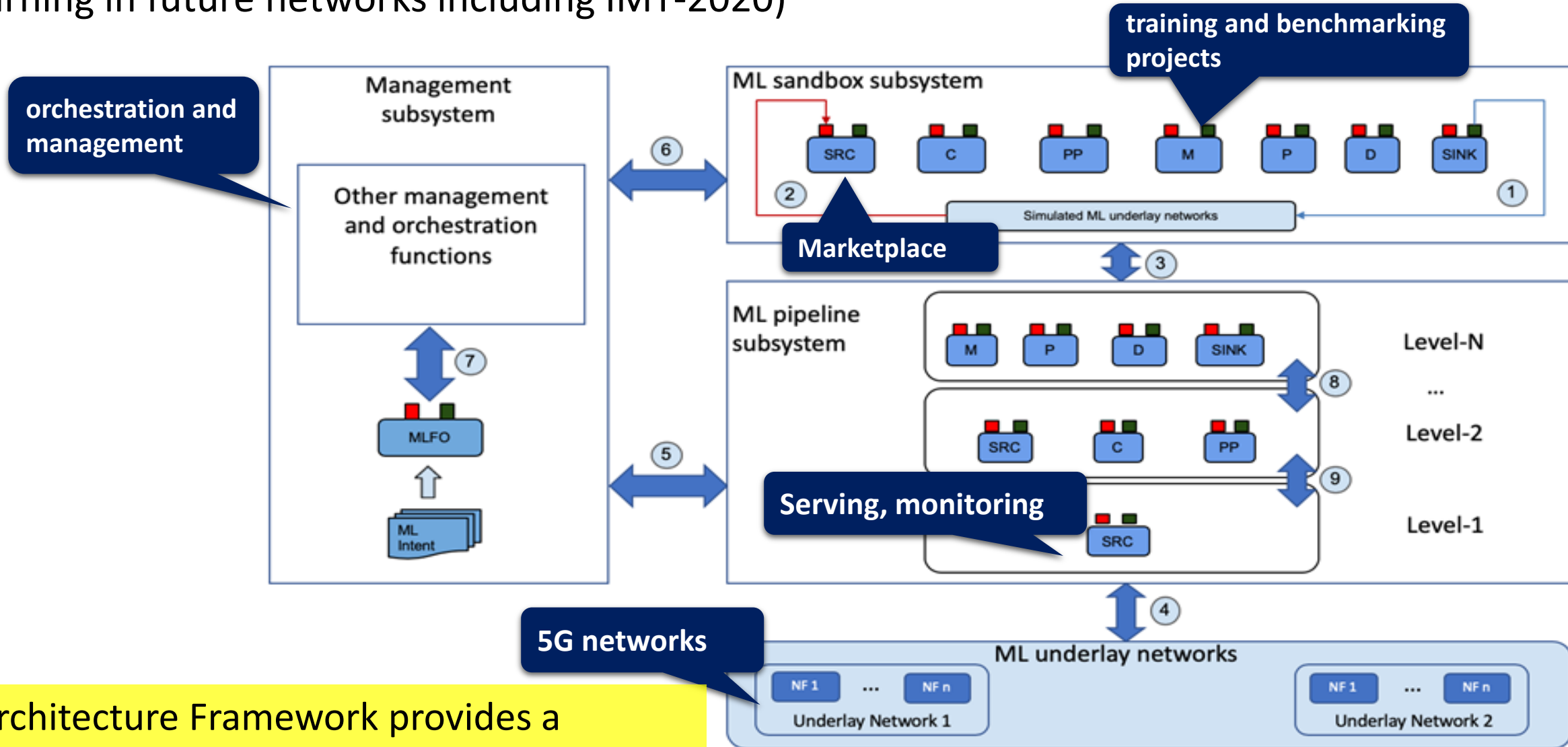
- Analysed more than 30 use cases
- Requirements classified as “critical”, “expected”, “added value”.



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

ITU's Architecture Framework for ML in networks

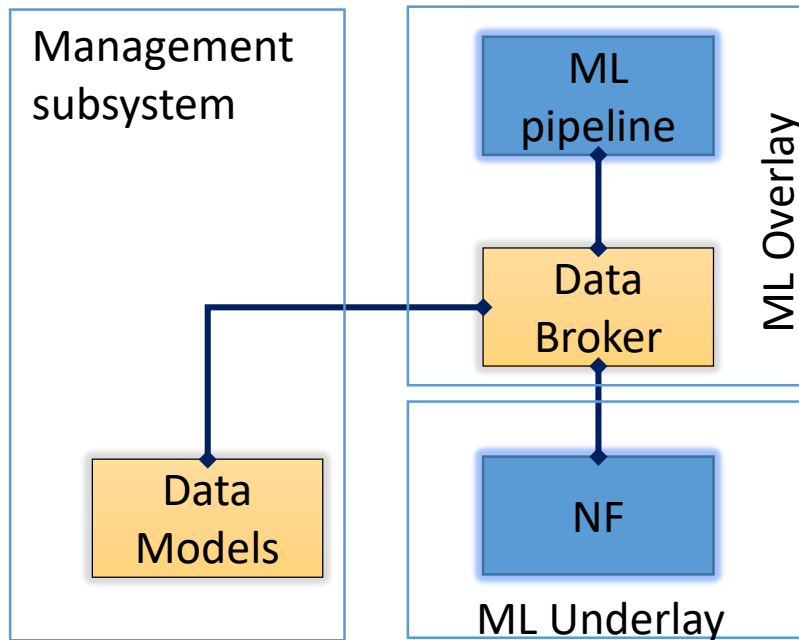
- Published by ITU as [Y.3172](#) (Architectural framework for machine learning in future networks including IMT-2020)



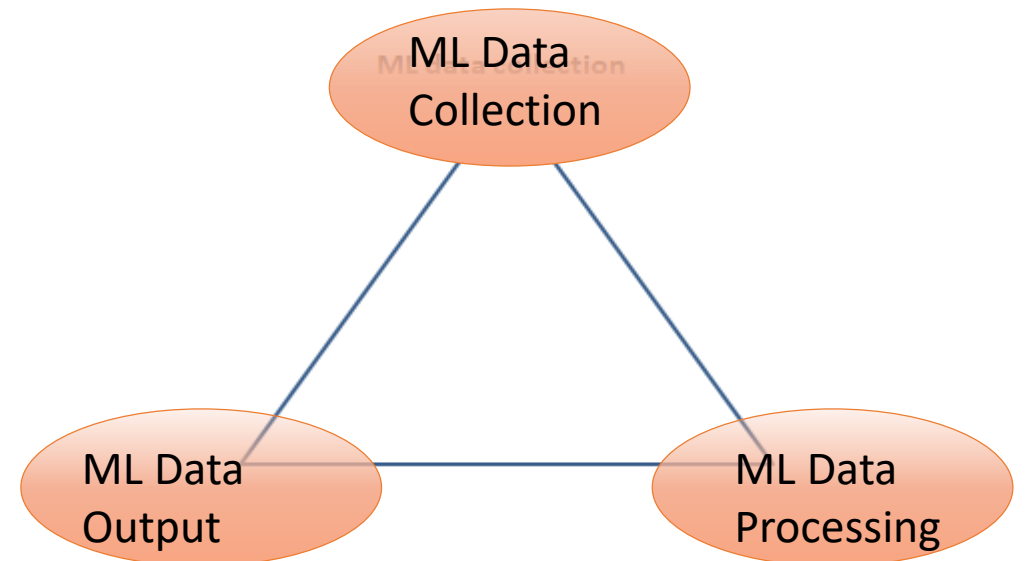
ITU's Architecture Framework provides a common language for managed ML in networks

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>



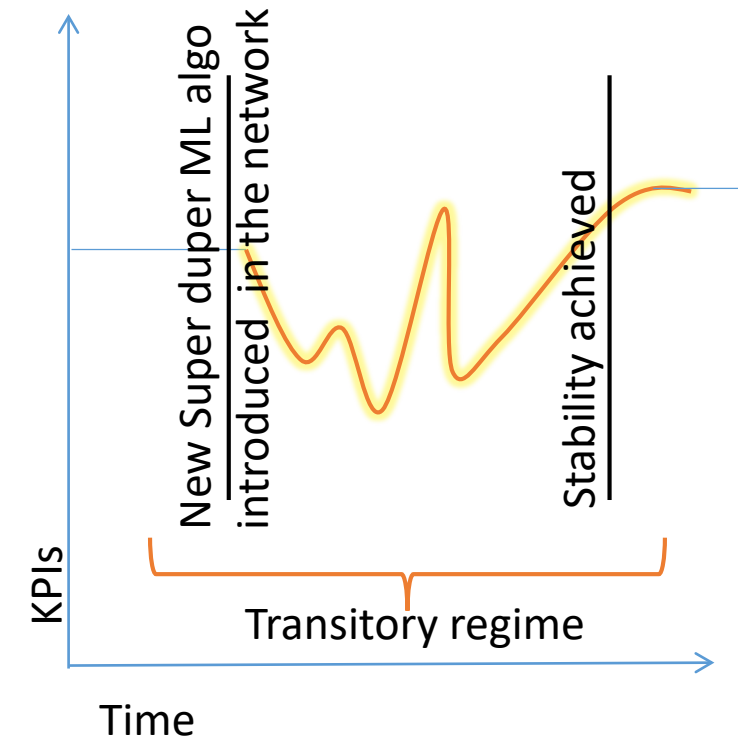
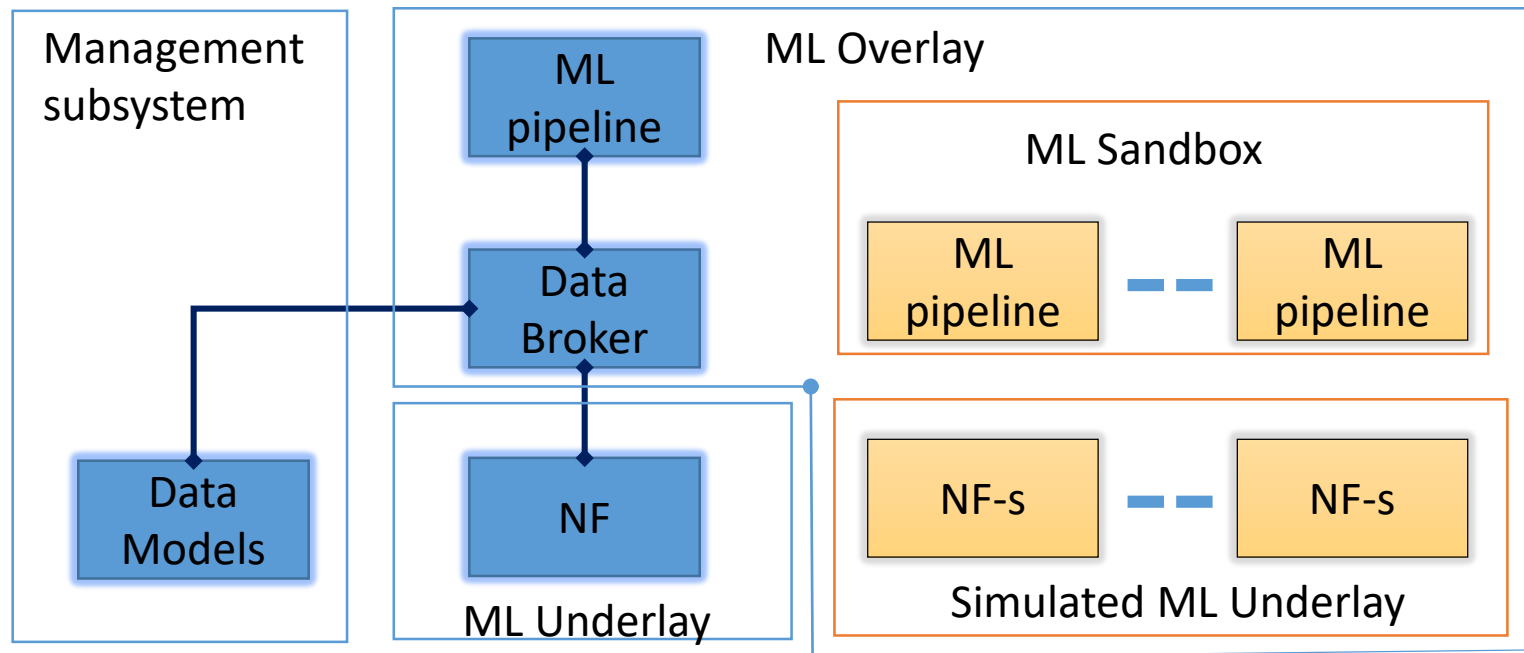
- How to handle the diversity in network data sources?
- How to handle the increased flexibility and agility in future networks?
- How to approach the different kinds of data handling requirements?



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

ITU Toolkit #2: ML Sandbox

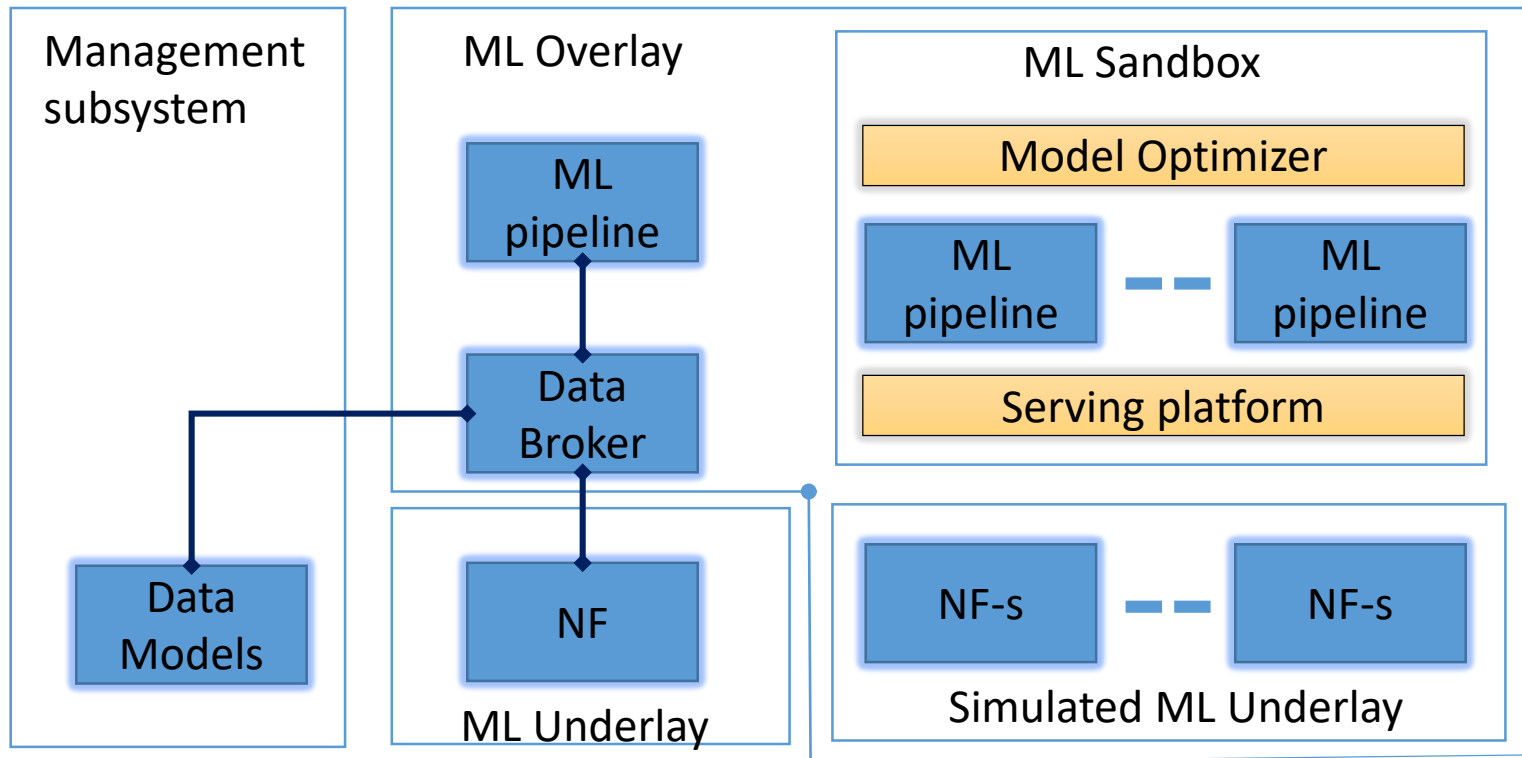
- Ongoing work: Machine Learning Sandbox for future networks including IMT-2020: requirements and architecture framework
- FG ML5G output [ML5G-O-035](#) (status: published)



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)

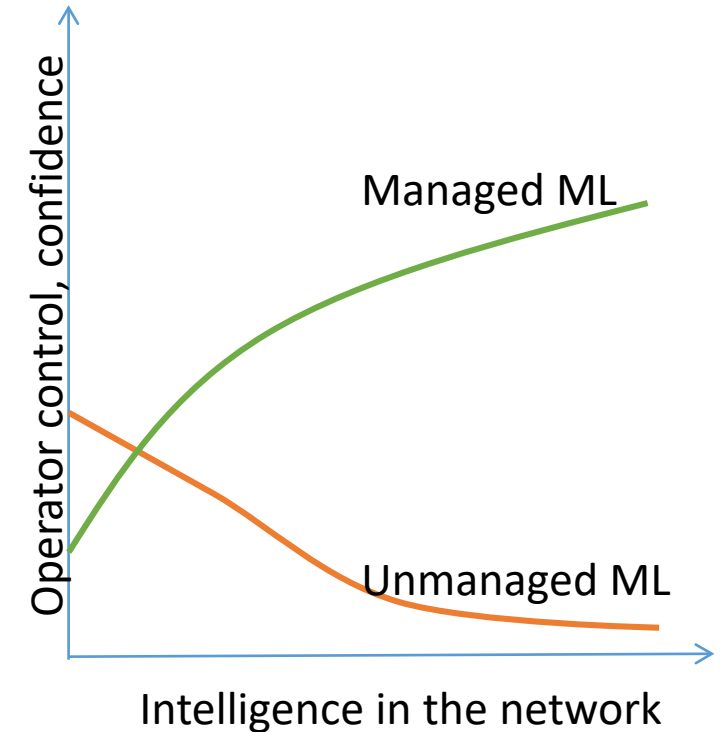
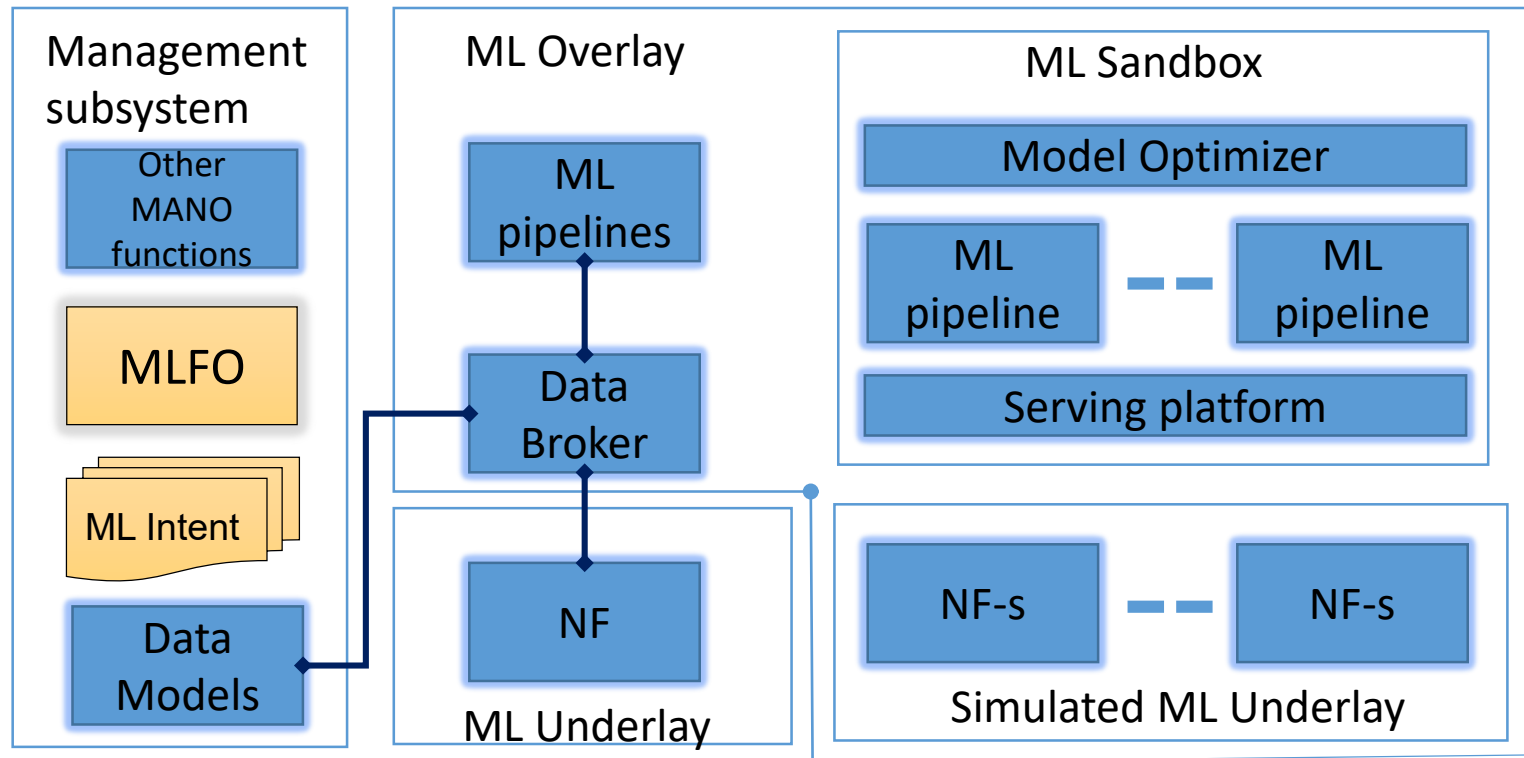


Requirements and architecture for **serving ML models** in future networks including IMT-2020, including **inference optimization, model deployment and model inference.**

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

ITU Toolkit #4: ML Function Orchestrator

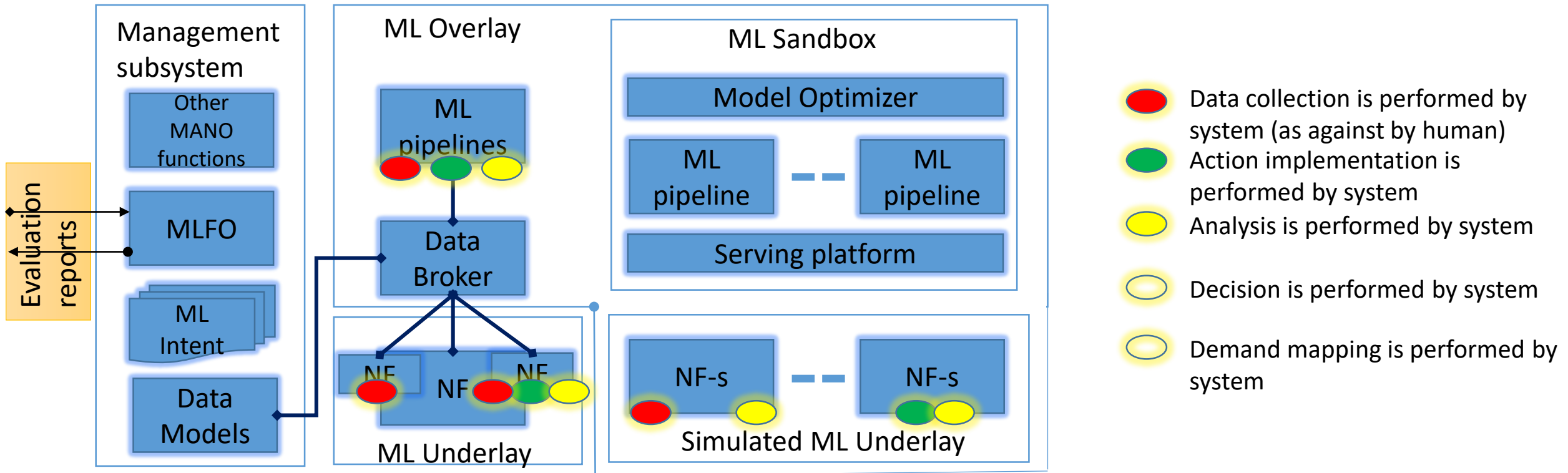
- Ongoing work: Requirements, architecture and design for machine learning function orchestrator
- FG ML5G output [ML5G-O-038](#) (status: published)



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

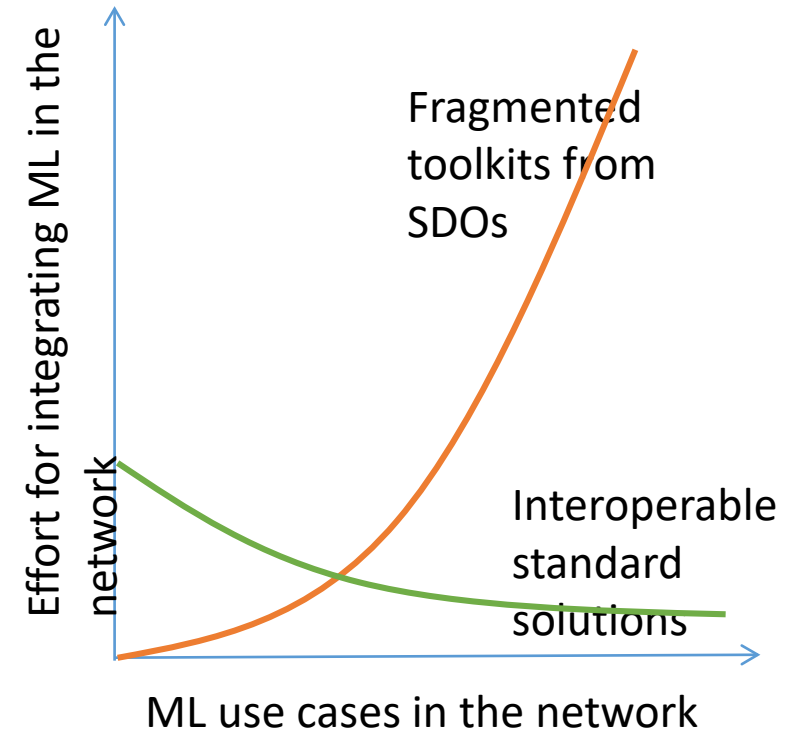
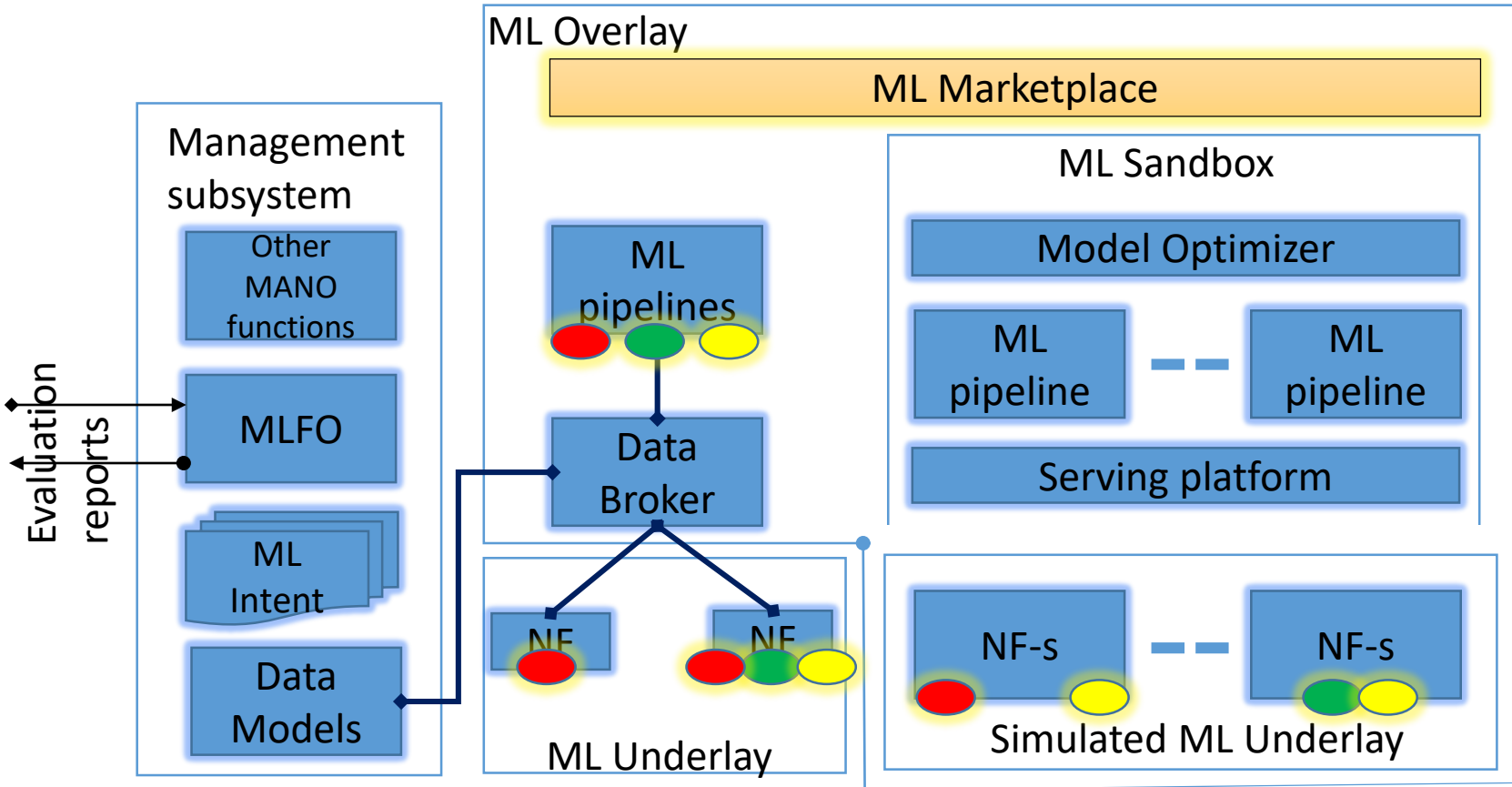
- Published: ITU-T Y.3173 “Framework for evaluating intelligence levels of future networks including IMT-2020”
- <https://www.itu.int/rec/T-REC-Y.3173/en>



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

ITU Toolkit #6: ML Marketplace

- ITU-T Recommendation Y.3176 : ML marketplace integration in future networks including IMT-2020 (published)



Enables standard mechanisms to exchange ML models and related metadata between the network and ML marketplace.

Agenda

- AI/ML in networks
- **Autonomous Networks**
- Opportunities for collaboration

Autonomous Networks and Y.3173

Table 1 – Framework approach for classification of autonomous network intelligence level (source: ITU-T Y.3173)

Network intelligence level		Dimensions				
		Action implementation	Data collection	Analysis	Decision	Demand mapping
L0	Manual network operation	Human	Human	Human	Human	Human
L1	Assisted network operation	Human and System	Human and System	Human	Human	Human
L2	Preliminary intelligence	System	Human and System	Human and System	Human	Human
L3	Intermediate intelligence	System	System	Human and System	Human and System	Human
L4	Advanced intelligence	System	System	System	System	Human and System
L5	Full intelligence	System	System	System	System	System

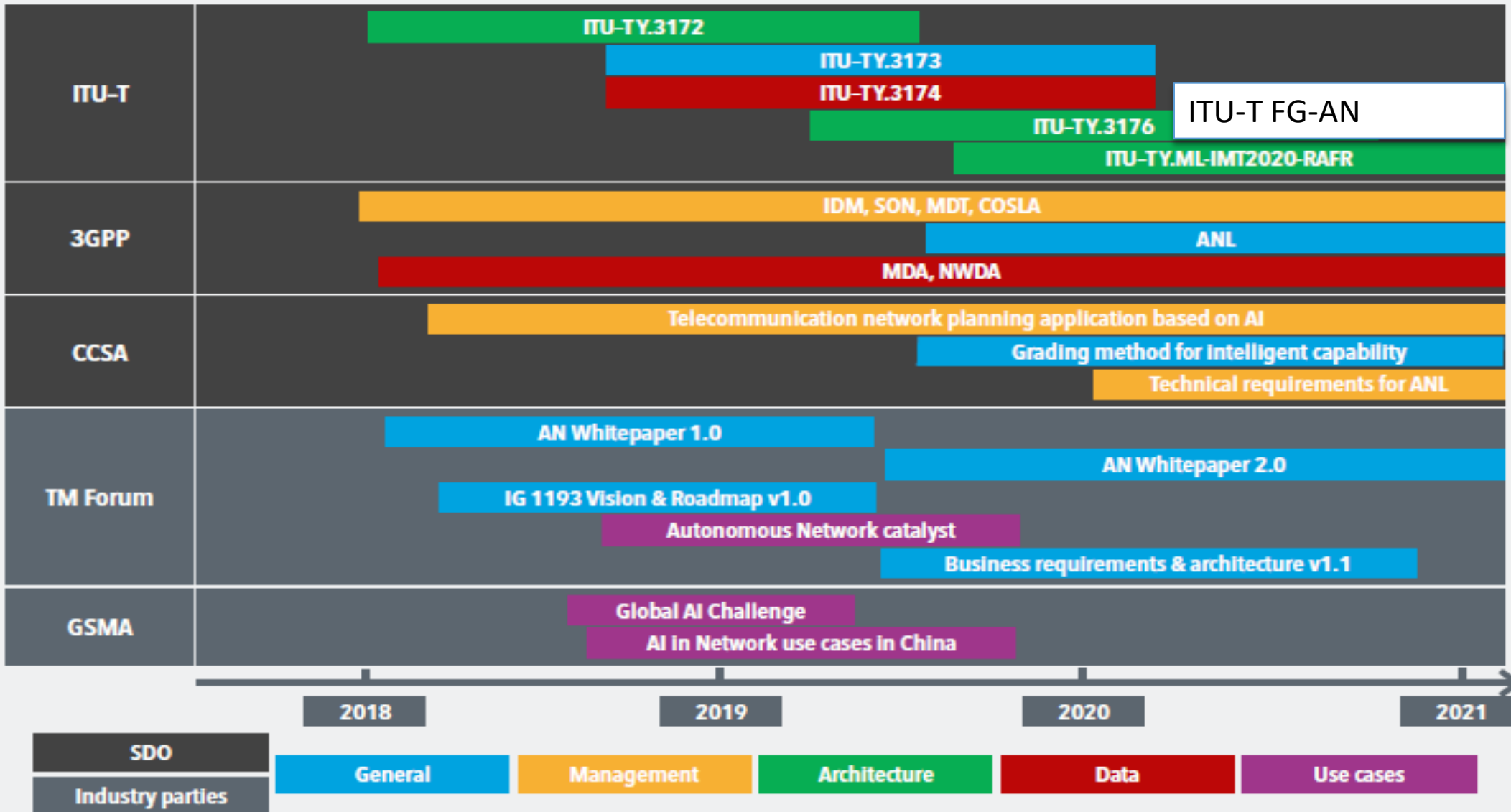
NOTE 1 – For each network intelligence level, the decision process has to support intervention by human being, i.e., decisions and execution instructions provided by a human being have the highest authority.

NOTE 2 – This table may be used to only determine the network intelligence level for each dimension (and not the overall network intelligence level).

Autonomous Networks

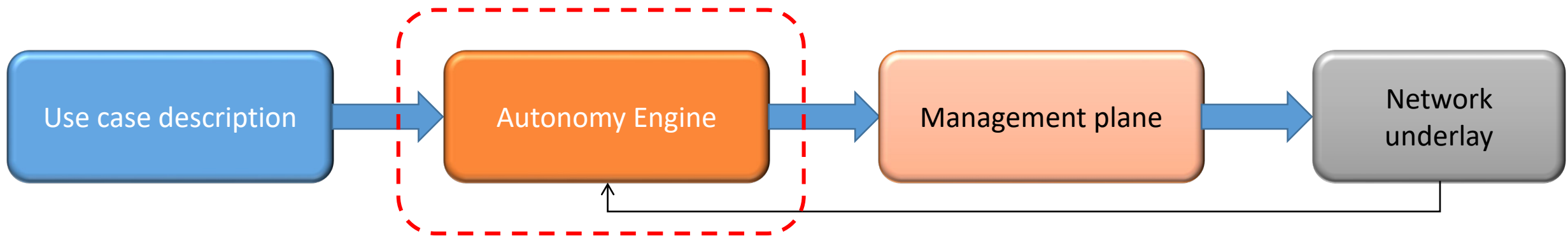
Figure 2 – Main activities of SDOs and industry bodies

Ref: “A standards round-up on autonomous networks”, <https://www.itu.int/en/myitu/-/media/Publications/ITU%20News%20Magazine/2020/En%20-%20AI%20and%20Machine%20Learning%20in%205G.pdf>



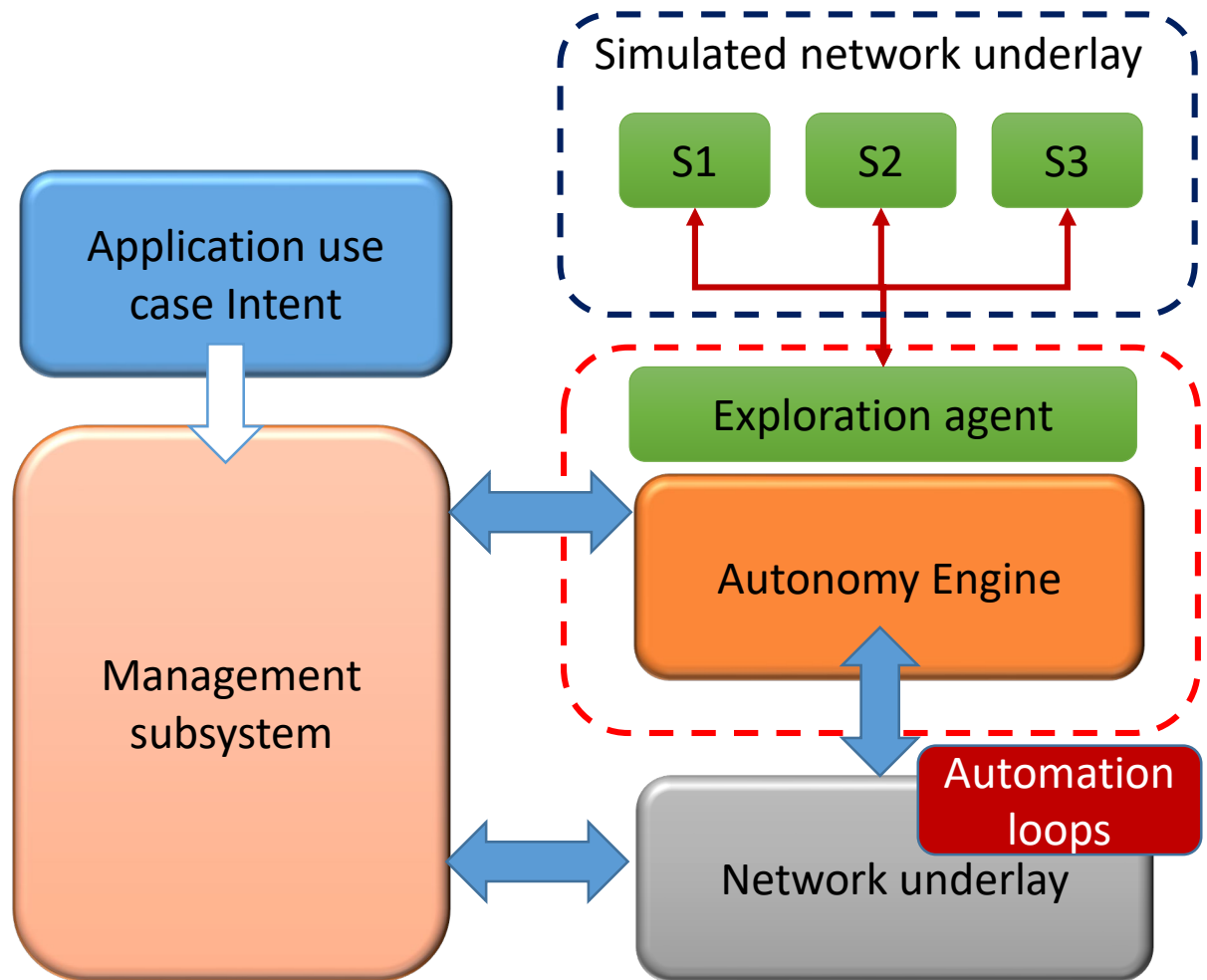
Autonomous Networks

- Knowledge center: Representation of human knowledge, combined with collected information from the network and ongoing knowledge gained through trial and error experimentation.
- Evolution: is a codifiable mechanism to drive the creativity that is required in addressing the unknown challenges of future networks.
- “Sandbox”: construction of simulation and canary testing environments



Ref: “Autonomous networks: Adapting to the unknown”, <https://www.itu.int/en/myitu/-/media/Publications/ITU%20News%20Magazine/2020/En%20-%20AI%20and%20Machine%20Learning%20in%205G.pdf>

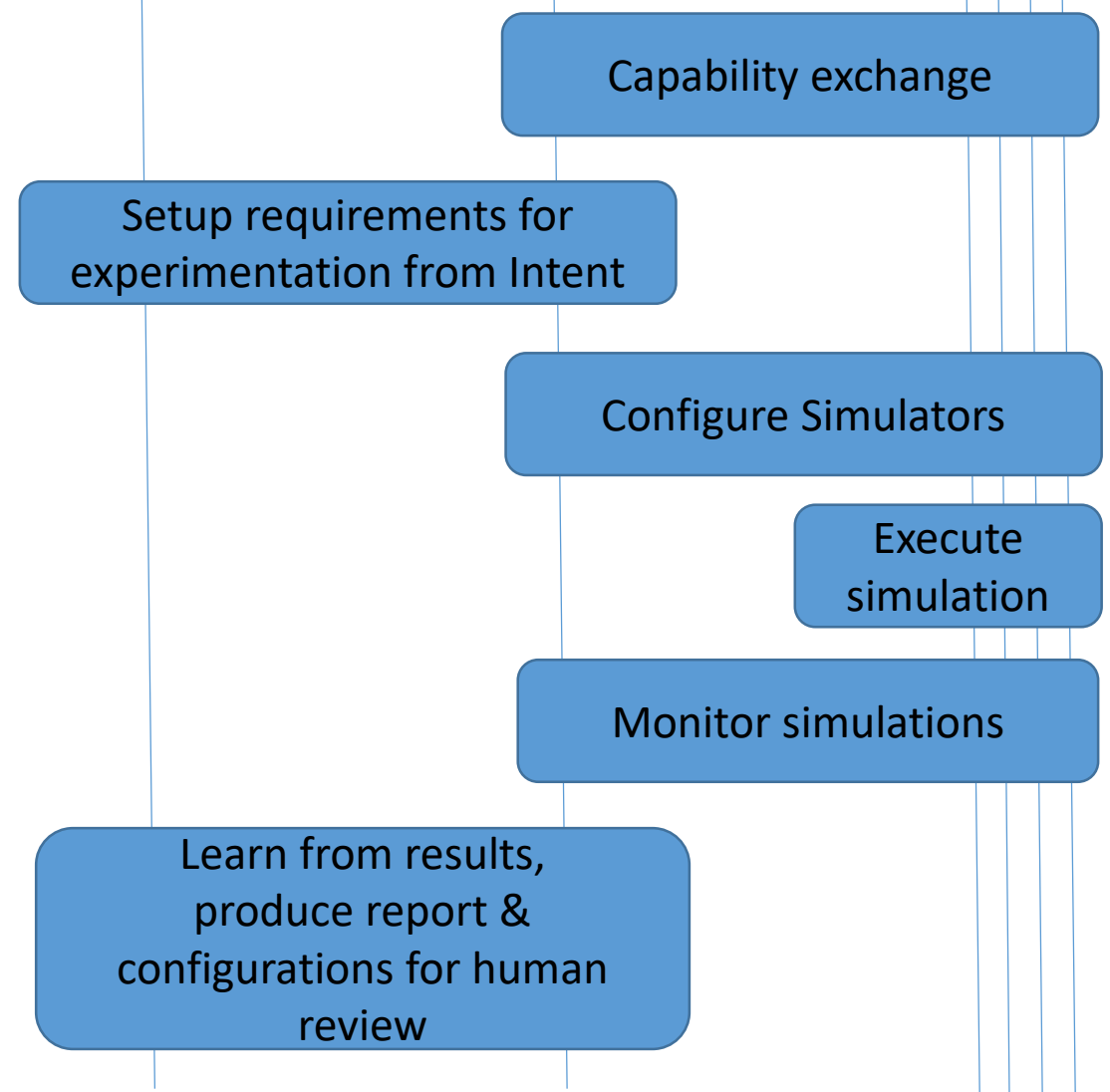
Use case analysis – cat 1



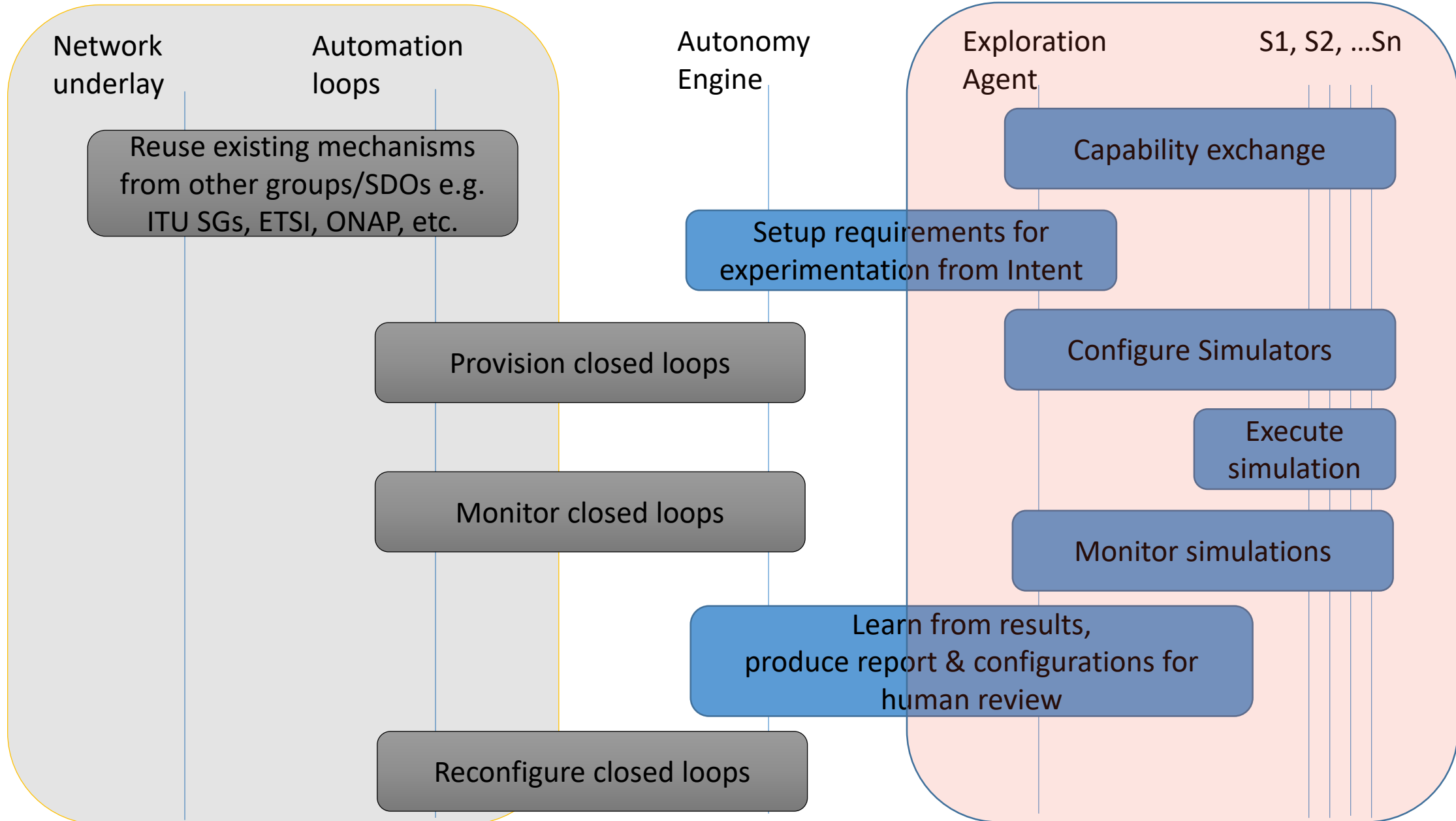
Autonomy Engine

Exploration Agent

S1, S2, ...Sn



Reference points

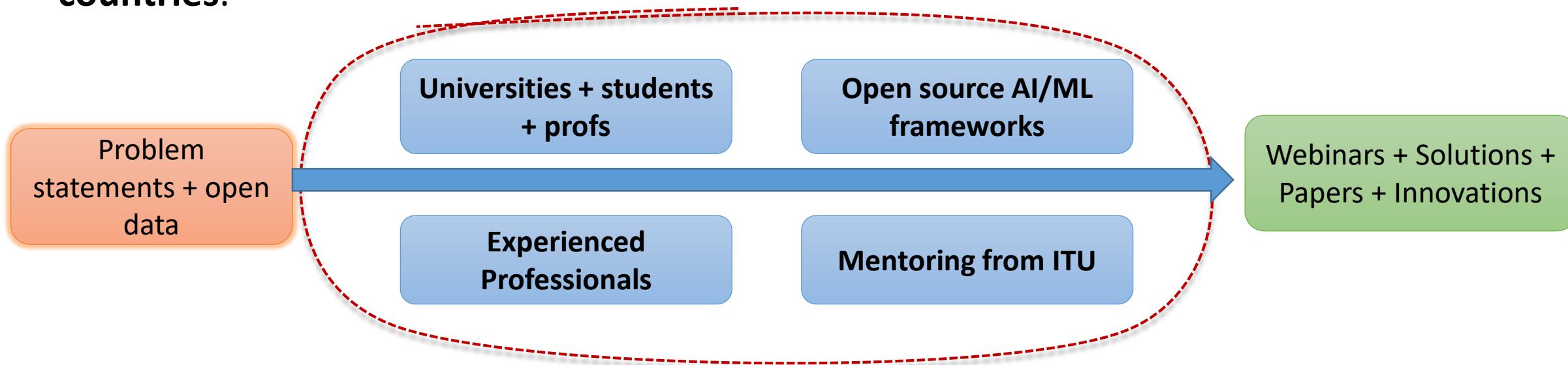


Agenda

- AI/ML in networks
- Autonomous Networks
- Opportunities for collaboration

ITU's AI/ML in 5G Challenge

- Example problems: How to predict network failures? How to use AI/ML for network traffic recognition? Channel estimation and Beam selection? Predicting packet delay using GNN, etc
- AI/ML in 5G Challenge concluded with “Grand Finale” on 15-17 Dec 2020
- Global competition in which **26 partners** (telecom operators, vendors, and academia) hosted **23 problem statements** with participation from **1300+ participants** from **60+ countries**.



Applying AI/ML standards from ITU, Creating crowd-sourced innovations and practical implementations
IIT/D was regional partner: <https://www.itu.int/en/ITU-T/AI/challenge/2020/Pages/default.aspx>

Challenge mythology

Myth	Data from real networks is all private and cannot be opened for the Challenge.
Fact	Open datasets, including from real networks, are available in ITU AI/ML in 5GChallenge website
Wish	However, we need more!

Myth	AI/ML challenges are for data scientists
Fact	A mix of participants (students, professionals, researchers) from 60+ countries
Wish	Equal access to GPUs and tools for model training and testing.

It is **MY** data.



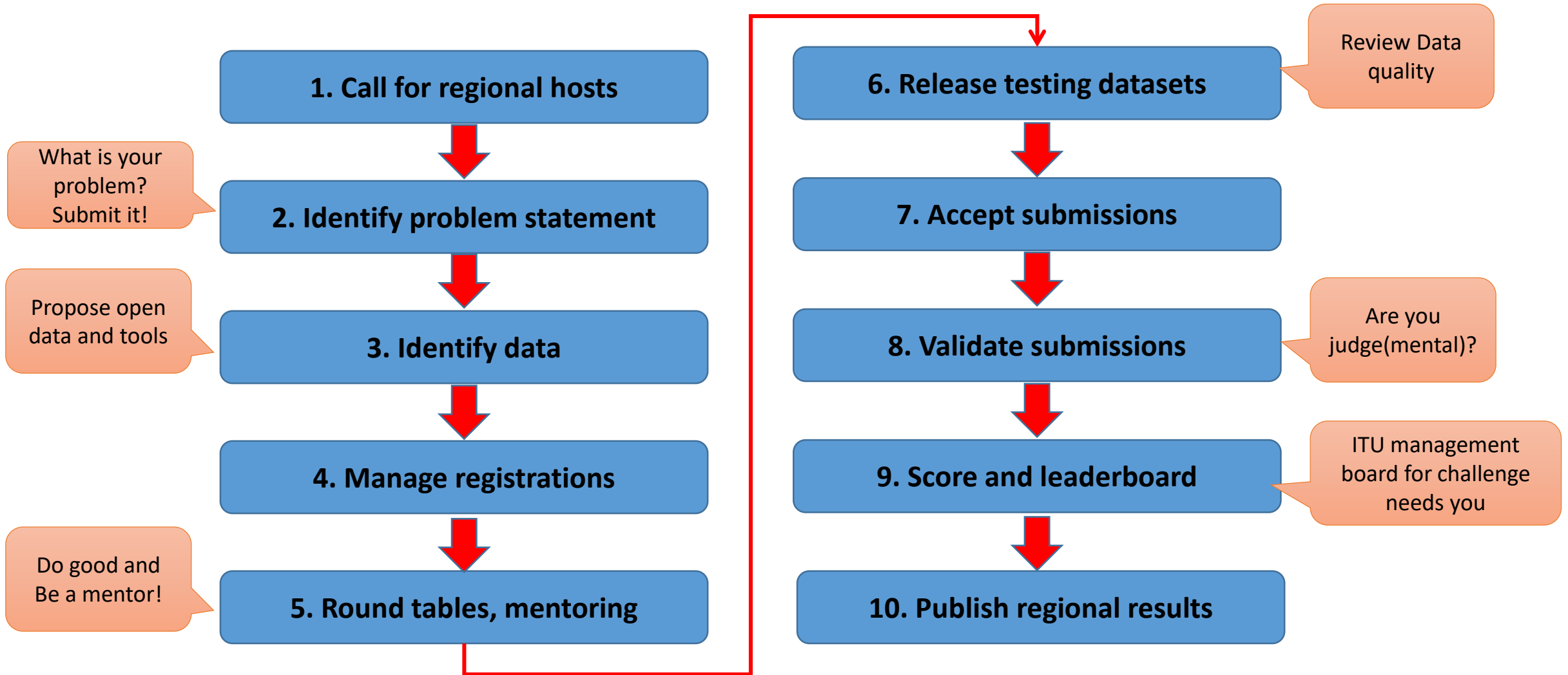
Book image:

<https://www.simonandschuster.com/books/Oscar-Wildes-The-Selfish-Giant/Oscar-Wilde/9781620875407>

Challenge mythology

Myth	We are here to win \$\$\$ as the prize
Fact	<ul style="list-style-type: none">• 26 webinars by leading researchers• Round-table discussions with participants and hosts• Connecting to ITU standards• Open source• Management team discussions• By the way - \$\$\$ too
Wish	Create a distributed team with mindshare in AI/ML and networks

Opportunities for collaboration



Opportunities for collaboration

ITU-T Focus Group on Autonomous Networks and its first virtual meeting: 2 - 4 February 2021 

- Participation in FG-AN is free of charge and open to all relevant parties
- <https://www.itu.int/en/ITU-T/focusgroups/an/>
- **Written contributions are invited on**
 - (1) specific use cases and their standardization questions; and
 - (2) key concepts of autonomous networks such as exploratory evolution, real-time responsive experimentation, dynamic adaptation as well as terms, definitions, concepts, requirements, research gaps, methods, formats, (standards) ecosystem.
- Written contributions should be submitted by e-mail to the FG Secretariat (tsbfgan@itu.int) by **27 January 2021**
- The meeting times are 13:00 – 16:00 (CET) on each of the three days

Thank you!
Vishnu.n@ieee.org