Workshop on Standards-driven Research @COMSNETS 2024

How to mess up a standardization opportunity

Vishnu Ram OV

Acknowledgement:
This work draws upon the last 5 years of work done in collaboration with ITU AI4Good, TSDSI as well as National Working Group of TEC, India.

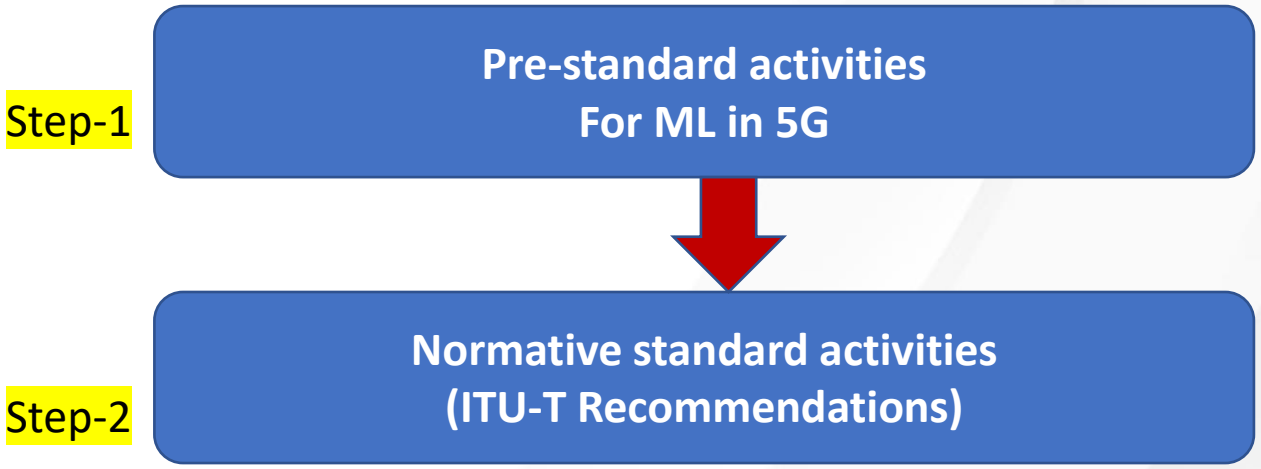
Agenda

1. Case study-1: ML5G standards
2. Case study-2: Autonomous Networks and AI Native
3. Case study-3: WTSA 2024, New Delhi

A set of 15 Learnings: to avoid falling down the standards wall.

Case study-1: ML5G standards (the initial goals)

Year: 2017
Goal: Create normative standards(ITU-T Recommendations) for ML in 5G.



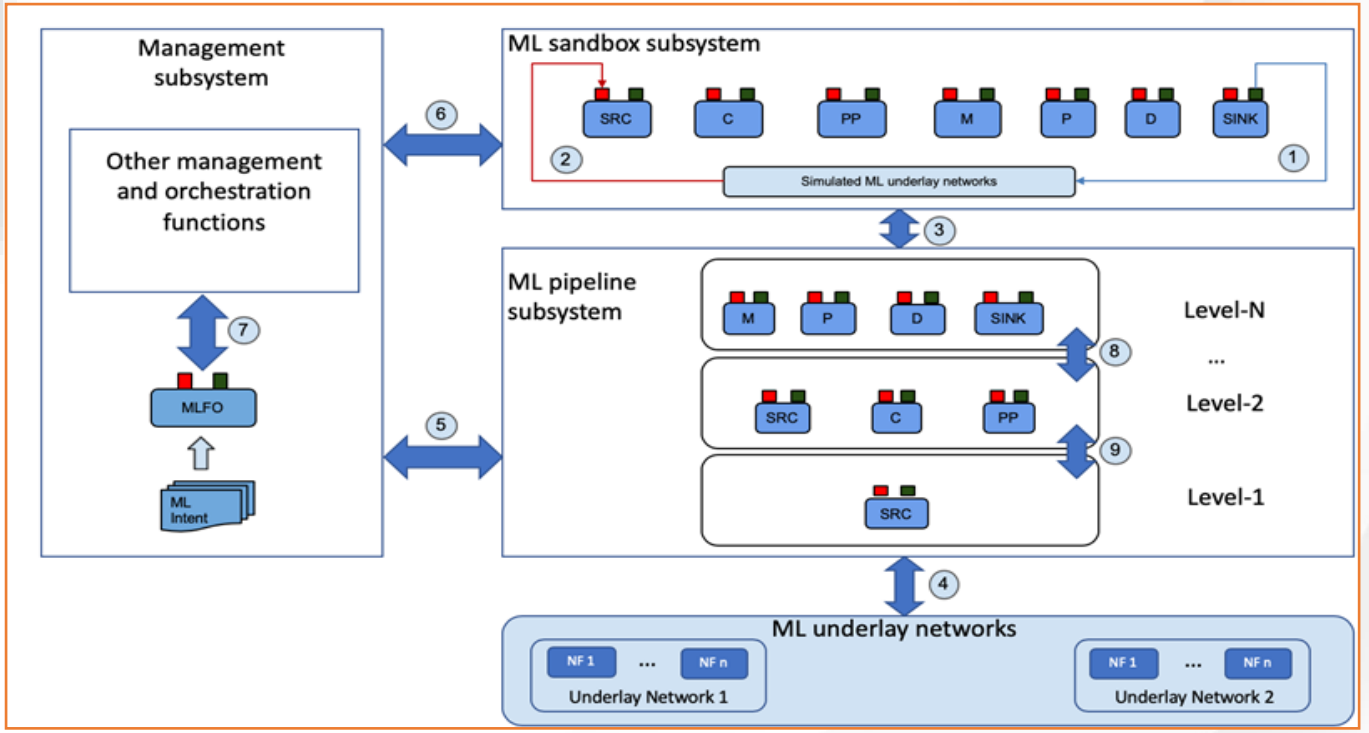
Case study-1 : ML5G standards (the output)

[2018-2020]

A study of use cases for ML in 5G

ITU-T Y.3172

- An open, collaborative study, driven by contributions from around the world
- Analysed more than 30 use cases
- Requirements classified as “critical”, “expected”, “added value”.
- Architecture Framework provides a common language for managed ML in networks



ITU-T Y.3172, “Architectural framework for machine learning in future networks including IMT-2020”

Case study-1: ML5G standards (the checkpoint)

Step-1

Pre-standard activities
(Focus Group documents, ITU-T Supplements)

Step-2

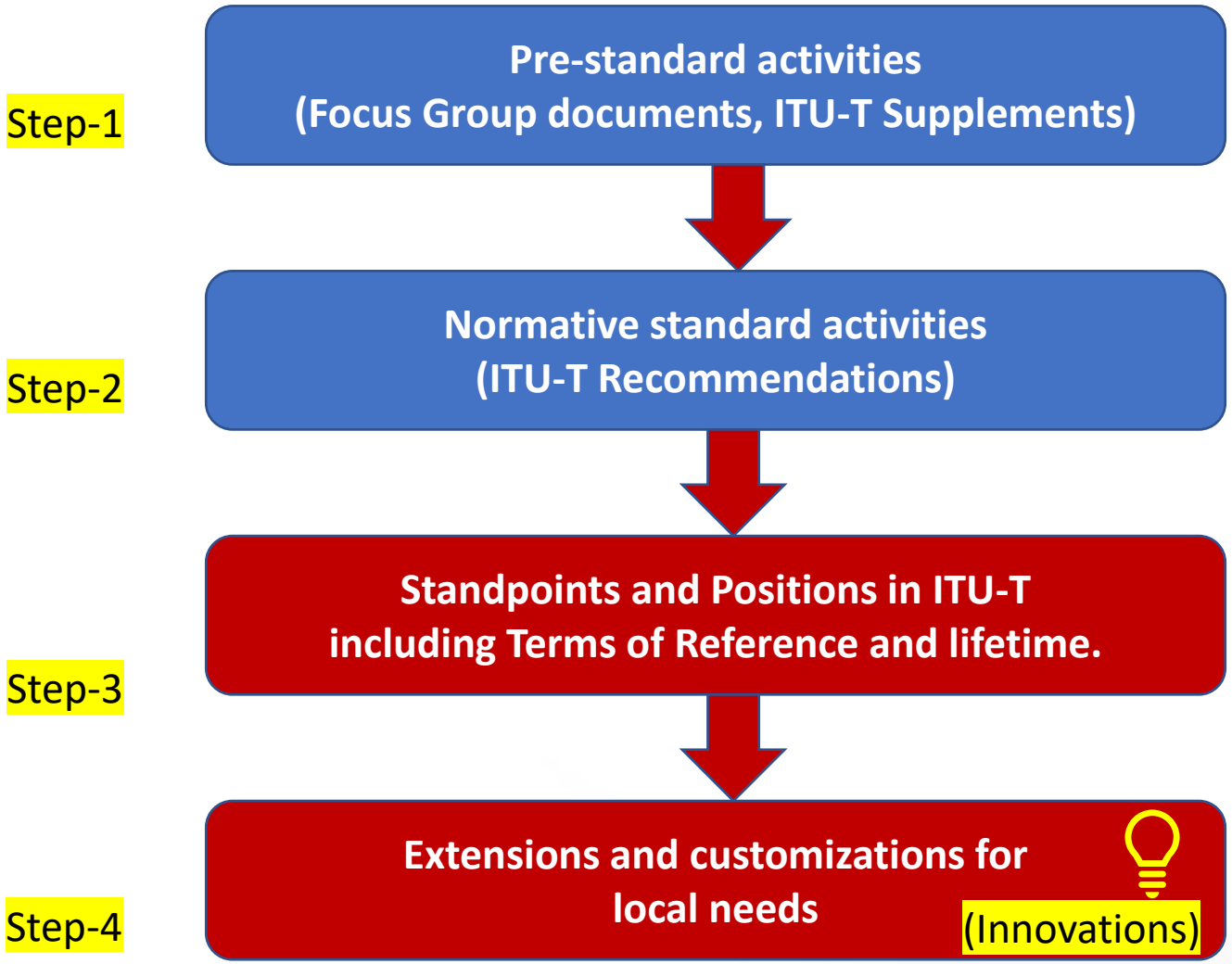
Normative standard activities
(ITU-T Recommendations)

ITU FG ML5G specification: Requirements, architecture and design for MLFO

ITU-T Y.3172, "Architectural framework for machine learning in future networks including IMT-2020", was one of the most downloaded "fresh" ITU-T standards.

Declare success?

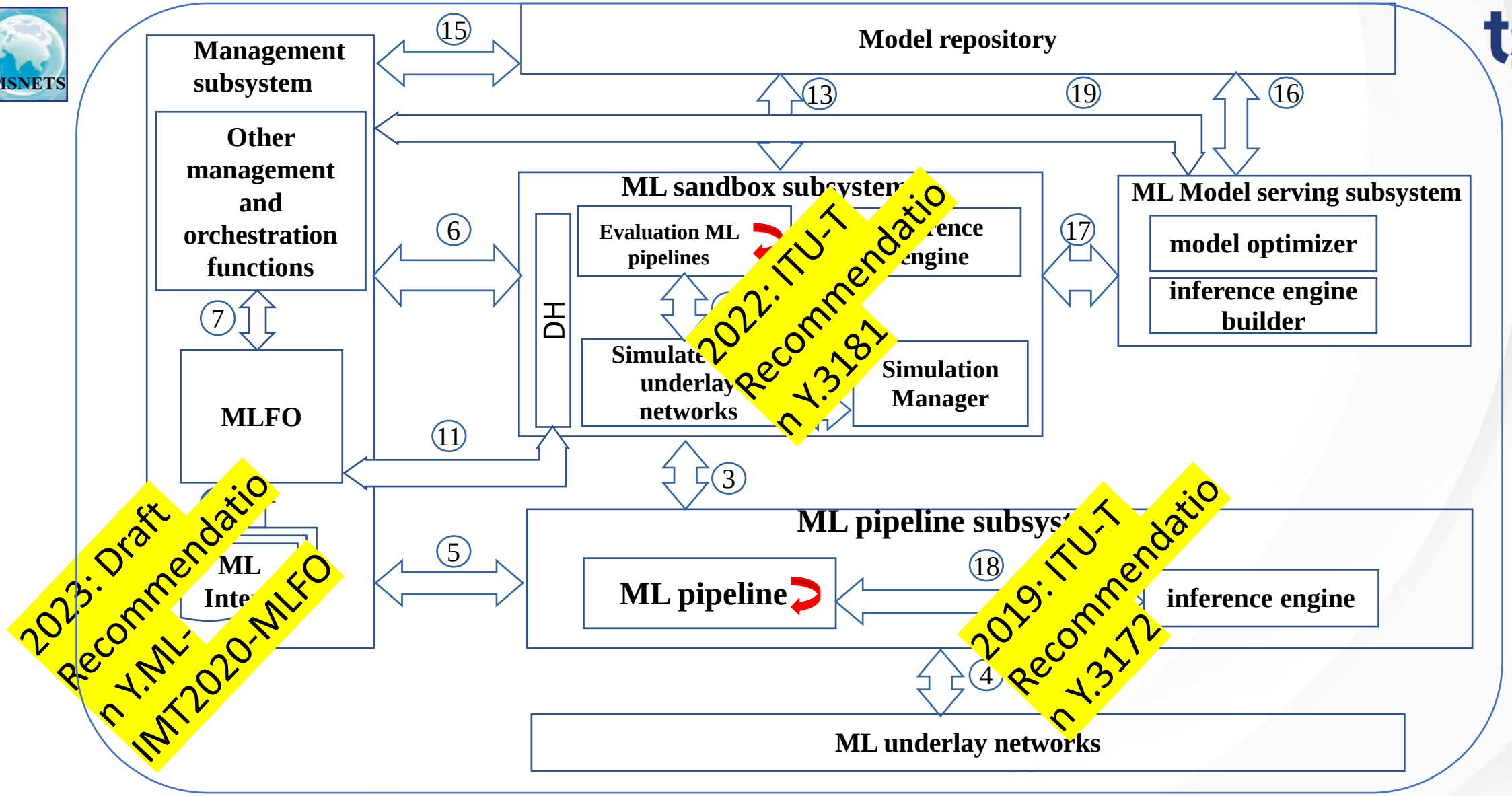
Learnings-1: study the gaps



Extensibility?

Monetising?

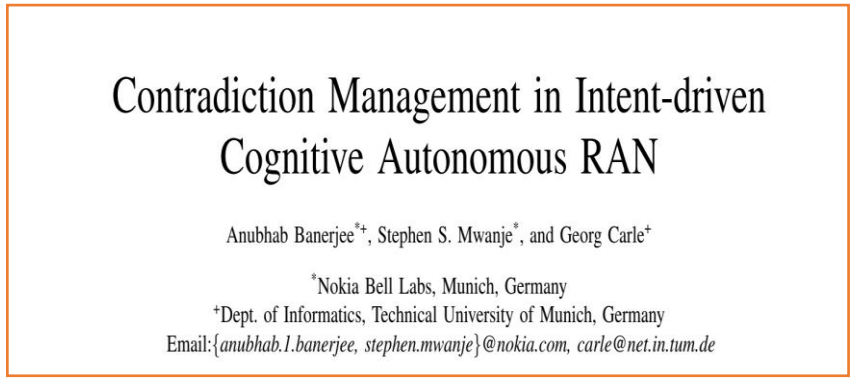
Implementations?



A long-term view for building a generic architecture framework, which forms the basis for AI/ML in 6G and future networks is important.

Learnings-2: study the impacts

- ITU-T Y.3172
- ITU-T Y.3173
- ITU-T Y.3174
- ITU-T Y.3176
- ITU-T Y.3179
- Suppl 55 to Y.3170



***TSDSI** mobilised participation in **local events, workshops and ITU level competitions in the area of Autonomous Networks** under the ITU-T Focus Group on Autonomous Networks with support from the India EU PP. The contributions of teams from India such as **IIT Bhilai, Nokia, TCS, Univ of Kashmir**, have been incorporated in the FG's technical report on PoCs. This Technical Report has been submitted to SG13. A collaborative paper on this work was also published in **the ITU Journal for Future and Evolving Technologies (ITU J-FET)** by these authors.*

Learning-3: Form the India blueprint

Pre-standard activities

- 2017-2019: **India Contribution:** ITU-T informative documents, [ITU-T Y.3170-series] Supp 55
- 2020: **India Contribution**: "Equitable AI" World Telecom Standards Assembly Resolutions
- 2022: **India Contribution**: [Y.Sup71] ITU-T Supplement 71

Normative standard activities

- 2019: **Editor** for ITU-T Recommendation Y.3172
- 2022: **Editor** for ITU-T Recommendation Y.3181

India-specific debate positions in ITU-T

- 2020: **India Contribution**: ITU-T Focus Group on Autonomous Networks was established by ITU-T Study Group 13.
- 2021: **India Contribution**: ITU-T Focus Group on Autonomous Networks was renewed by ITU-T Study Group 13.

Extensions and Customizations

- 2023: **Editor**: Draft Recommendation Y.ML-IMT2020-MLFO "Architectural framework for MLFO in future networks including IMT-2020"

Case study-2: Network Autonomy and AI Native (the goal)

Study use cases for local applications

Pool Knowledge Base from around the world

Study the advances in AI/ML

- **2022**: Created ITU knowledge base and co-pilot and data collection was done for autonomous networks.
- **2023**: ITU FG AN Build-a-thon on-going is generating use cases and validating in human loop

Study the AI-native features in 6G

- **2022:** Webinars on digital twins, guidance on simulations and sensing helps in cognitive, AI-native features
- **2020-2023:** Published Architecture framework Composition and Evolution of network functions

Gaps and integration for ML/6G

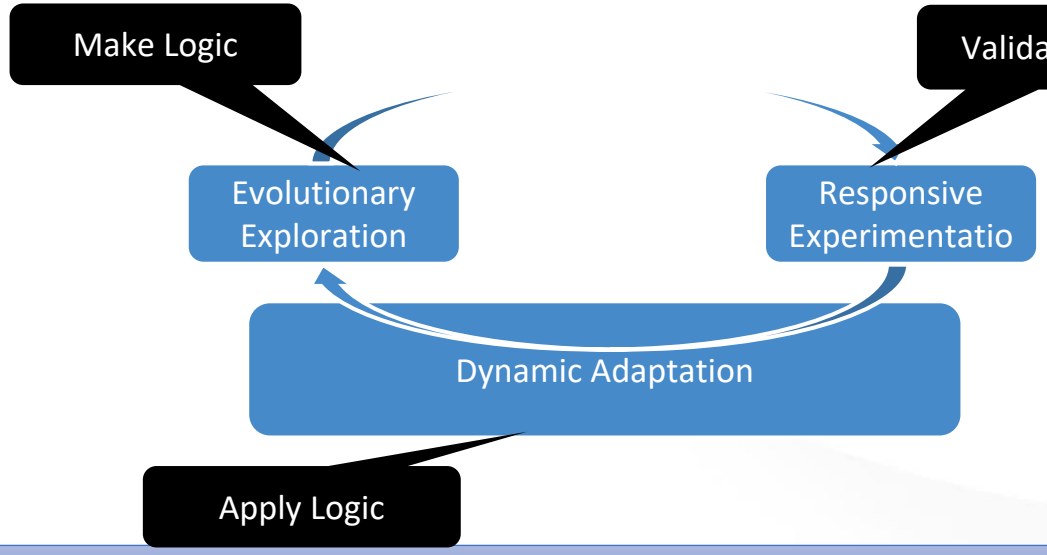
- **2024: Ongoing.**

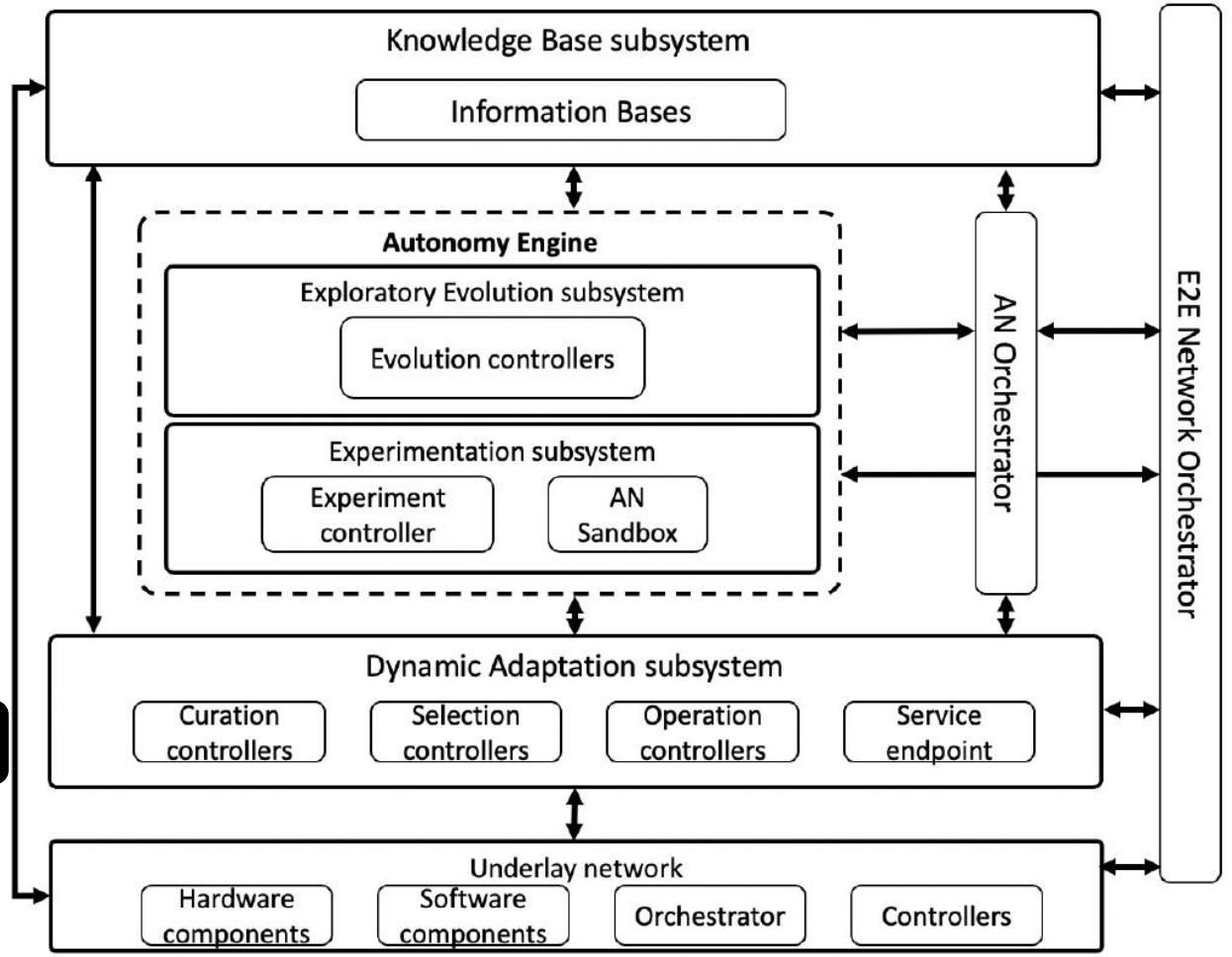
Case study-2: Autonomy & AI Native (the output)

Studied use cases for AN

Architecture framework for AN

Build-a-thon Proof of Concept





Build-a-thon PoC is a coding competition with **100+** participants since 2020

Learning-4: Do you have a local foothold?

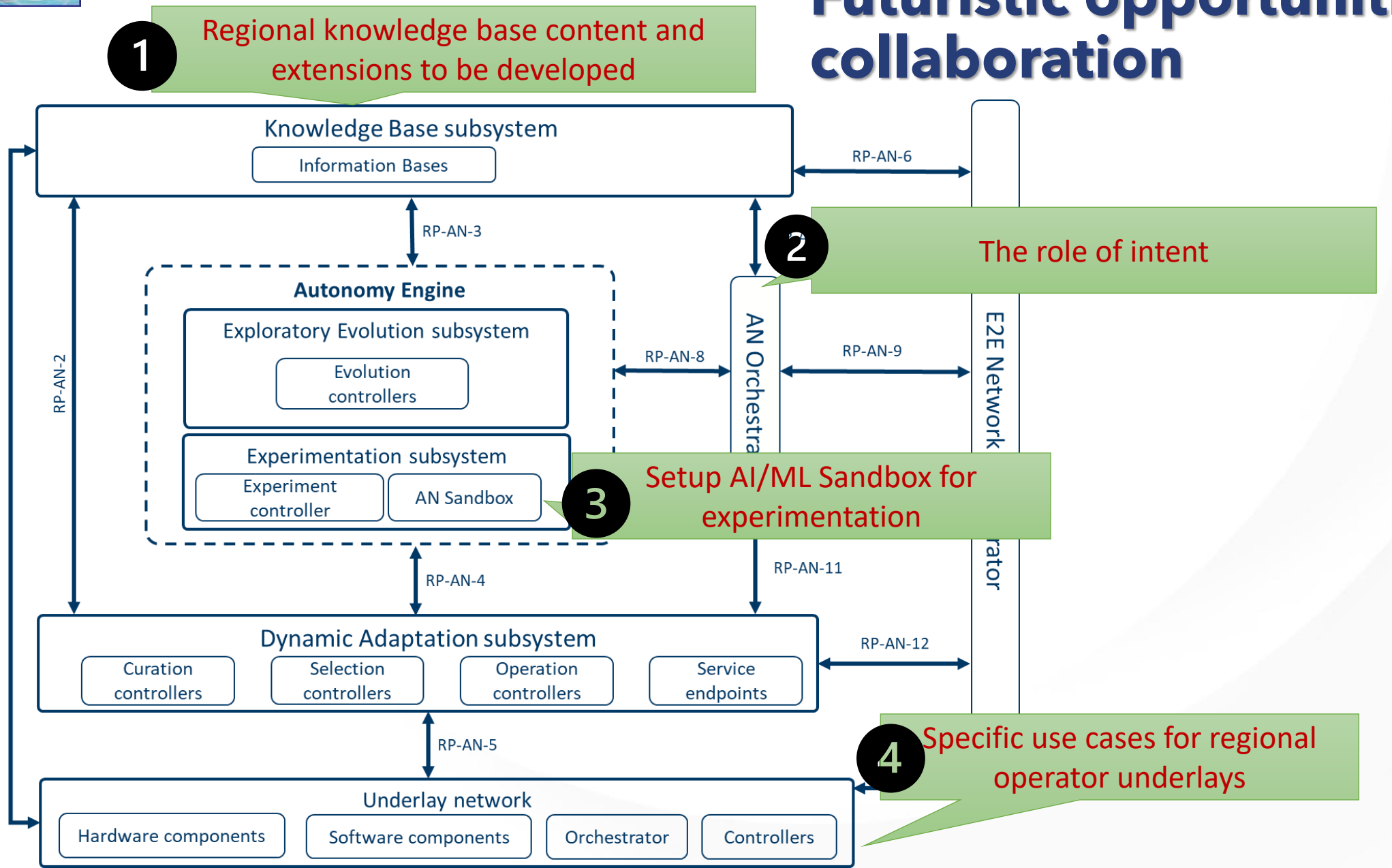
- Study use cases for local applications
- Pool Knowledge Base from around the world
- Fine tune with local experience and data
- Monitor with feedback

Local relevance?

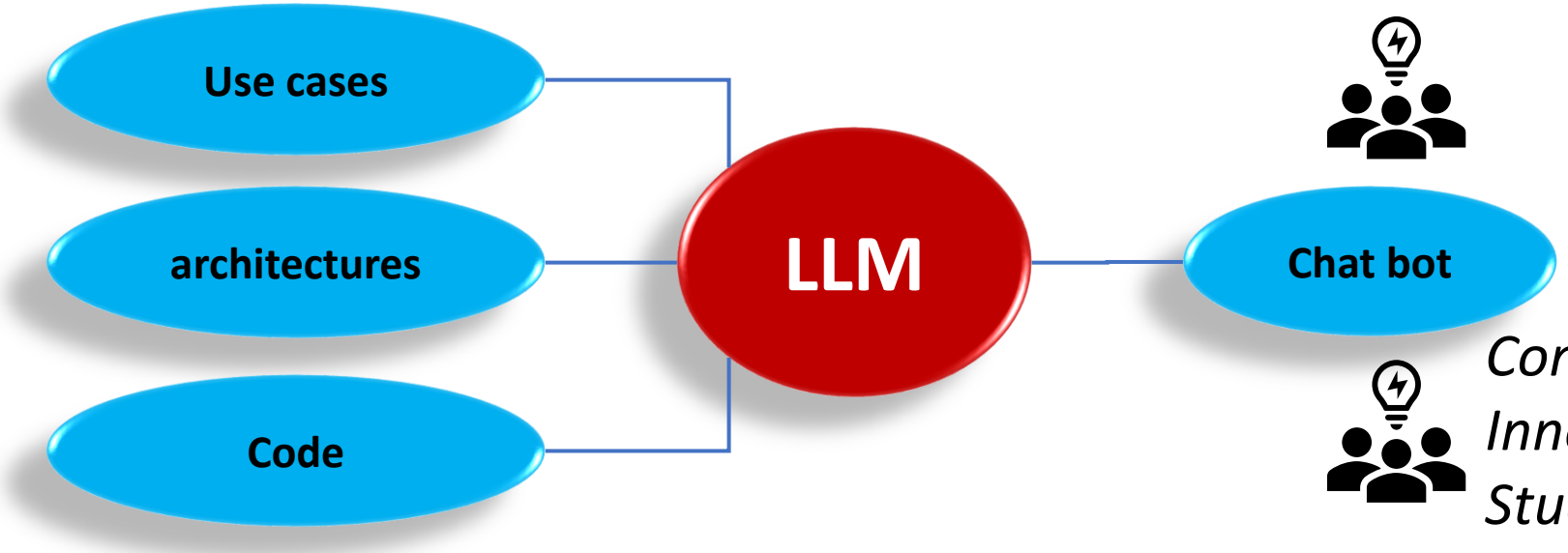
Expert ecosystem?

Proof of Concept?

Learnings-5: Identify: Futuristic opportunities for collaboration



Learnings-6: Prove a point with PoC

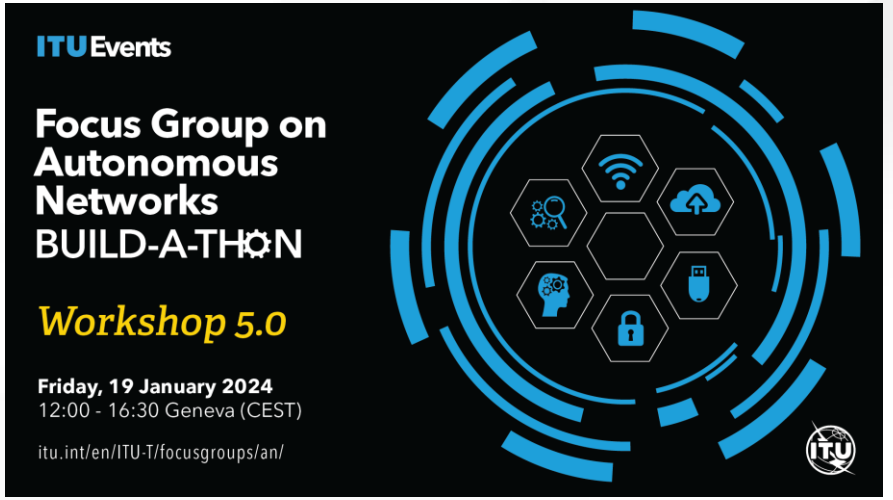


Contributors and Innovators and Students

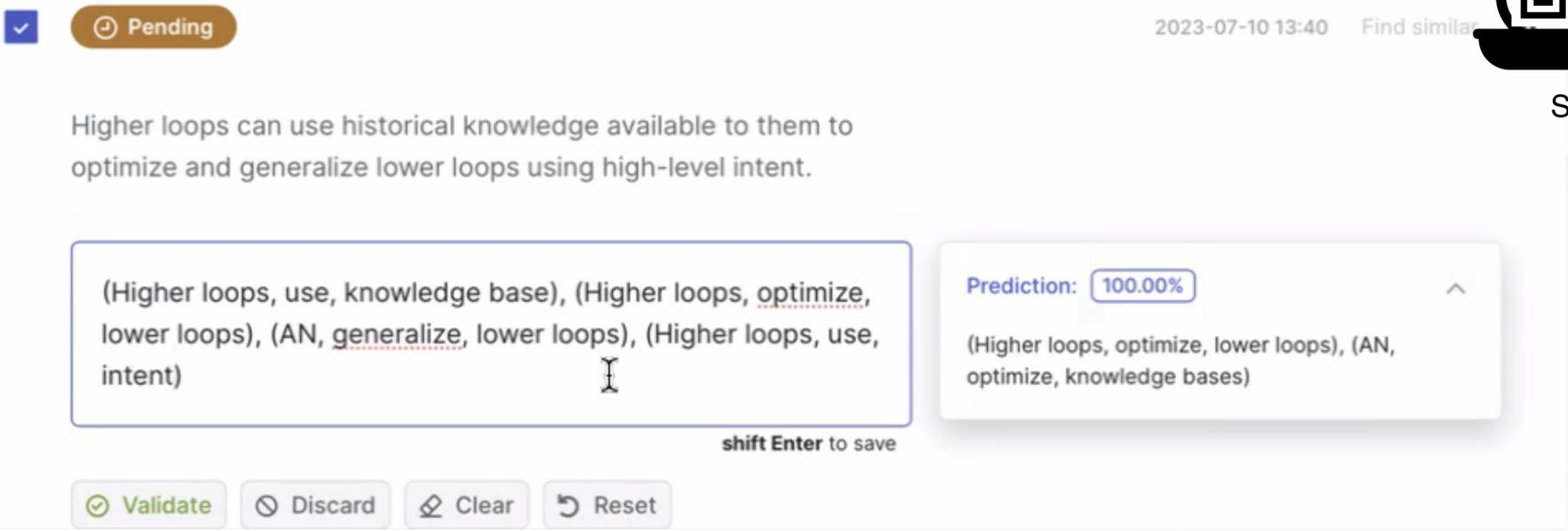
Scan me!

- ITU is conducting Autonomous Network Build-a-thon
- A chatbot is trained to assist contributors and innovators

https://github.com/vrra/FGAN-Build-a-thon



Learnings-7: Single-click hosted notebooks



Scan me!

Learnings-8: local datasets in HF

Datasets: vishnuramov / ITU-T-Build-a-thon like 0

Dataset card | Files | Community | Settings

Dataset Preview Size: 15.9 kB | API | Go to dataset viewer

text (string)	inputs (dict)	prediction (null)	prediction_agent (null)	annotation (null)
"Debido a que las suscripciones móviles…	{ "text": "Debido a que las suscripciones…	null	null	null
"standortübergreifende Impact und Root Cause…	{ "text": "standortübergreifend…	null	null	null
"從4/5G綜合網管收集實時數據，然後根據數據監控網元，…	{ "text": "從4/5G綜合網管收集實時數據，然後根據數…	null	null	null

Scan me!

Learnings-9: Open datasets as standards Enablers

- We consider measurements for **8 days** from **>1000 RRU/AAUs**, comprising **12 different products**
- The following datasets are available:
  - **Base Station basic information**
    - configuration parameters and hardware attributes.
  - **Cell-level data**
    - hour-level count[illegible]luding service compliance counters (e.g., [illegible] and energy-saving methods counters ([illegible]ation of energy saving mode activation)
  - **Energy consumption data**
    - hour-level energy consumption specifications (e.g., total energy consumption of the base stations)

Source: Huawei

https://challenge.aiforgood.itu.int

https://www.youtube.com/watch?v=zSetefnu3y8

In Progress **ITU-ML5G-PS-001: AI/ML for 5G-Energy Consumption Modelling**

to design a machine learning-based solution that can be trained on a dataset of few scenarios a nd then generalize successfully to data from scenarios not seen before to achieve more energy-efficient network deployments

Organizer：Huawei

In Progress **ITU-ML5G-PS-007: Graph Neural Networking Challenge 2023 - Creating a Network Digital Twin with Real Network Data**

This edition of the Graph Neural Networking challenge focuses on developing for the first time a GNN-based Network Digital Twin using a dataset from a real network.

Organizer：BNN-UPC

In Progress **ITU-ML5G-PS-006: Intrusion and Vulnerability Detection in Software-Defined Networks (SDN)**

Using provided datasets, participants will provide a machine learning model that can classify tra ffic flows and detect Intrusion and Vulnerability in SDN

Organizer：ULAK

In Progress **PS-003: Multi-environment automotive QoS prediction**

Berlin V2X offers multi-operator vehicular communication data across urban environments for Q oS prediction, lending itself to transfer learning & domain adaptation to generalize across domai ns.

Organizer：Fraunhofer HHI

Learnings-9: Open datasets as Enablers (2)

Berlin V2X: A Machine Learning Dataset from Multiple Vehicles and Radio Access Technologies
https://arxiv.org/abs/2212.10343

In Progress **PS-005 -- Depth Map Estimation in 6G mmWave systems**

propose an AI/ML algorithm that reconstructs the depth map of an indoor environment, given a data set consisting of mmWave MIMO channel impulse responses and the corresponding depth map representation of the room.

Organizer：NIST

In Progress **PS-002 - Fault Impact Analysis: Towards Service-Oriented Network Operation & Maintenance**

leveraging ML/AI to predict the impact of faults on network KPIs

Organizer：Huawei

In Progress **tinyML Hackathon Challenge 2023: Pedestrian Detection**

Cost effective and accurate solutions are needed to detect pedestrians during the day and espe cially at nighttime to implement safety measures.

Organizer：tinyML Foundation

Data category	Source	Tool	Sampling interval	Features
LTE stack	In-vehicle device	MobileInsight	10 ms	PHY: SNR, RSRP, RSRQ, RSSI
			20 m	PDSCH/PUSCH: RBs, TB Size, DL MCS, UL Tx Power
			Ev ased	RRC: Cell Identity, DL/UL frequency, DL/UL bandwidth
Quality of Service	In-vehicle device	ping		Delay
		iperf		DL Datarate, Jitter
	Server	iperf	s	UL Datarate, Jitter
Position	GPS	NA	1 s	Latitude, Longitude, Altitude, Velocity, Heading
Side information	Internet database	HE	min	Traffic Jam Factor, Traffic Street Name, Traffic Distance
			1 hour	Cloud cover, Humidity, Precipitation Intensity & Probability, Temperature, Pressure, Wind Speed
Metadata	NA		NA	Scenario, operator, drive type, target datarate, direction

Source: Fraunhofer and AI4Mobile

https://challenge.aiforgood.itu.int

https://www.youtube.com/watch?v=XLmla59BS7w

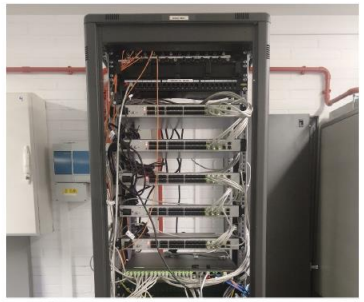
Learnings-10: testbeds are more important than real networks

https://challenge.aiforgood.itu.int

https://www.youtube.com/watch?v=QzDTYyWzpr0

Building a Network Digital Twin using data from Real Networks

https://bnn.upc.edu/challenge/gnnet2023



Cash Prizes:
1st Prize: 2000 EUR
2nd Prize: 500 EUR

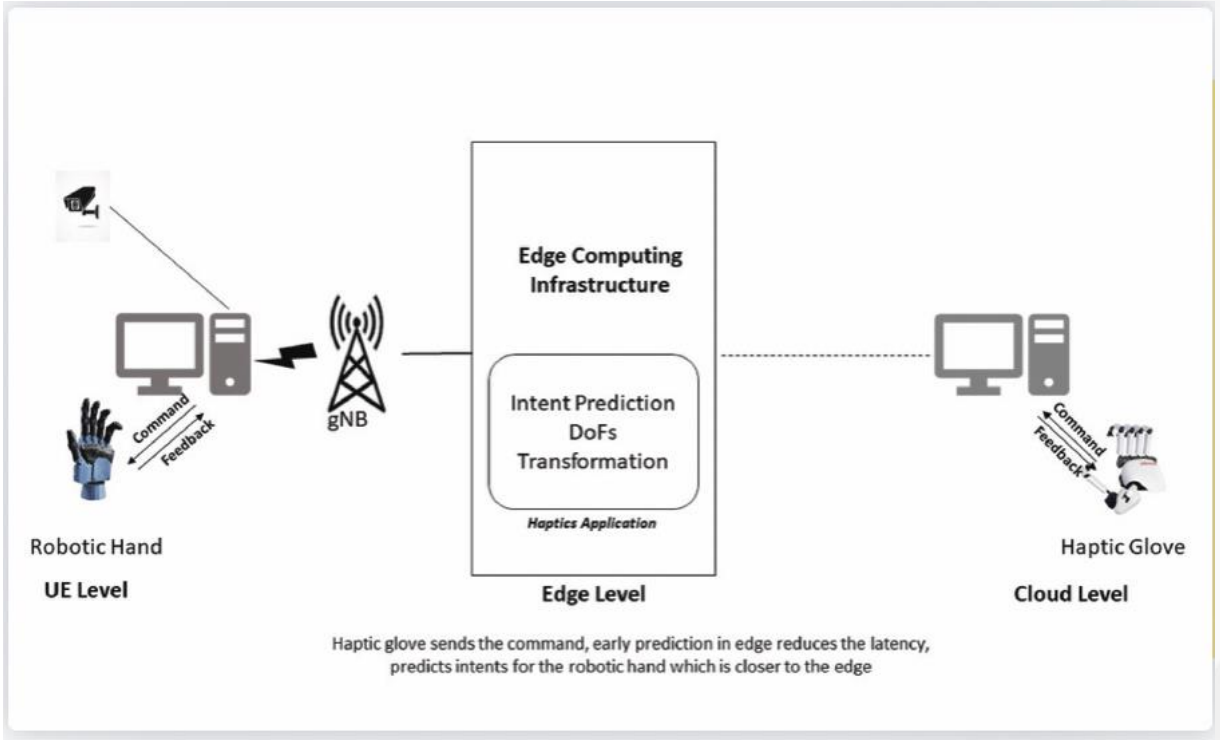
- Build the **first** Network Digital Twin using data from a **real network**
- Input traffic are realistic packet traces
- **Registration is now open**
- Submit your solutions by October 2nd 2023

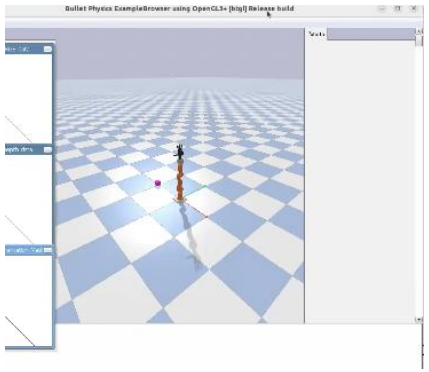
- GNN have been recently proposed by DeepMind *et al.* to learn and model information structured as a **graph**

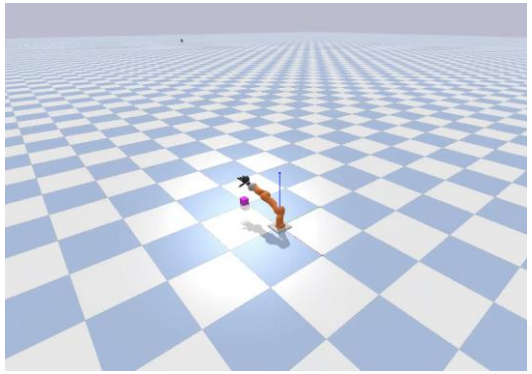
Component	Entities	Relations	Rel. inductive bias	Invariance
Fully connected	Units	All-to-all	Weak	-
Convolutional	Grid elements	Local	Locality	Spatial translation
Recurrent	Timesteps	Sequential	Sequentiality	Time translation
Graph network	Nodes	Edges	Arbitrary	Node, edge permutations

Learnings-10: testbeds are more important than real networks

- MEC Test Bed integrated with 5G Core conforming ETSI standards
- Time series Labeled Datasets were provided
- tested on the Test-Bed with actual hardware (Allegro Hand and Haptic glove)
- APIs for the test bed to integrate







References: [FGAN-I-289-R5]

- Problem statement I - Slip Detection and Force Estimation
- Problem statement II - Object Detection

https://bhartischool.iitd.ac.in/build_a_thon/index.html

Learnings-11: Energize local experts

100+ Webinars since 2020

> 10,000 views in 2021

6 May 2022

From 5G to 6G: The key challenges to overcome

14:00 - 15:30 CEST, Geneva | 08:00-09:30 EDT, New York | 20:00-21:30 CST, Beijing

Sławomir Stańczak (HHI)

13 June 2022

Multi-Modal Sensing Aided Communicatic and the Role of Machine Learning

18:00 - 19:30 CEST, Geneva | 12:00-13:30 EST New York | 00:00-01:30 CST, Beijing

Thomas Basikolo (ITU), Vishnu Ram OV, Ahmed Alkhateeb (Arizona State University)

22 July 2020

ITU AI/ML in 5G Challenge: Radio Link Failure Prediction Challenge

14:00 - 15:00

Salih Ergut (OREDATA)

Discovery - AI/ML in 5G

12 May 2021

Towards cognitive autonomous networks (5G and beyond)

14:00 - 15:00

Henning Sanneck (Nokia Standards)

Discovery - AI/ML in

10 November 2021

Data-driven baseband processing and sensing for smart & efficient virtualized RAN in 5G and beyond

15:00 - 16:00

Tim O'Shea (DeepSig

10 May 2022

Federated traffic prediction for 5G and beyond

14:00 - 15:30 CEST, Geneva | 08:00-09:30 EST, New York | 20:00-21:30 CST, Beijing

Francesc Wilhelmi (CTTC), Marco Miozzo (CTTC), Paolo Dini (CTTC)...

1 March 2022

From infancy to independent Neural Networks: The current stage of AI development

10:00 - 10:10

Wei Meng (ZTE)

Perspectives

https://aiforgood.itu.int/eventcat/ai-ml-in-5g/

3 July 2023

Graph Neural Networking challen 2023: Building a Network Digital Twi using data from rea networks

14:00 - 15:00

Albert Cabellos (Universitat Politècn de Catalunya),

12 June 2023

AI – Fuel for the NextGen AR/VR

13:00 - 14:00 CEST Geneva | 07:00-08:00 EDT, New York | 19:00-20:00 CST, Beijing

Brejesh Lall (Indian Institute of Technology), Thomas Basikolo (ITU), Vishnu Ram OV (Consultant)

Discovery - AI/ML in 5G

Learnings-12: Form an ecosystem

COMSNETS

tsdsi
India's Telecom SDO

2020-now

AI for Good
Machine Learning
in 5G Challenge
Solve machine learning puzzles

Arizona State University

Barcelona Neural Networking Center

CTTC

upf. Universitat Pompeu Fabra Barcelona

OLF NETWORKING

ZTE

中国移动 China Mobile

RISING

NIST National Institute of Standards and Technology

KDDI KDDI Research

ITU

Northeastern University

Fraunhofer Heinrich Hertz Institute

HUAWEI

भारतीय प्रौद्योगिकी संस्थान दिल्ली

Cash Prize

GOLD

3'000 CHF

NOKIA Bell Labs

Learnings-13: publications are important

2022 paper based on Build-a-thon PoC

ITU Journal
Future and evolving technologies

Network resource allocation for emergency management based on closed-loop analysis

Authors: Guda Blessed, Ibrahim Aliyu, James Agajo, Thiago Lima Sarmento, Cleverson Volese Nahum, Lucas Novoa, Rebecca Aben-Athar, Mariano Moura, Lucas Matni, Aldebaro Klautau, Deena Mukundan, Divyani R Achari, Mehmet Karaca, Doruk Tayli, Özge Simay Demirci, V. Udaya Sankar, Sai Jnaneswar Juvvisetty, V.M.V.S. Aditya, Abhishek Dandekar, Shabnam Sultana, Jinsul Kim, Vishnu Ram OV
Status: Final
Date of publication: 22 September 2022
Published in: ITU Journal on Future and Evolving Technologies, Volume 3 (2022), Issue 2, Pages 175-201
Article DOI : https://doi.org/10.52953/HVPI8935

2023 paper based on Build-a-thon PoC

ITU Journal
Future and evolving technologies

Build your own closed loop: Graph-based proof of concept in closed loop for autonomous networks

Authors: Jaime Fúster de la Fuente, Álvaro Pendás Recondo, Paul Harvey, Tarek Mohamed, Chandan Singh, Vipul Sanap, Ayush Kumar, Sathish Venkateswaran, Sarvasuddi Balaganesh, Rajat Duggal, Sree Ganesh Lalitaditya Divakarla, Vaibhava Krishna Devulapali, Ebeledike Frank Chukwubuikem, Emmanuel Othniel Eggah, Abel Oche Moses, Nuhu Kontagora Bello, James Agajo, Wael Alron, Fathi Abdeldayem, Melanie Espinoza Hernández, Abigail Morales Retana, Jackeline García Alvarado, Nicolle Gamboa Mena, Juliana Morales Alvarado, Ericka Pérez Chinchilla, Amanda Calderón Campos, Derek Rodríguez Villalobos, Oscar Castillo Brenes, Kodandram Ranganath, Ayushi Khandal, Rakshesh P Bhatt, Kunal Mahajan, Prikshit CS, Ashok Kamaraj, Srinwaynti Samaddar, Sivaramakrishnan Swaminathan, M Sri Bhuvan, Nagaswaroop S N, Blessed Guda, Ibrahim Aliyu, Kim Jinsul, Vishnu Ram
Status: Final
Date of publication: 14 September 2023
Published in: ITU Journal on Future and Evolving Technologies, Volume 4 (2023), Issue 3, Pages 503-536
Article DOI : https://doi.org/10.52953/OPDK5666

Learnings-14: It is important to be generous – Free GPUs

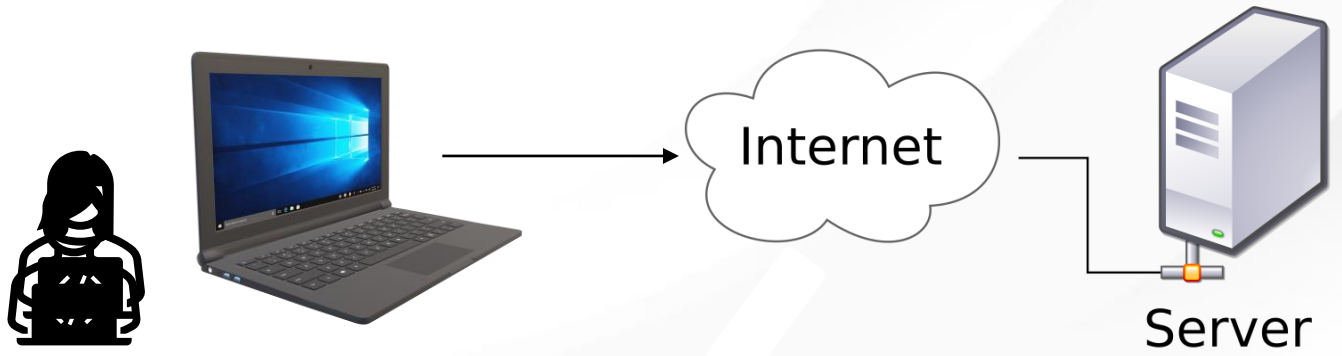
ITU provides State-of the art compute platform for Challenge participants

I. Free GPU access

II. Jupyter Notebooks

III. Python IDE

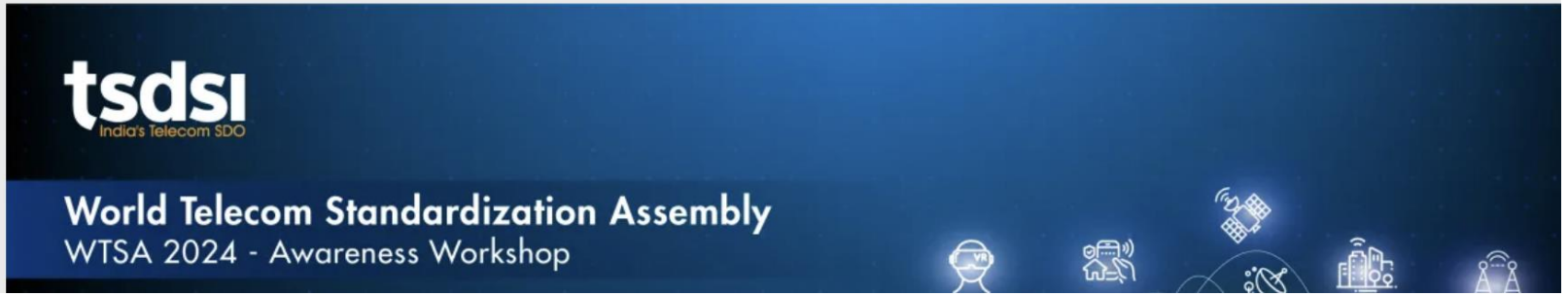
Main Motivations	
	Level the playing field
	Common reference solutions based on standards
	Encourage collaboration and quality submissions.
	Create a Sandbox of cross-domain knowledge



Case Study-3: WTSA New Delhi 2024

World Telecom Standardization Assembly (WTSA) 2024 – Awareness Workshop organised by TSDSI August 11, 2023

August 11, 2023 @ 2:30 pm - 4:30 pm



https://tsdsi.in/event/world-telecom-standardization-assembly-wtsa-2024-awareness-workshop-organised-by-tsdsi/

The World Telecommunication Standardization Assembly (WTSA) is held every four years and defines the next study period for ITU-T. It brings together industry leaders, policymakers, and experts from around the globe to address the challenges and opportunities of the rapidly evolving telecommunication landscape. WTSA serves as a critical platform for setting the agenda and shaping the future of international telecommunication standards.

Case Study-3: WTSA New Delhi 2024

1. Are there collaborations between SDOs which needs to be triggered?
2. Is the standards awareness and support in developing countries enabled enough?
3. Are there regional network of experts in ITU that I can tap into?

considering

.. increased participation of interested entities and organizations in the standard-making process of ITU;

.. enables the Sectors to admit participation of entities or organizations in the work of a given study group as an Associate

..

recognizing

.. that organizations and entities from developing countries1 have found great difficulty in playing an active role in ITU-T activities

..

.. *instructs the Director of the Telecommunication Standardization Bureau*

to prepare the necessary logistics for the participation of Associates in the work of ITU-T, including possible impacts of study group reorganization.

https://www.itu.int/dms_pub/itu-t/opb/res/T-RES-T.31-2022-PDF-E.pdf

Learnings-15: Consensus and support are key to successful Resolutions

WTSA Resolutions:

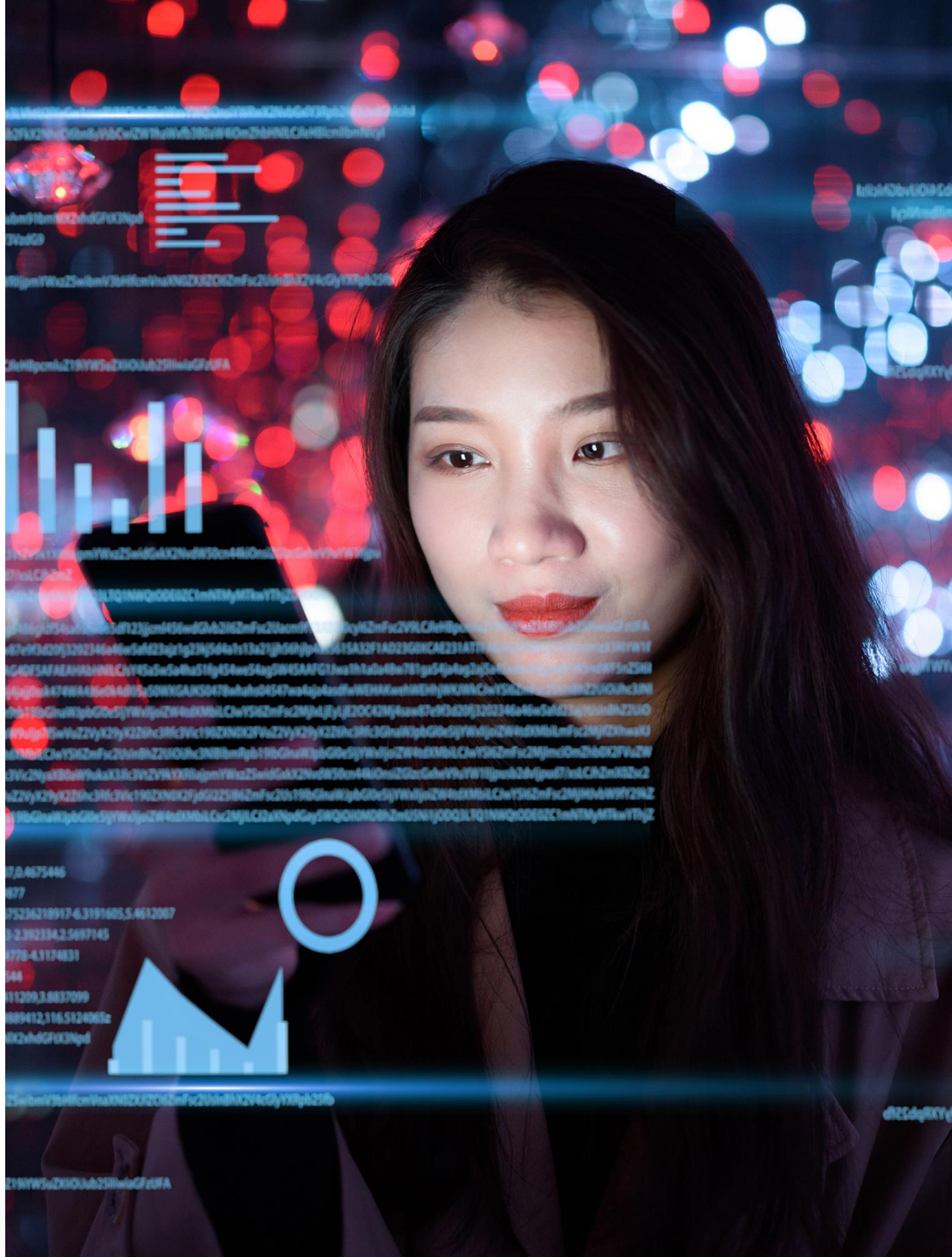
1. **Are derived from practical problems faced by members in making and adopting standards and technologies**
2. **The value derived from an inclusive diverse pool (such as in India) is invaluable.**
3. **Resolutions contain clear background, descriptions and inputs.**
4. **Resolutions set the direction of study (and work) of various part of ITU including Study Groups.**

DOT/TEC in India are the main coordinators at National level for recommending new resolutions / Value additions to the existing work in the SGs of ITU-T and other related forums.

NoW in ITU-T

- Formerly known as the Women in Standardization Expert Group (W.I.S.E), the Network's mission is to **accelerate gender equality in ITU standardization activities & bridge the gender digital divide**
  - ITU-T Resolution 55 (Rev. Geneva, 2022)
  - ITU Plenipotentiary Resolution 70 (Rev. Busan, 2014)

- Objectives:
  1. Increase women's representation & participation in ITU-T meetings and the decision-making process
  2. Encourage them to take more leadership roles
  3. Recognize their achievements
  4. Build a supportive community
  5. Raise awareness on gender disparities and biases in the ICT sector



ITU NoW (Network of Women) Event in October 2024

NoW program is being planned as part of WTSA2024 will be held in New Delhi, India. This is a survey to seek your interest / nomination.

Link for the Survey From - https://forms.gle/QV1ko28oVBQ133LR6

(please see link to the last WISE event held in 2022 - https://www.itu.int/en/ITU-T/wtsa20/wise/Pages/default.aspx)

Learnings [Summary]

- study the gaps, lit survey, prior arts
- study the impacts, citations possibilities
- Form an India blueprint
- Create a local support base
- Identify future collaboration opportunities
- Prove a point with PoC
- Ease of submissions, Single click notebooks
- Local datasets
- Open datasets as standards enablers
- Local testbeds are more important than “real” networks
- Energize local experts
- Form a local ecosystem
- Publish! Publish! Publish!
- Sometimes Free lunch helps (Free GPUs)
- Consensus and support makes successful standards

Thank You

< Vishnu@tsdsi.in >