AI/ML for Mobile Networks: Workshop Introduction

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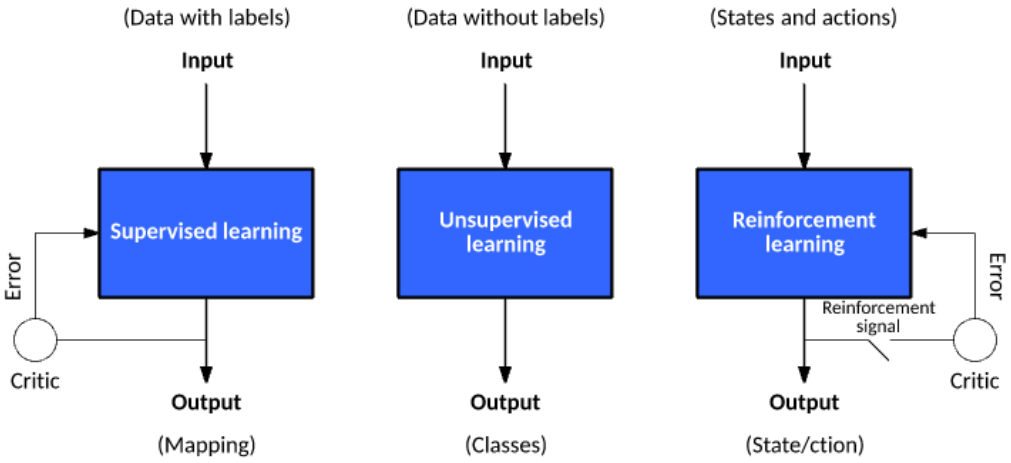
5GPPP, TB Meeting, 27/05/2020

Sessions Overview

- **Part 1.** Session Chair: Daniel Camps Mur, 5G-CLARITY
  - **0905 – 0920** "*AI/ML for mobile networks: Workshop introduction*", Daniel Camps Mur, **5G-CLARITY**
  - **0920 – 0940** "*Cross-modular applications of AI in Beyond5G*", Edwin Yaqub, **ARIADNE**
  - **0940 – 1000** "*AI/ML as an Enabler for Autonomous Network Management - 5G-CLARITY Vision and Use Cases*", Erik Aumayr, **5G-CLARITY**
  - **1000 – 1020** "*A Deep Learning Approach for vRAN Resource Orchestration*", Andres Garcia-Saavedra, **5Growth**
  - **1020 – 1030** Q&A
- **(1030 – 1040 Break)**
- **Part 2.** Session Chair: Mir Ghoraishi, 5G-CLARITY
  - **1040 – 1100** "*SliceNet architecture Cognition Sub-plane, and application use-cases*", Kenneth Nagin, **SliceNet**
  - **1100 – 1120** "*AI/ML applied to Service Assurance*", Joan Pujol Roig (tentative title, presenter), **5G VINNI**
  - **1120 – 1140** "*Machine Learning for increasing location measurement sampling frequency and accuracy*" - Ben Eunier, **IoRL**
  - **1140 – 1200** "*OPEX-Limited 5G RAN Slicing: An Over-Dataset Constrained Deep Learning Approach*", Hatim Chergui, **5GSolutions**
  - **1200 – 1230** "*Q&A, Summary and Next Steps*", moderated by Mir Ghoraishi, **5G-CLARITY**

Q1: AI/ML in Mobile Networks, at what level ?

- **Level 1** : Network Planning assistants
  - e.g. where to deploy gNBs? How to plan C-RAN cluster?
- **Level 2**: Operational assistance to Mobile Network experts
  - e.g. through data-mining detect sub-optimal HO threshold configurations. Recommend alternative?
- **Level 3**: ML functions/algorithms embedded in the network
  - **O-RAN loop-1:** Non-real time (> 1 second)
    - e.g. slice resource management, admission control, etc
  - **O-RAN loop-2:** Near Real time (10-500 ms)
    - E.g. long term scheduling, handover, etc
  - **O-RAN loop-3:** Real Time (TTL-1 ms)
    - e.g. Channel estimation, decoding, MAC scheduling, etc
- Best ML (Deep Learning) tools for each NW problem?
  - Supervised, Unsupervised, RL

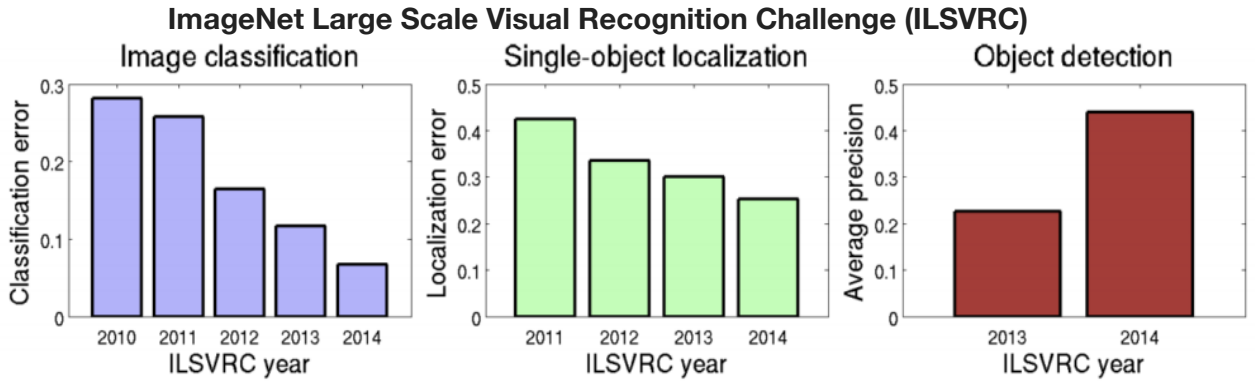


Source:ibm

Q2: Role of standardized data-sets, interfaces and Open Source

ML feeds on data

- Open datasets in CV [1] and open challenges
- In NWs, e.g. standardized **Handover data-set**



Source: Russakovsky, Olga, et al. "Imagenet large scale visual recognition challenge." International journal of computer vision 115.3 (2015): 211-252.

What will be the role of open source ?

- Will NN models/weights be open source for quick progress?
  - E.g. For object recognition: https://github.com/AlexeyAB/darknet
  - Will MNOs have access to a open sourced baseline NN model which they can fine-tune?
- Should open source focus on NW simulators that MNOs can be used as digital twins for training?

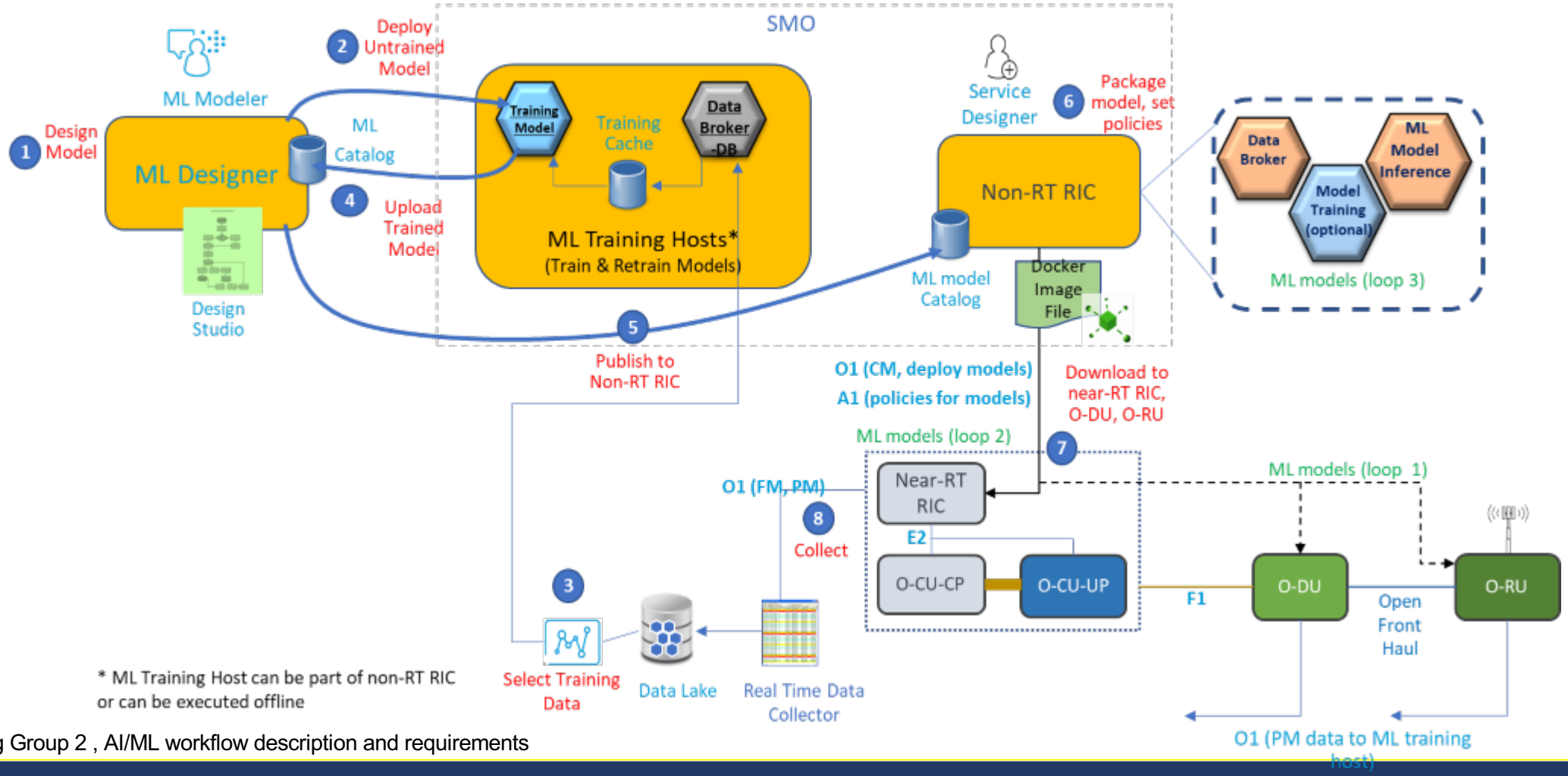
How will the ML function provider ecosystem evolve?

- Decoupled from the NW vendor ecosystem?
- New “operator – vendor” relation?
- What are the key interfaces that need to be standardized?
  - Telemetry (e.g. 3GPP NWDAF) / Actions towards the programmable network

[1] https://www.analyticsvidhya.com/blog/2018/03/comprehensive-collection-deep-learning-datasets/

Q3: How to manage the lifecycle of ML models?

Model development → Offline Training → On-boarding → On-line training → Retraining/Decommissioning



O-RAN Working Group 2 , AI/ML workflow description and requirements

Q4: Distributed versus Centralized AI

- Public clouds offer ML training/inference resources to 3rd parties (e.g. https://cloud.google.com/ai-platform)
  - Will MNOs use public cloud training/inference resources ?

- How will training/inference be deployed in Mobile Networks?
  - In Centralized telco clouds ? Does it scale?
  - Distributed at MEC level, e.g. central office? Only inference, or training too?
  - Extreme distribution (UE level) ? e.g. each UE trains its own HO algorithm based on baseline model provisioned from the network

- What are the specific ML challenges arising from its application in the domain of mobile networks?
  - e.g. Qualcomm on ML model simplification for inference in constrained devices, https://github.com/quic/aimet

Q5: How will operators trust AI functions?

- Will we need ML function certification programs?
  - E.g. Certification labs generate testing environments where ML function vendors pass tests. Standard KPIs need to be defined.
- Explainable AI: Why did the AI perform that action?
  - Human comprehensible models are simple but underperforming – powerful models are black boxes
- Accountability: Who is to blame?
  - ***Operator****: The ML model performed a wrong inference that caused a network melt-down.*
  - ***ML vendor****: The data you fed to the model was outside its operational domain*
- How to design safety nets for ML functions?
  - Under what conditions can an MNO allow a ML model to configure the network?
  - Can we define safe operational margins?
    - e.g. human operators sets parameter limits (MAX, MIN) constraining ML function operation
  - Policy system for ML models needs to be defined, allowing MNOs to expand ML function scope as trust increases

Q6: Is it worth the hype?

- Emerging technologies are hyped
  - Gartner Hype Cycle has many AI/ML technologies on the road to peak hype
  - Expectation of market impact
  - Struggle to adapt at all cost for fear of losing competitive advantage
    - Errors in adaptation can impact customer trust
- Will AI/ML take off as expected and make 5G more manageable?
  - Many PoCs and even more marketing
    - Long way until true AI/ML approaches make it into product
  - How much of a common commodity will AI/ML turn out to be in 5G and beyond?
  - What are the timeframes for adoption?

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