

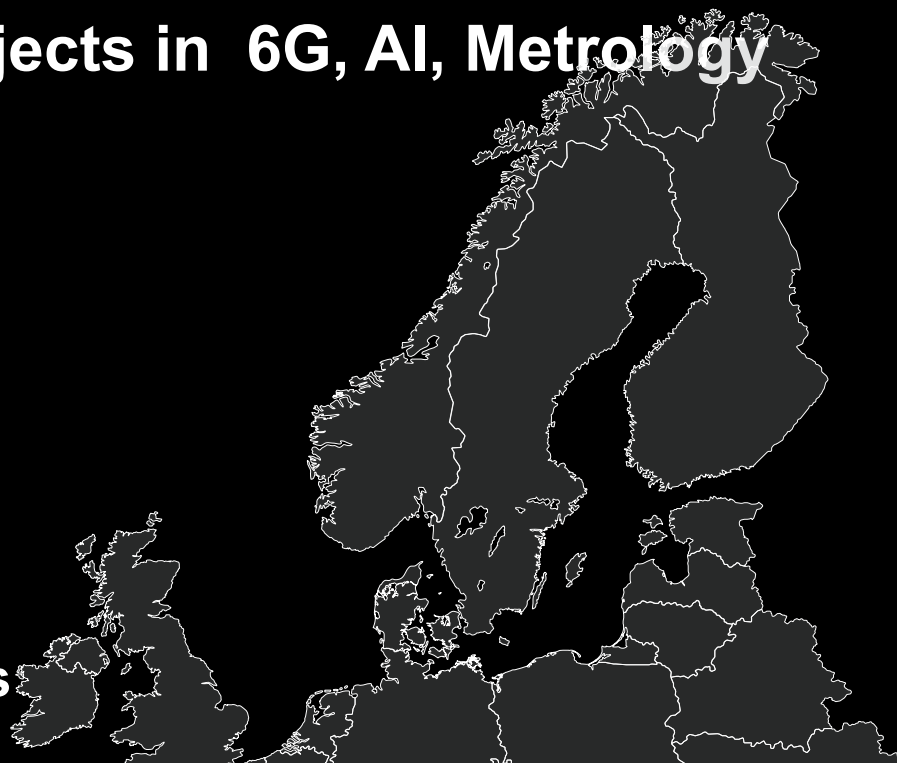
The Integration of AI and 6G

Exploring AI-Native air interfaces, use cases, and validation techniques for enhanced network performance

Mattia Lecci <mattia.lecci@keysight.com>
one6G Summit 2025 - Bologna

Keysight Participation to Cooperative EU Projects in 6G, AI, Metrology

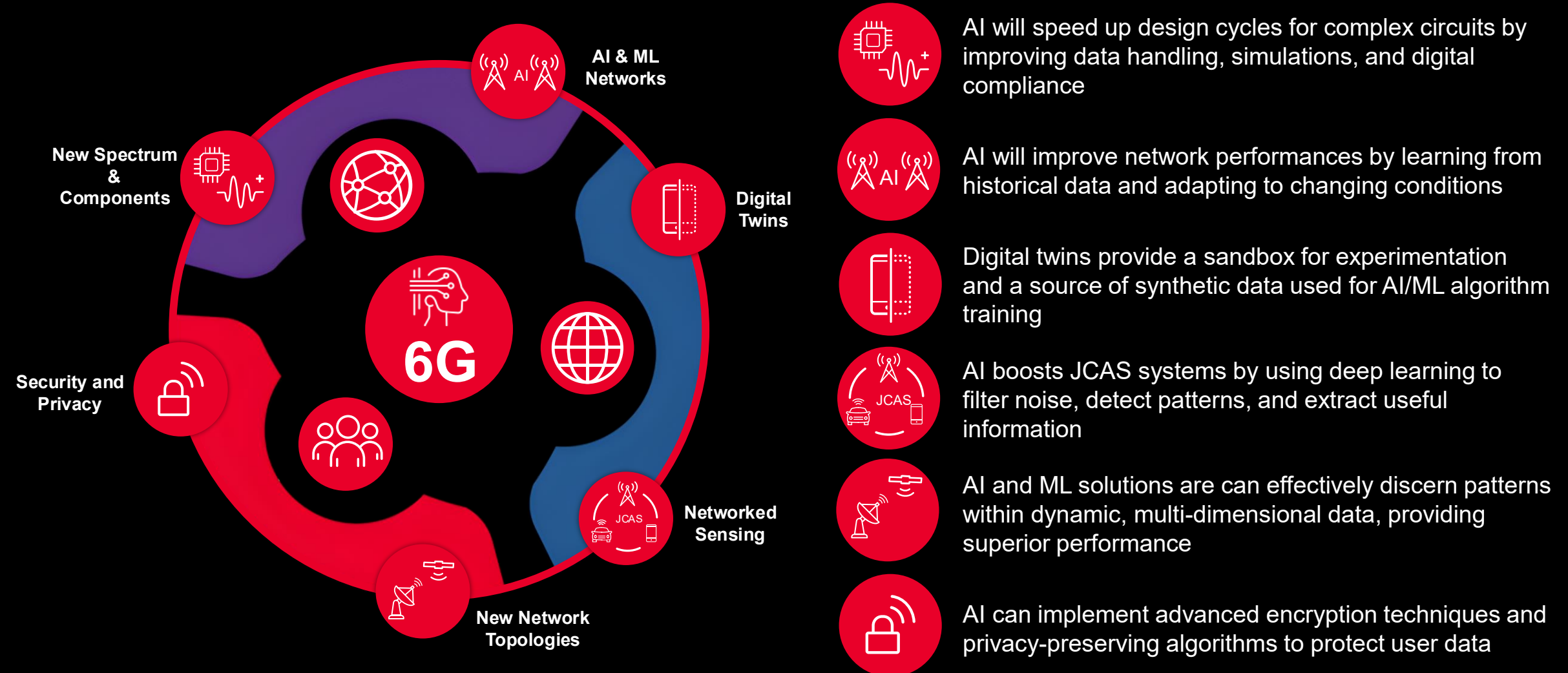
- 28** Countries
- 58** Universities
- 31** R&D Institutions/Metrology Institutes
- 41** Network Operators/Industry Leader
- 100** High-tech Small and Medium-sized Enterprises



Agenda

- When and How AI Meets 6G?
- Wireless Testing with AI – Why is it Different?
- 6G AI-Based Models Validation Solution
- 6G AI Neural Receiver Design Solution
- Conclusion

6G Key Technologies and How AI impact Them



Toward a 6G AI-Native Air Interface

Three main steps

5G

The classical architecture

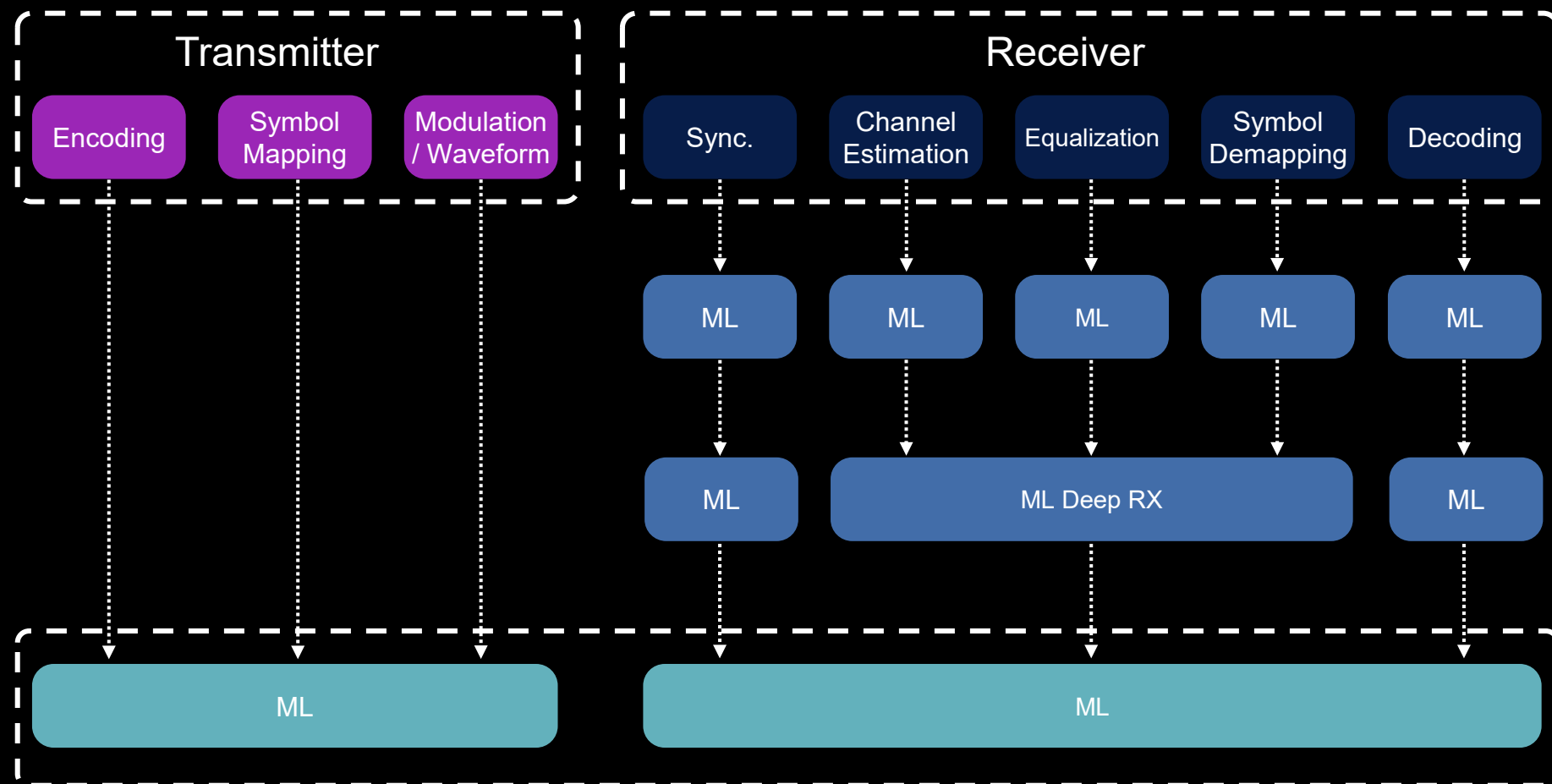
5G-Advanced

ML replaces/enhances individual processing blocks

ML replaces multiple processing blocks

6G

ML designs part of the air interface itself (PHY/MAC)



Agenda

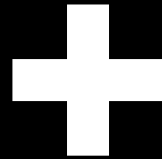
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Testing 6G with AI – Why Is It Different?

AI-based systems need to be validated the 'right' way to analyze functionality, performance, security...

Example of training and test description in a simple explainable world for an AI engine:

I'm a car and I need to be able to avoid a pedestrian and cyclists ↔ I'm a car and I need to avoid obstacles



- The definition of the test and certification needs to be done differently in many cases
- You can easily test what you trained for, but is this enough?
- You cannot predict what is not trained behavior, but do you know what was not trained?

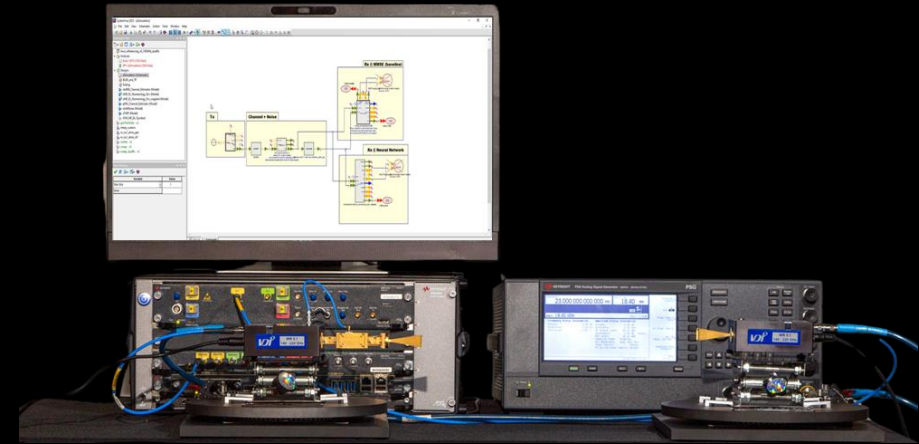
In other words, do you know what you don't know?

Wireless Testing With AI – Why is it different?

Hardware-in-the-Loop and Black Box testing

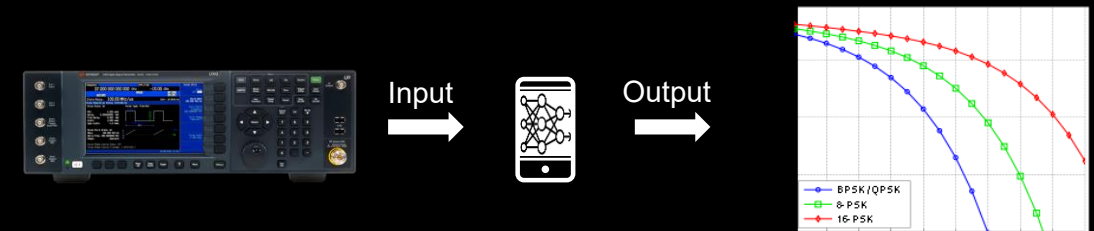
Hardware-in-the-Loop (HIL) Testing

- Enable real-time interaction between physical hardware and simulated environments.
- Allowing engineers to evaluate AI algorithms under various conditions without costly field trials.
- Ensures AI-driven components are robust and adaptable, leading to more reliable and efficient wireless communication systems.



Black Box (BB) Testing

- Focuses on assessing the system based on its inputs and outputs, without considering the internal workings of the components.
- Evaluating how effectively the system performs essential tasks such as signal processing, resource allocation, and adaptation to changing network conditions.
- Ensuring that the system can handle real-world tasks efficiently and reliably, providing a clear picture of its operational capabilities.



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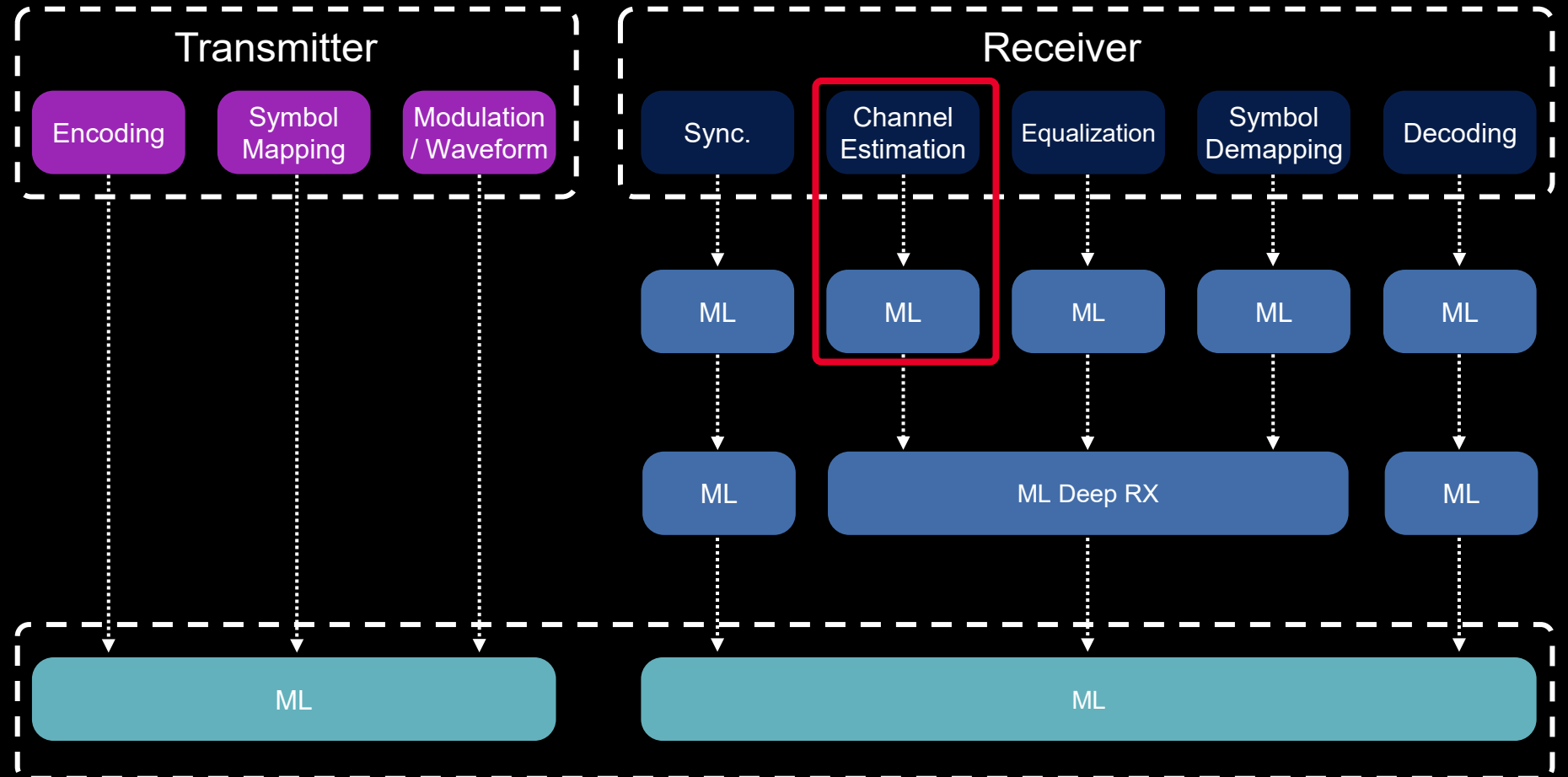
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6G AI-Based Models Validation Solution

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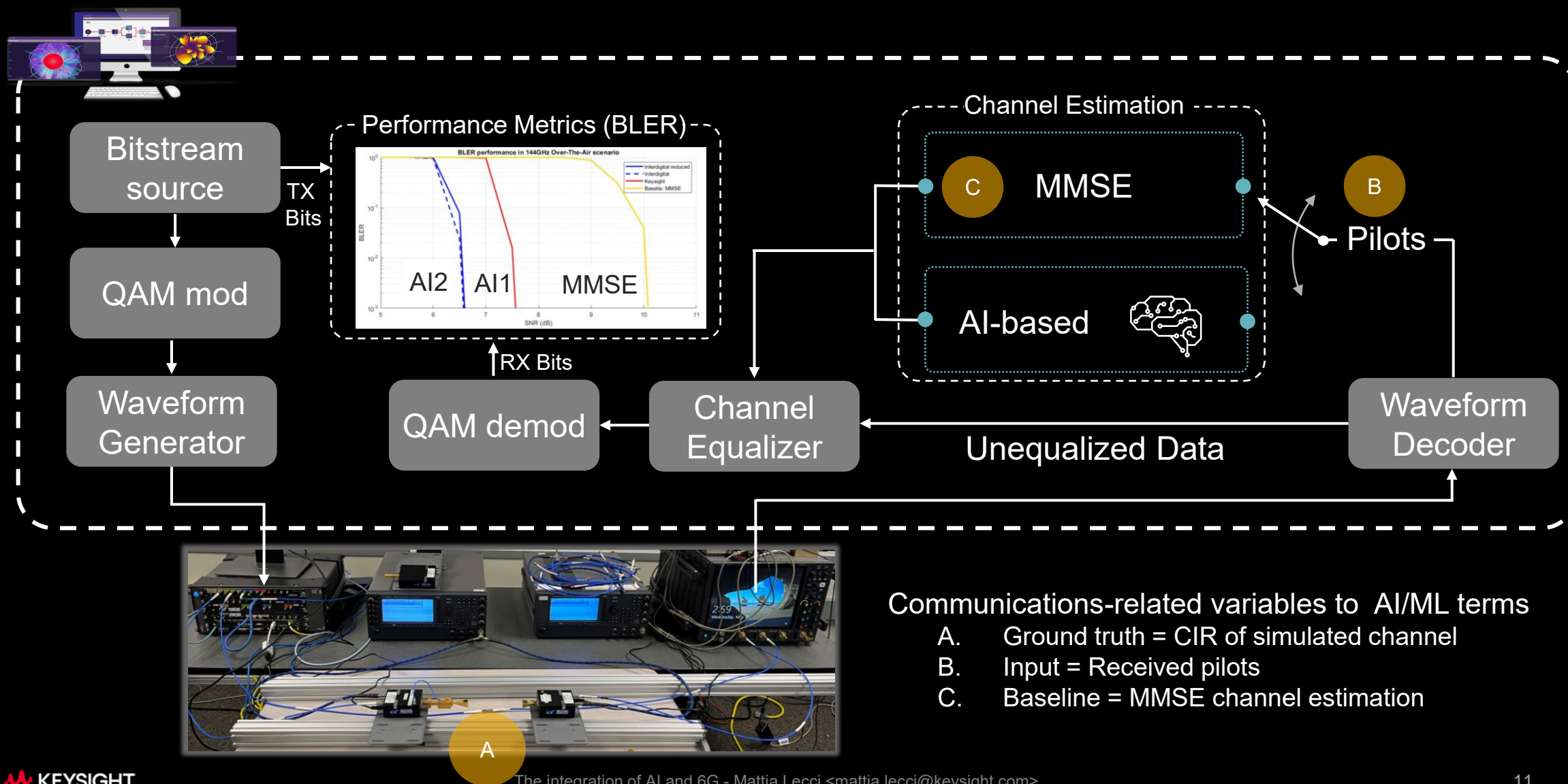
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6G AI-Based Models Validation Solution



6G AI-Based Models Validation Solution

Solution Components

- Arbitrary Waveform Generator
 - [M8199A AWG](#)
- Vector Signal Generator
 - [E8267D PSG Vector Signal Generator](#)
- Digitizers
 - [M8131A 16/32 GSa/s Digitizer](#)
 - [Infiniium UXR-Series Oscilloscope](#)
- Measurement software
 - [89601C Custom Modulation Analysis Bundle](#)
 - [PathWave Vector Signal Analysis](#)
 - [Pathwave System Design](#)
- Sub-THz frequency extenders (VDI)



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6G AI Neural Receiver Design

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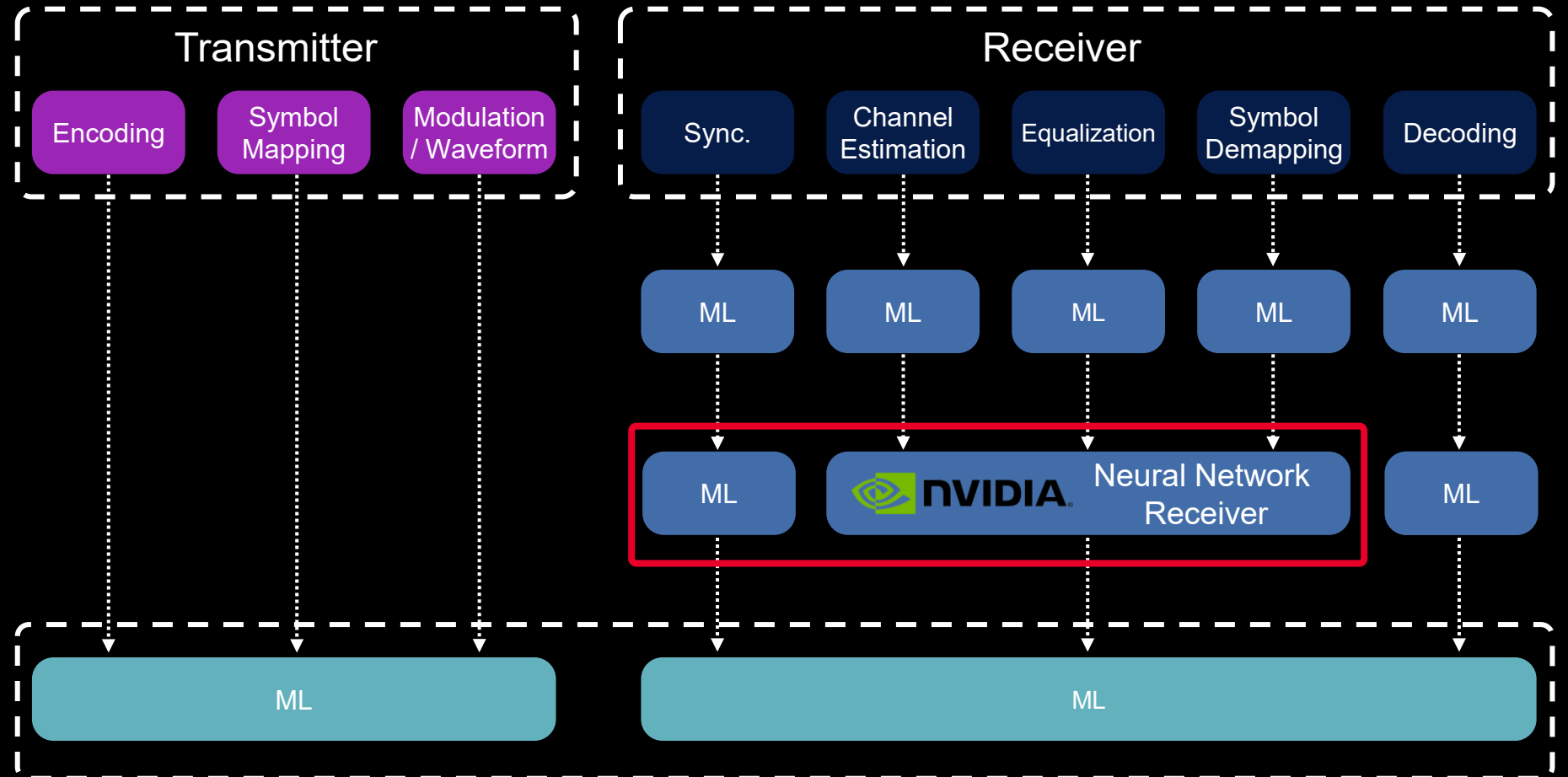
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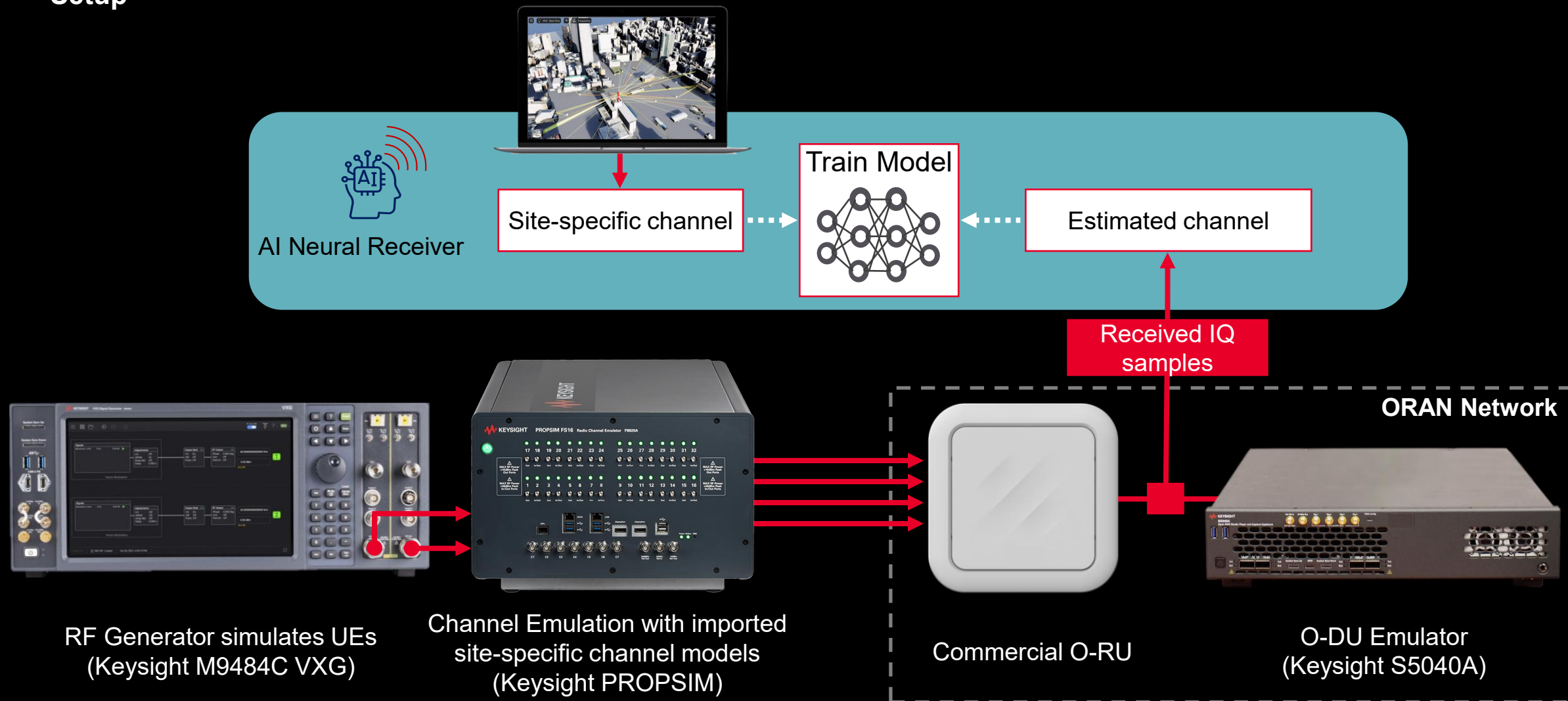
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6G AI Neural Receiver Design

Setup

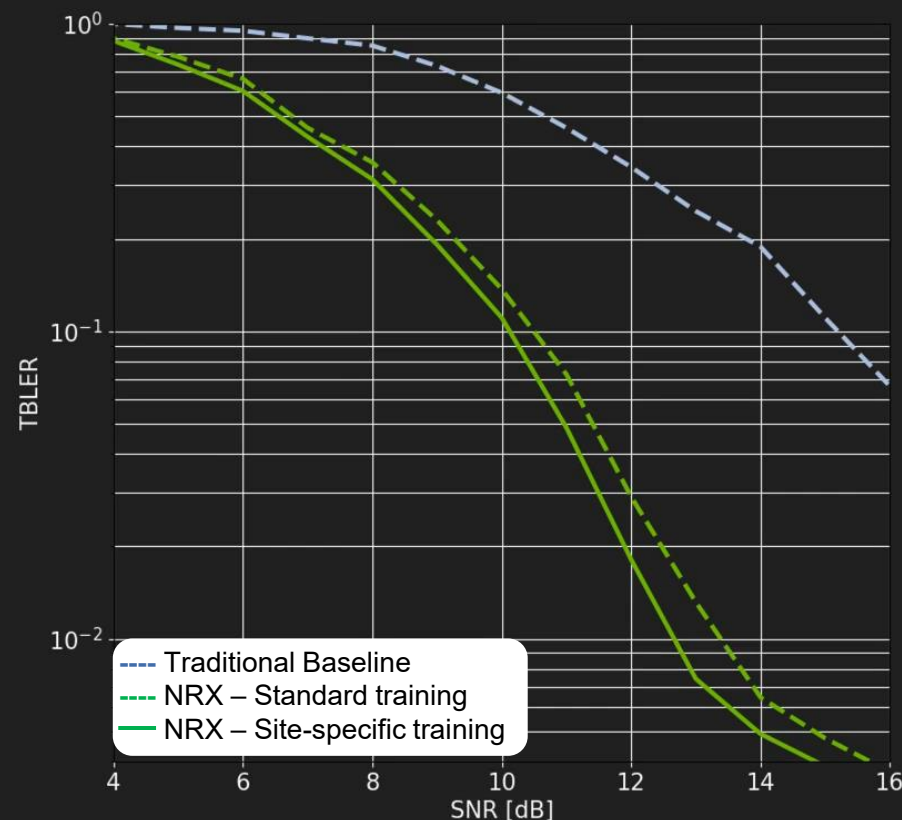


6G AI Neural Receiver Design

NVIDIA Neural Receiver

- Neural Receiver receives live data from ORAN Testbed.
- We can see live results converged to the precomputed curves.
- Clear gains between NRX and the baseline.
- Site-specific training improves performance.
- **It works!**

O-RAN Testbed for Site-Specific Neural Receivers



Start Live Measurement

Replay Pre-recorded Data

Reset

Number of UEs 2
Number of RX ants 3
Number of PRBs 132
MCS index 14
Modulation order 16-QAM
Target coderate 0.54
Transport block size 40976 bit

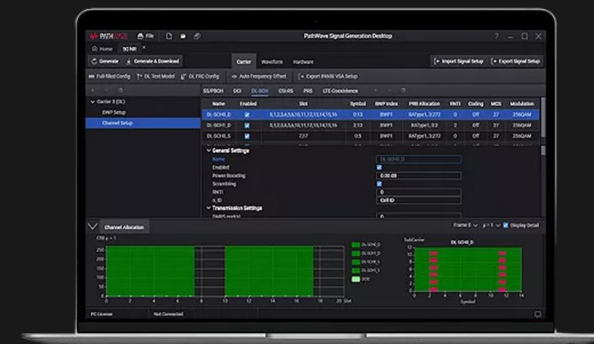
PUSCH throughput 198.3 slot/s
PUSCH datarate 8.1 mbit/s



6G AI Neural Receiver Design

Solution Components

- Vector Signal Generator
 - [M9484C VXG Vector Signal Generator](#)
- Channel emulation
 - [F8820B PROPSIM FS16 Radio Channel Emulator](#)
- ORAN Emulation
 - [S5040A Open RAN Studio Player and Capture Appliance](#)
- Measurement software
 - [PathWave Signal Generation](#)
 - [PathWave Vector Signal Analysis](#)
 - [PathWave System Design](#)
 - [Keysight Channel Studio](#)



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The Integration of AI and 6G

Conclusion

- 6G will build on previous generations while introducing groundbreaking capabilities, integrating advanced AI for end-to-end optimization and automated operations.
- It will feature new spectrum technologies, AI-native air interfaces, networked sensing, extreme connectivity, innovative network topologies, and robust security tools, promising ultra-low latency, high reliability, and massive connectivity.
- AI-enabled 6G devices will require advanced testing methods like Hardware-in-the-Loop and Black Box testing to ensure robust performance under unpredictable real-world scenarios.

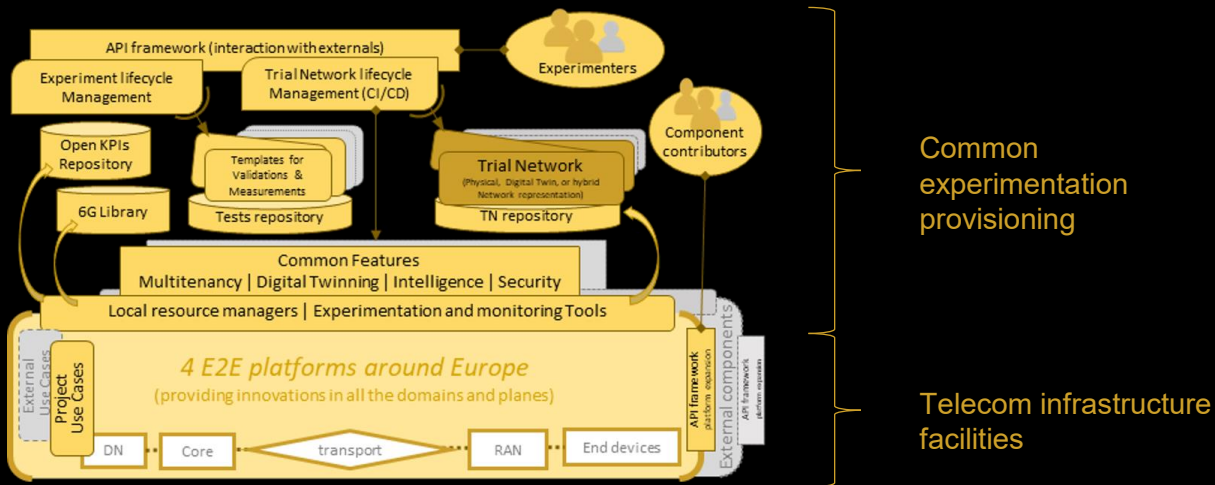
Thank you



(6G-SANDBOX) TRIAL NETWORK

Fully configurable, manageable and controllable network which combines digital and physical nodes and provides services for 6G technology validation and 6G KPI measurements

- the experimenter can manage the lifecycle of the experiment and the trial network
- the open calls target both experimenters and component contributors



NTN Trials



RIS Trials

New open calls!

- Large scale NTN experimentation with ESA
- RIS trials in multiple frequency ranges (FR1, FR2, FR3) and environments (e.g., dense urban scenario)

