MAVENIR

BUILDING THE FUTURE OF NETWORKS – TODAY.

CLOUD-NATIVE. AI-ENABLED. GREEN BY DESIGN.

AI enabled Open RAN for Beam Management

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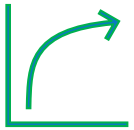
VP RAN Technology and Strategy CTSO

November 12th 2024

5G Advanced capabilities

Higher Downlink Speeds

10 Gbps downlink



Uplink-Centric Design

Higher uplink speeds up to 1 Gbps

Improved Latency and Reliability

From 1ms to 10ms in 5G, 5.5G aims for 10-fold decrease

Enhanced IoT Capabilities

100 billion IoT connections by 2030

Energy savings

Reduce energy consumption through Extremely Large Antenna Arrays (ELAA)

Integrated Sensing and Communication

Detect and respond to environmental conditions

5G Advanced supports RedCap and emerging use cases (XR, IoT)

These require Extended and Reliable Coverage and Capacity

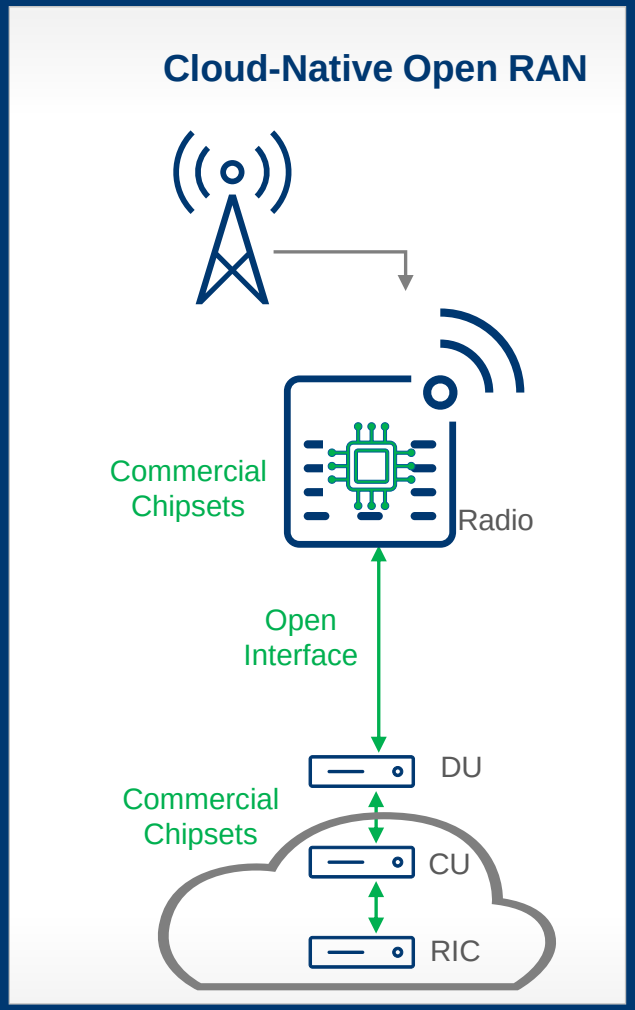
Open RAN delivers unique network capabilities

1. Faster Innovation

- Open Silicon HW, Open Interfaces GP hardware and platform disaggregation
- High performance and energy efficiency
- Flexible deployment choices

2. Intelligent Programmable and Automated Networks

- Optimal use of network resources
- Simplify Telco complexity and faster RCA



3. Migration to Cloud and Multi cloud partnerships

- Improve operational efficiencies
- Faster refresh cycles

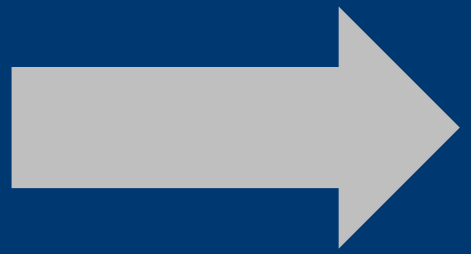
4. Improved Customer Experience

- Leverage AI/ML to boost network performance
- Proactively predict KPIs, reduce congestion and drops

Software Centric RAN facilitates innovation with 3rd parties

Current RAN algorithms are based on signal processing techniques.

1. Modulation and Demodulation
2. Channel Estimation and Equalization
3. Error Correction
4. Interference Management
5. Scheduling and Resource Allocation
6. Beamforming and MIMO
   - manage multiple antennas and optimize signal transmission and reception, improving coverage, capacity, and spectral efficiency.



Data-driven AI-based approach

AI enabled RAN delivers high performance

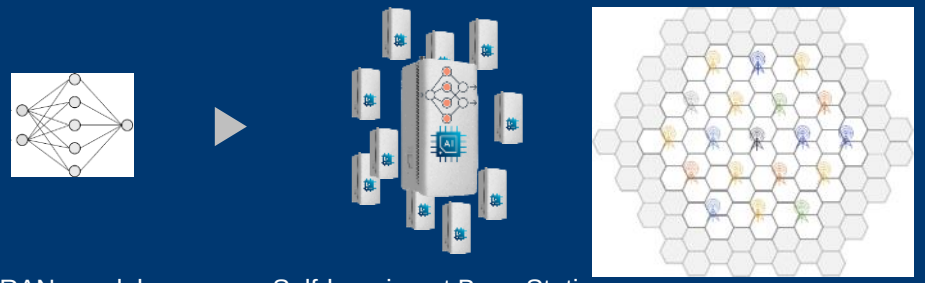
Today's RAN

RAN algorithm

Base Stations

Common solution for millions of base stations

Future: AI integrated in the RAN



AI-RAN model

Self-learning at Base Stations

AI for L1/L2

AI native RAN will enable customized solutions for each base station

AI integrated in the RAN

AI is designed into the RAN L1/L2 functions.

RAN can learn from its environment and uniquely adapt various DU parameters to the channel conditions.

Enables

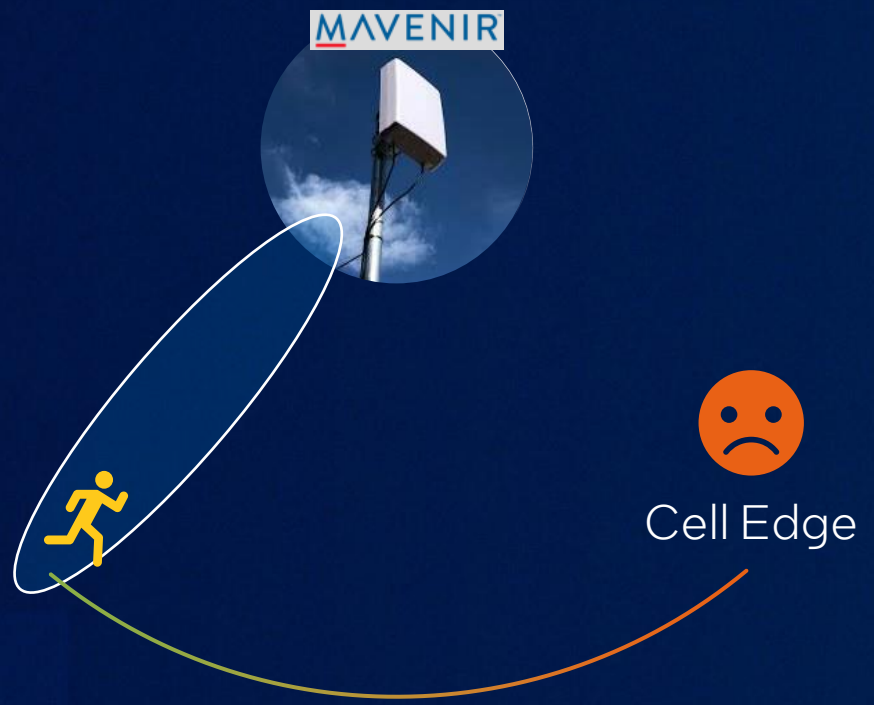
A solution that is perfectly optimized for its unique environment

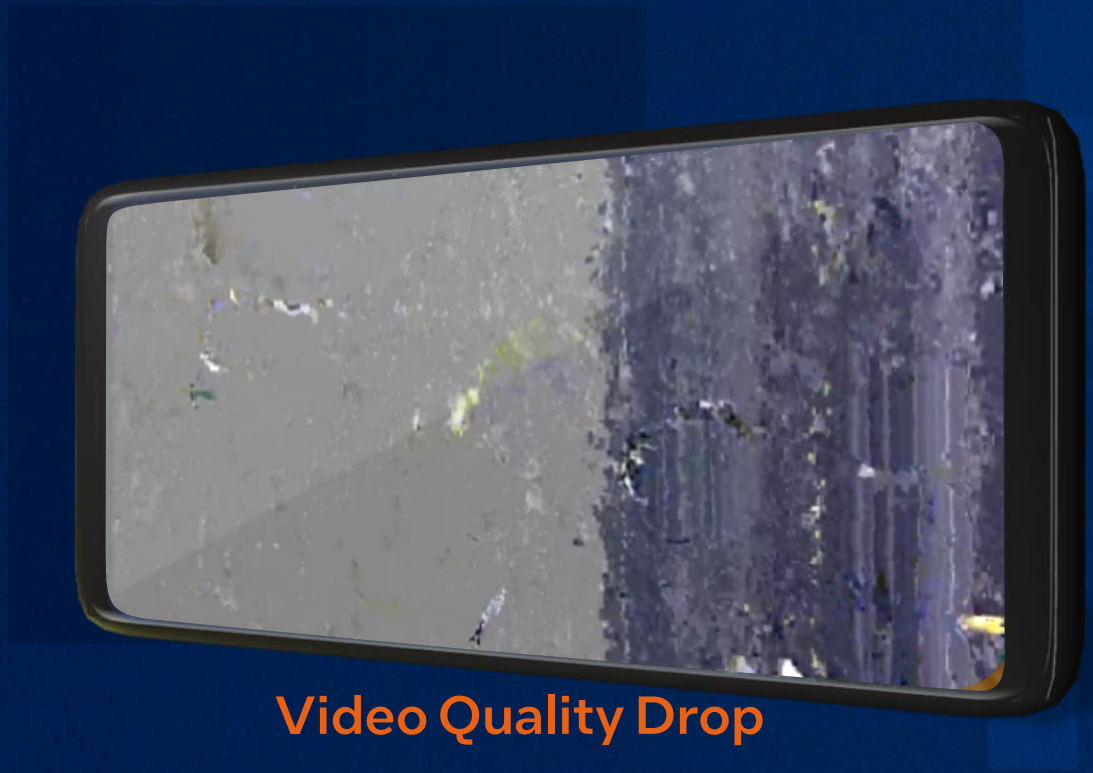
Delivering best network and UE performance.

AI enabled RAN with Intel Grid of Beams codebook

To improve Cell Edge Throughputs

Beam Management Challenge at the Cell Edge





Video Quality Drop

massive MIMO (mMIMO) beamforming

Aim is to direct signals efficiently to multiple users by controlling the beam patterns from multiple antennas.

Techniques are **Zero Forcing (ZF) beamforming** and **Grid of Beams (GoB) codebook-based approach**

Zero Forcing is more computationally intensive but provides better interference cancellation, making it suitable for systems with full CSI.

Grid of Beams is a simpler, codebook-based approach, more efficient for systems with limited CSI, but may not offer the same performance in terms of interference management.

Both methods serve different trade-offs between performance and complexity

Mavenir Open RAN with Intel® vRAN AI Development Kit

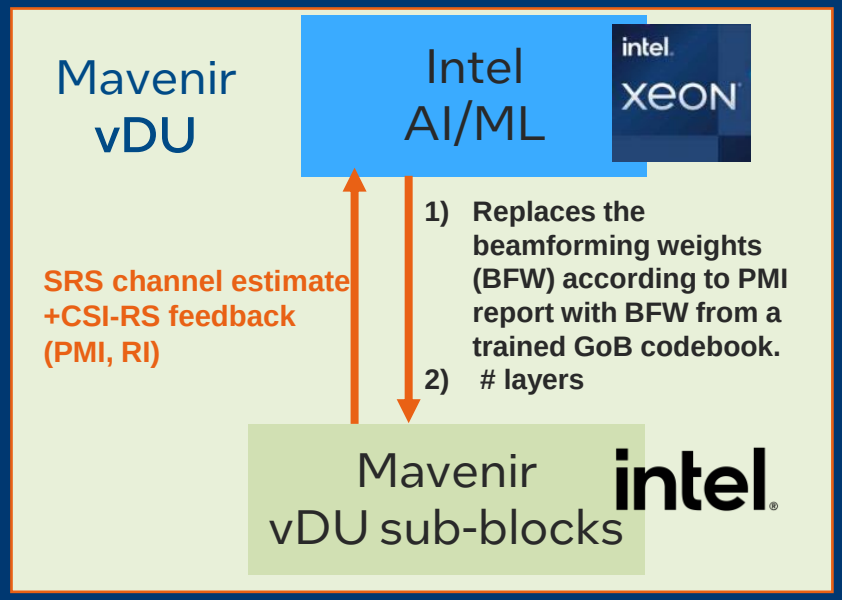
Objective

AI enabled beam management

Improve cell edge user throughputs for
TDD DL 32TRX mMIMO

Highlights

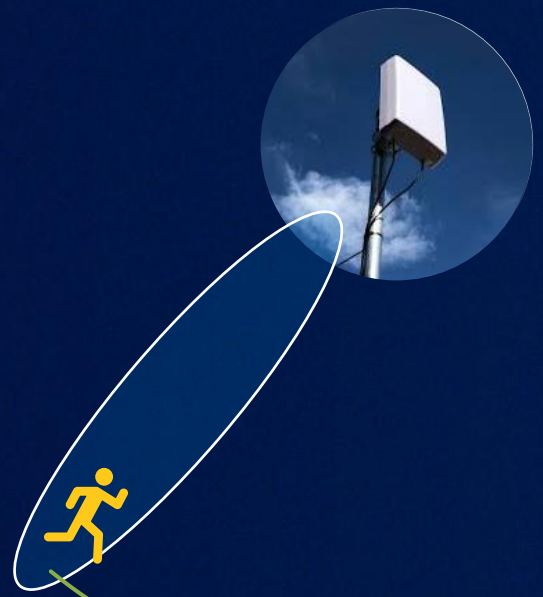
- Mavenir's commercial mMIMO vDU software combines Intel's AI/ML model and Intel's Flexran™ reference software channel estimates to deliver:
- Expected to deliver superior UE throughputs in cell edge and in the vertical direction.



First integration of Intel AI models with commercial Open RAN software

Intel AI enabled Beam Management Solution at the Cell Edge

MAVENIR intel KEYSIGHT



Cell Edge

Keeps UHD quality

Solution

> Mavenir has integrated Intel’s AI model for beam management and Intel FlexRAN™ reference software with Mavenir's commercial mMIMO vDU software to deliver enhanced network performance and user experience.

> Intel's RAN AI model, trained on 3GPP channel model datasets, optimizes beam weights and number of layers to maximize each UE’s throughput.

> The combined Mavenir and Intel solution is designed to improve performance in challenging radio environments, such as cell edges and high-rise building scenarios, and is applicable for both TDD and FDD deployments.

Intel® vRAN AI Development Kit

- AI Model Design
- Pretrained Models
- Optimized Inference Code
- E2E Reference Use Case

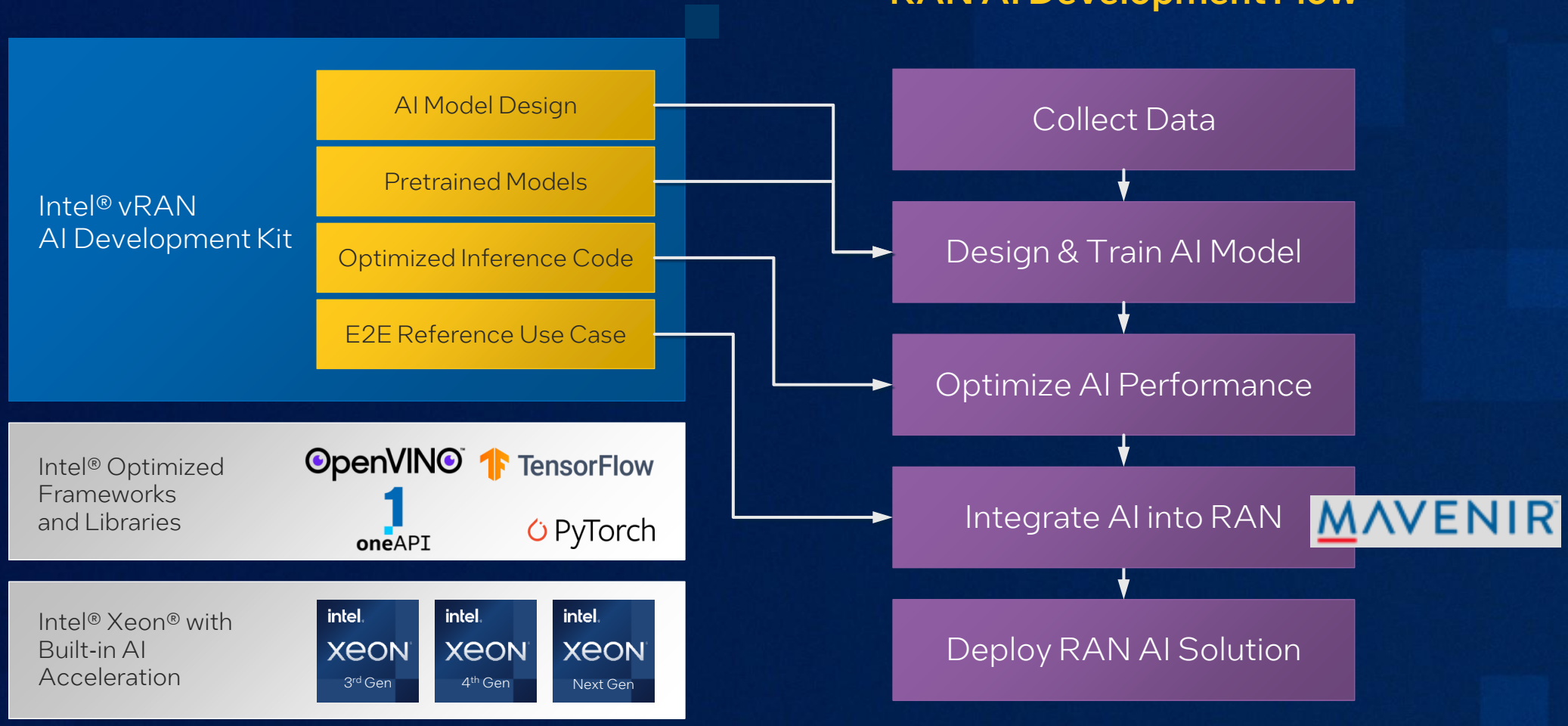
Intel® Optimized Frameworks and Libraries

OpenVINO™ TensorFlow oneAPI PyTorch

Intel® Xeon® with Built-in AI Acceleration

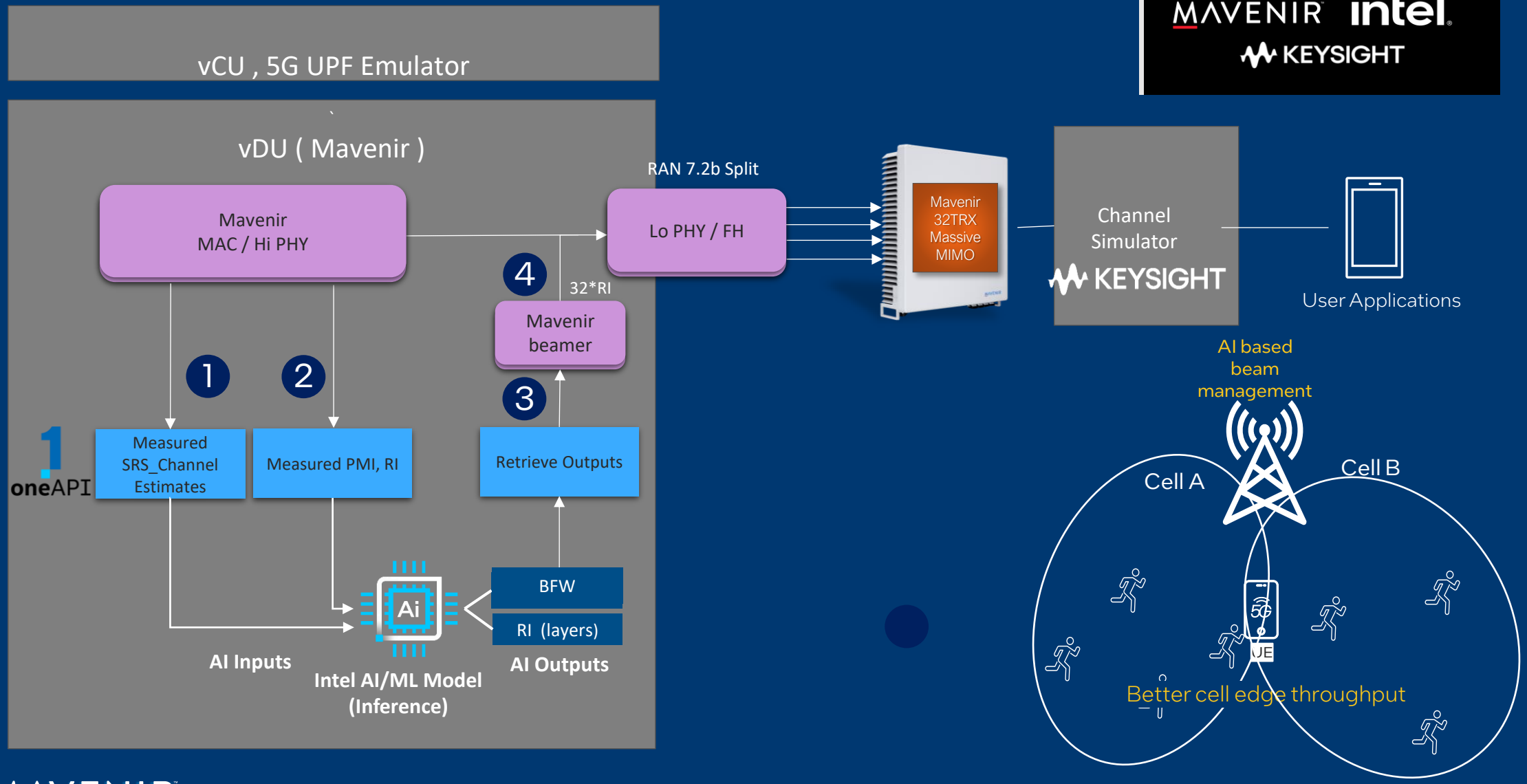
intel Xeon 3rd Gen | intel Xeon 4th Gen | intel Xeon Next Gen

RAN AI Development Flow

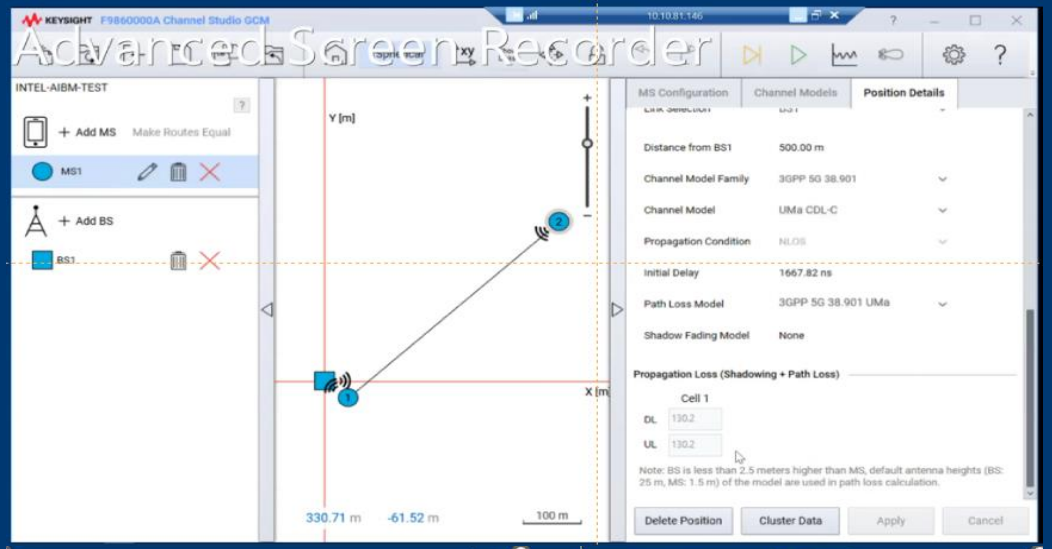


AI Assisted Beam Management Target RAN Benefits:	Improved user throughput	Improved cell edge coverage	Extended SRS/CSI-RS periodicity	Higher network performance

Beam Management data flow –UE level beam refinement AI/ML inference model integration into Open RAN



Demo


Advanced Screen Recorder
KEYSIGHT F9860000A Channel Studio GCM
INTEL-AIBM-TEST
+ Add MS
Make Routes Equal
MS1
+ Add BS
BS1
MS Configuration
Channel Models
Position Details
Distance from BS1
500.00 m
Channel Model Family
3GPP 5G 38.901
Channel Model
UMa CDL-C
Propagation Condition
NLOS
Initial Delay
1667.82 ns
Path Loss Model
3GPP 5G 38.901 UMa
Shadow Fading Model
None
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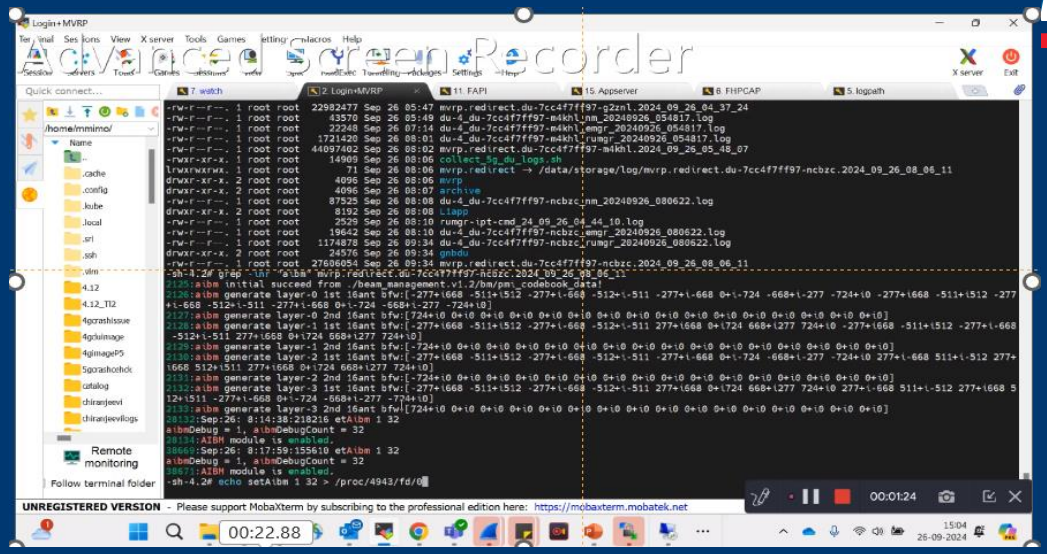
DL
UL
Delete Position
Cluster Data
Apply
Cancel
330.71 m
-61.52 m
100 m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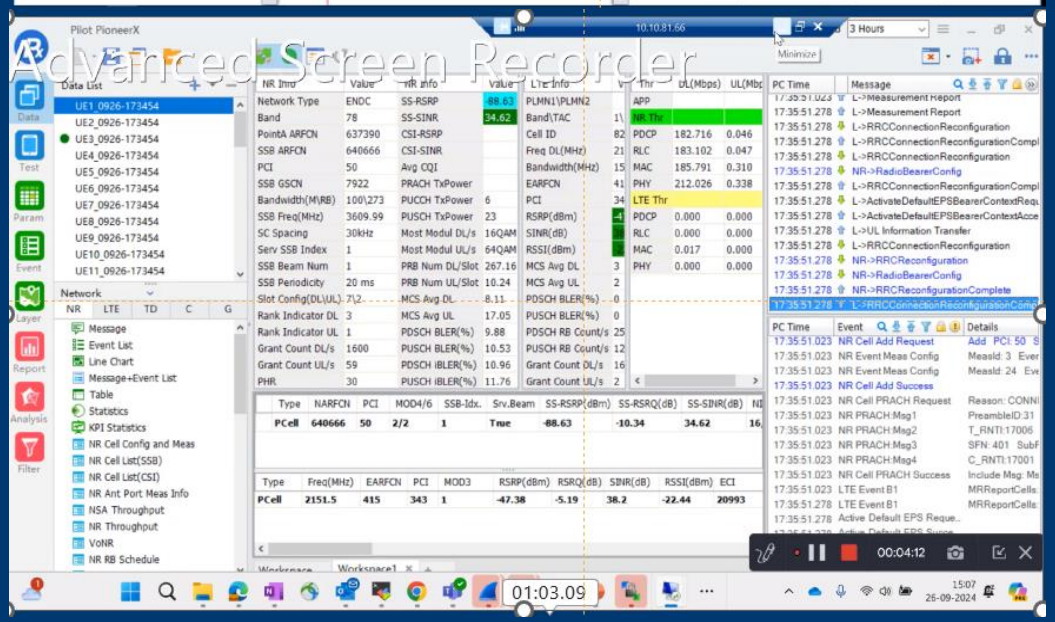
Advanced Screen Recorder
Pilot PioneerX
Data List
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UE2_0926-173454
UE3_0926-173454
UE4_0926-173454
UE5_0926-173454
UE6_0926-173454
UE7_0926-173454
UE8_0926-173454
UE9_0926-173454
UE10_0926-173454
UE11_0926-173454
Network
Message
Event List
Line Chart
Message+Event List
Table
Statistics
KPI Statistics
NR Cell Config and Meas
NR Cell List(SSB)
NR Cell List(CSI)
NR Ant Port Meas Info
NSA Throughput
NR Throughput
VoNR
NR RB Schedule
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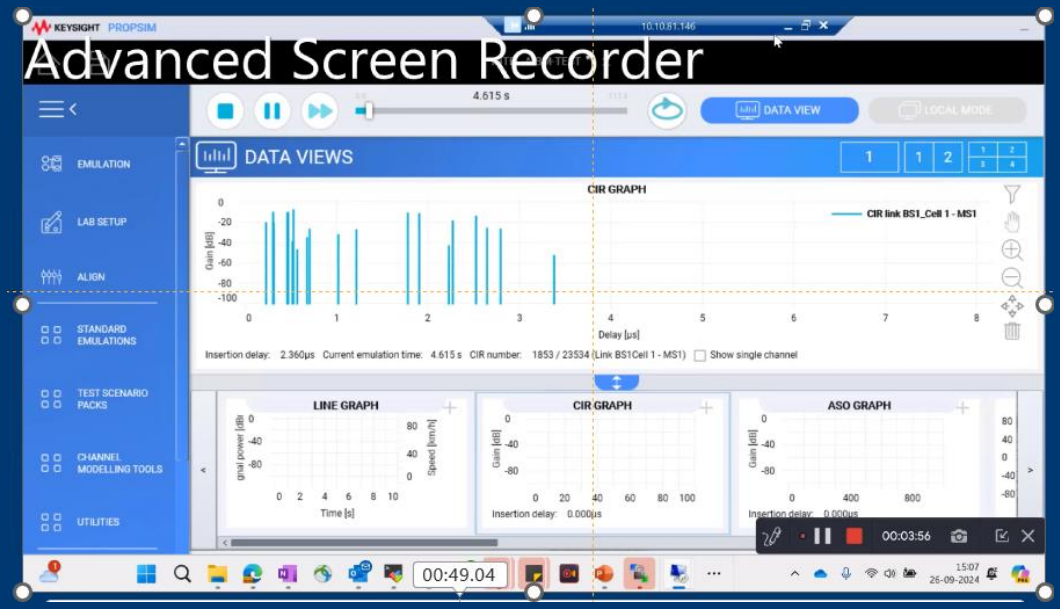
00:04:12


Advanced Screen Recorder
KEYSIGHT PROPSIM
DATA VIEW
DATA VIEWS
EMULATION
LAB SETUP
ALIGN
STANDARD EMULATIONS
TEST SCENARIO PACKS
CHANNEL MODELLING TOOLS
UTILITIES
CIR GRAPH
LINE GRAPH
ASO GRAPH
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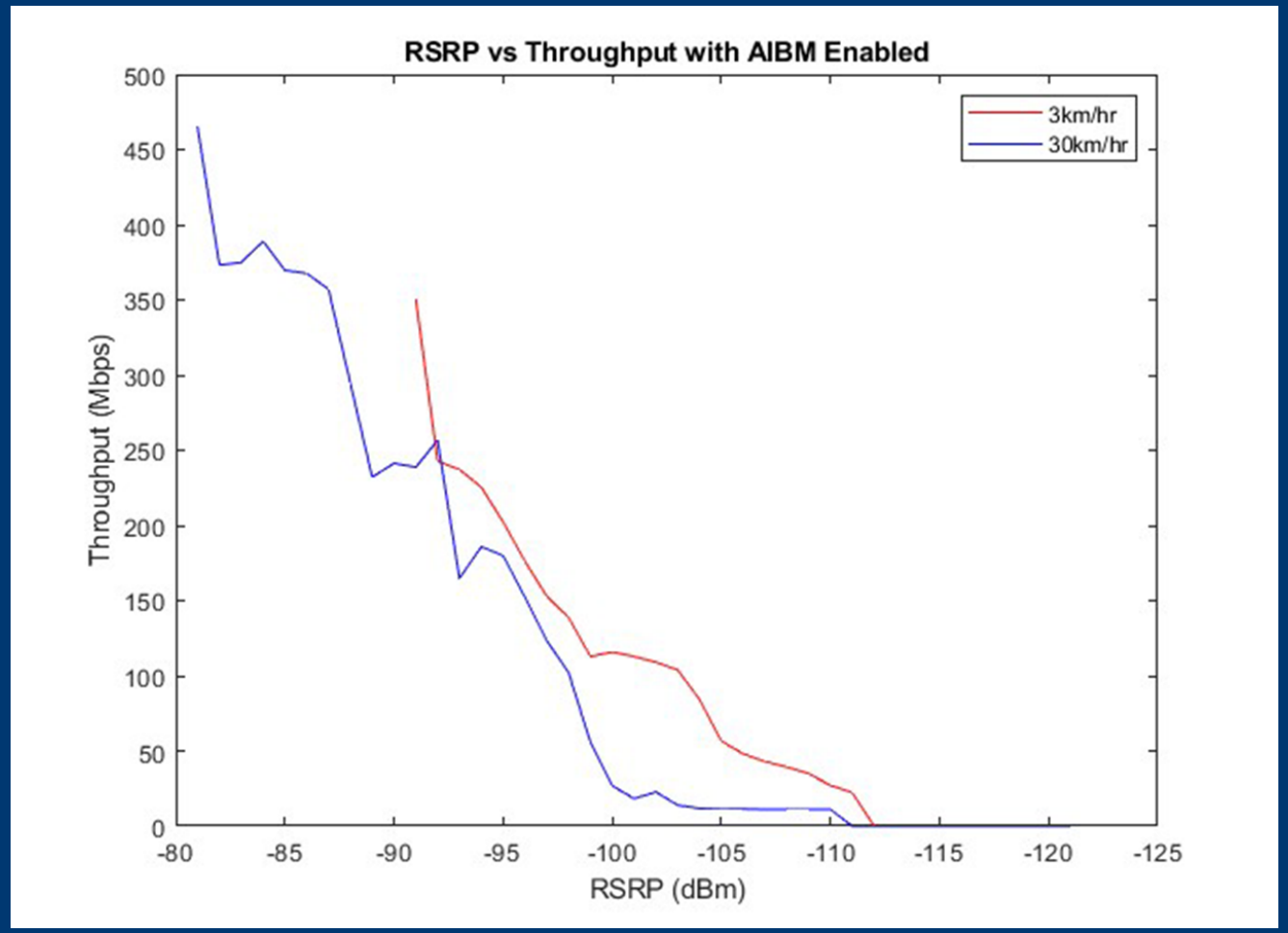
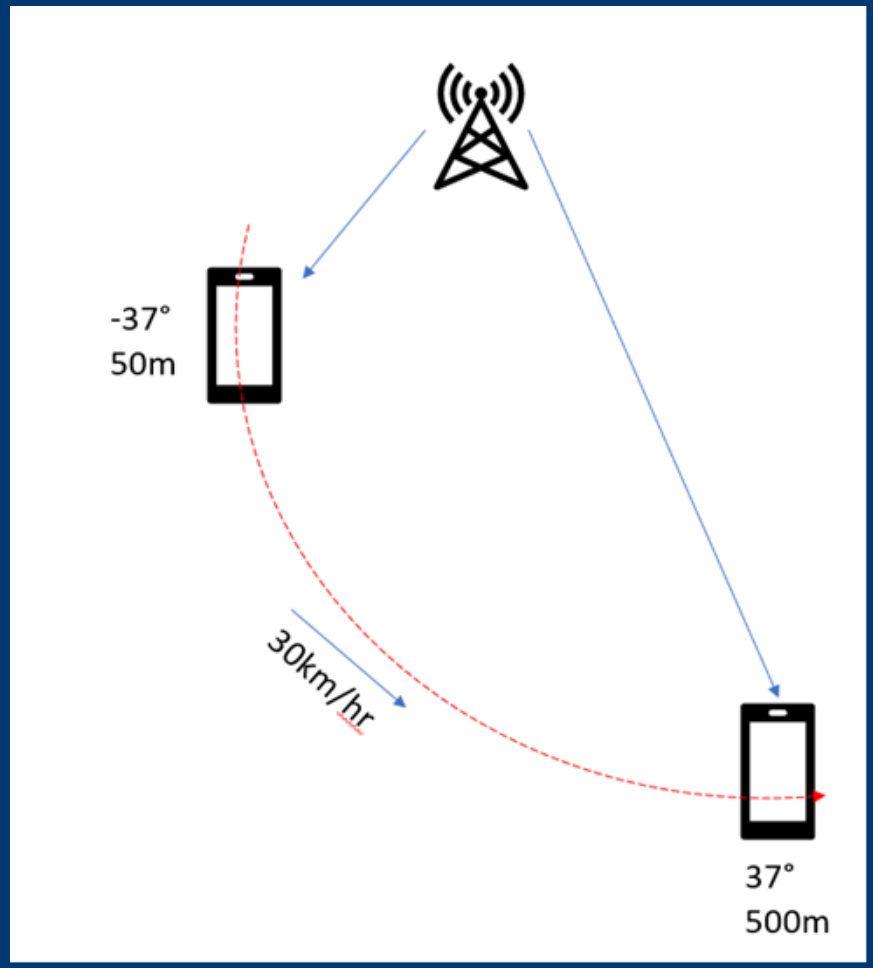
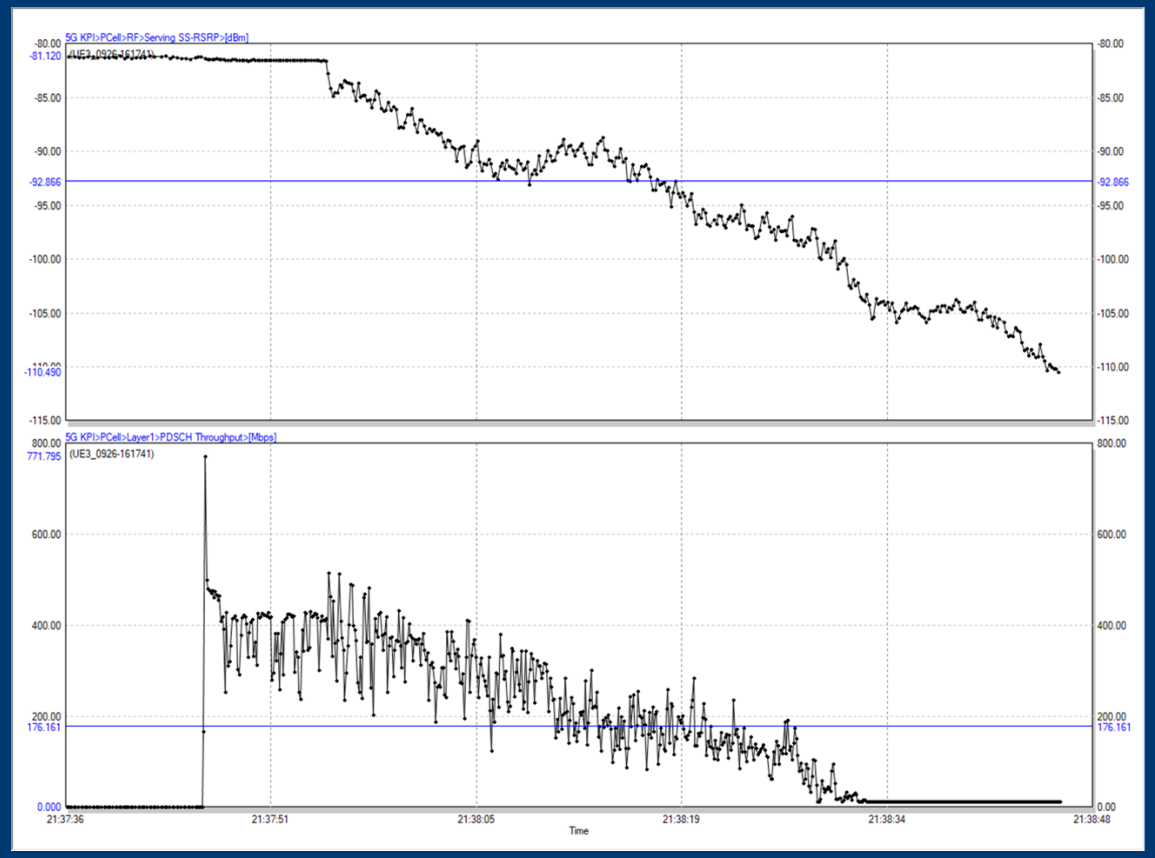
Throughputs - as UE moves from cell center to cell edge

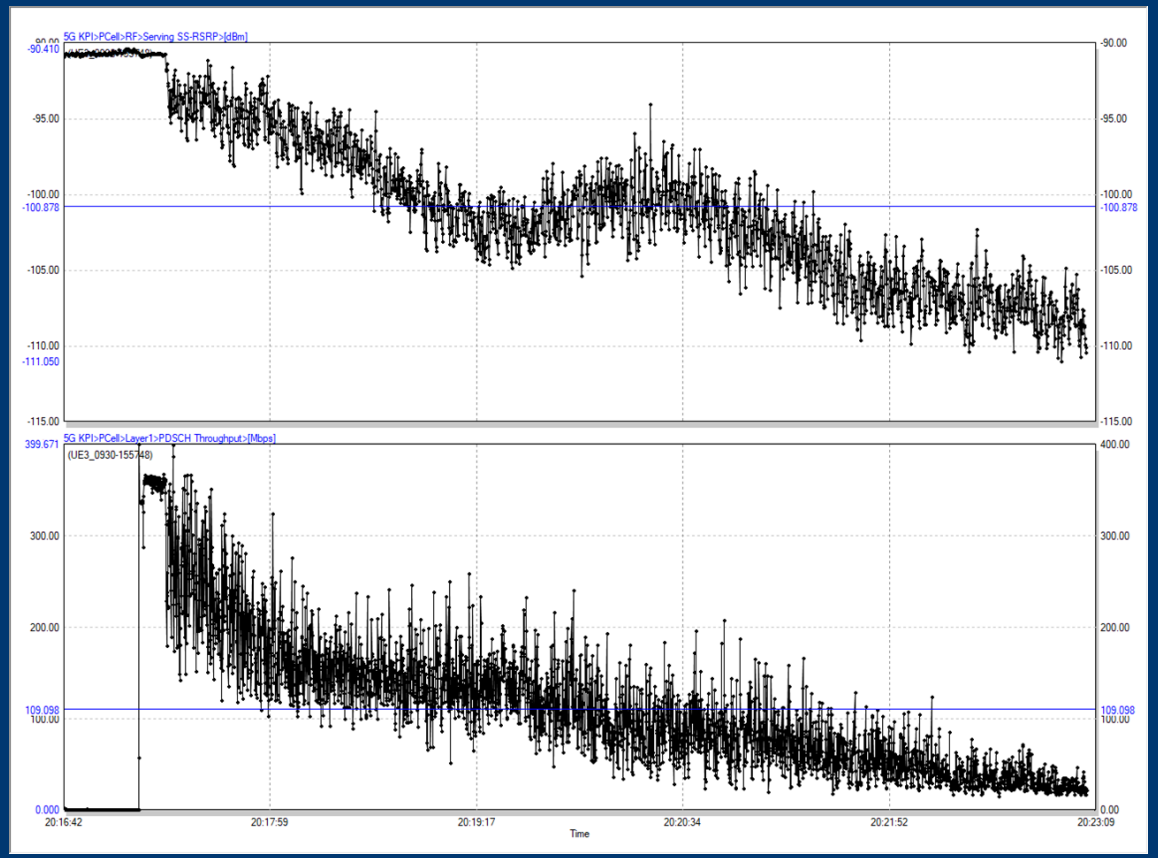




RSRP and Throughputs



30km/hr AIBM enabled



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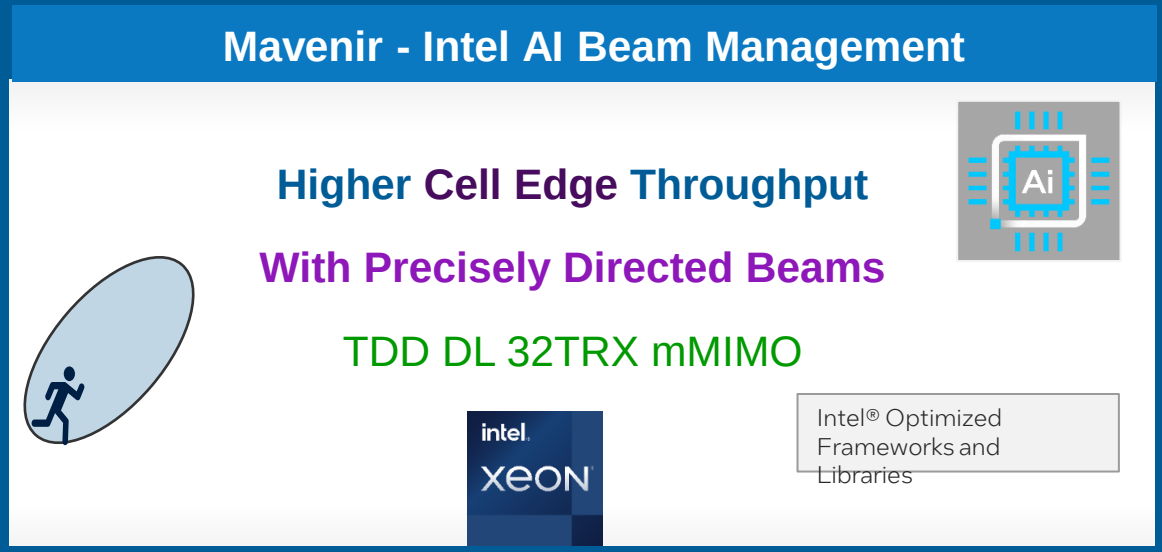
Summary: AI-enabled RAN



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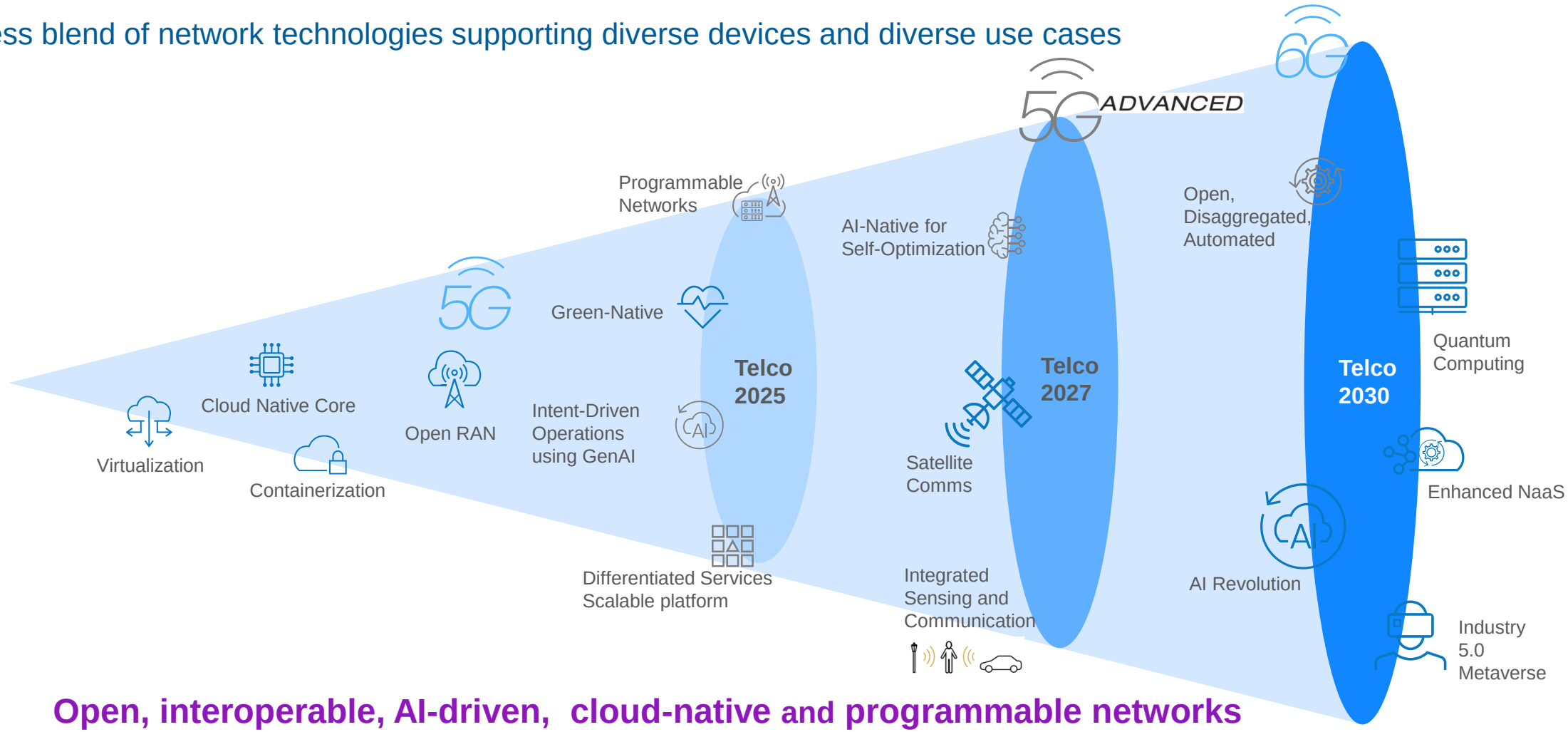
- Applicable for TDD and FDD deployments.

The future of networks is being built today in 5G with Open RAN

Seamless blend of network technologies supporting diverse devices and diverse use cases



Open, interoperable, AI-driven, cloud-native and programmable networks Delivered on Any Cloud

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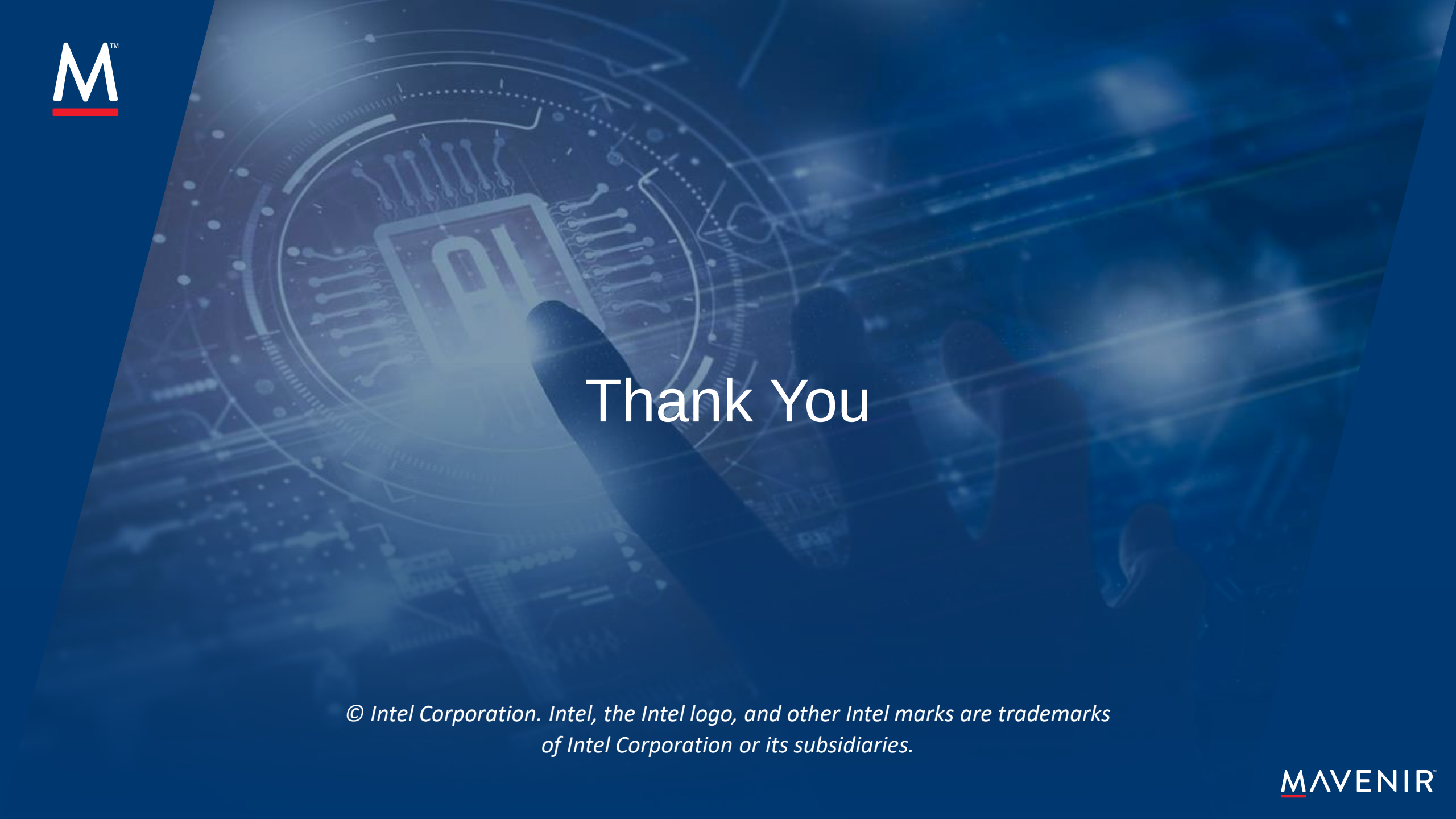

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