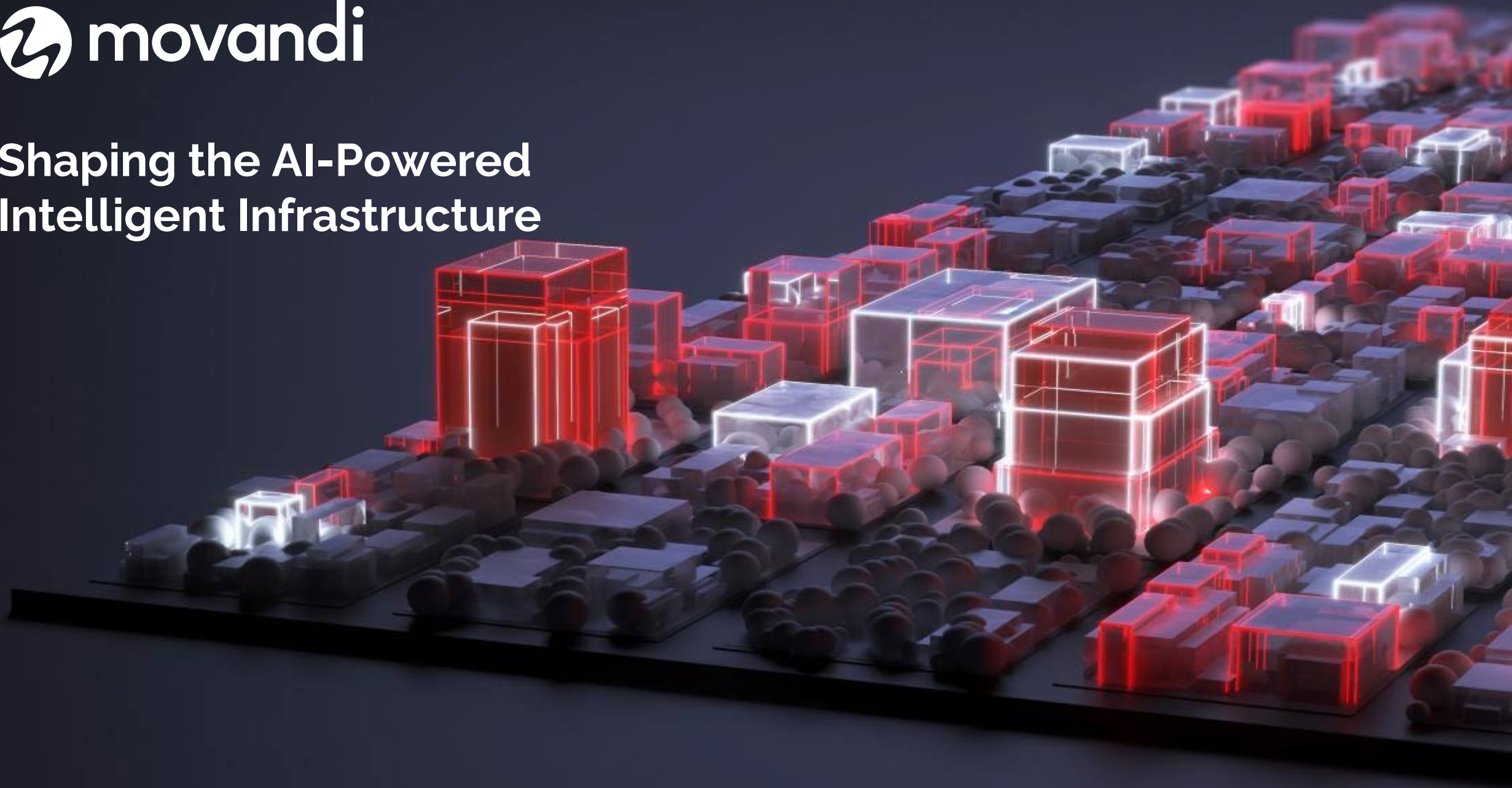




Shaping the AI-Powered Intelligent Infrastructure

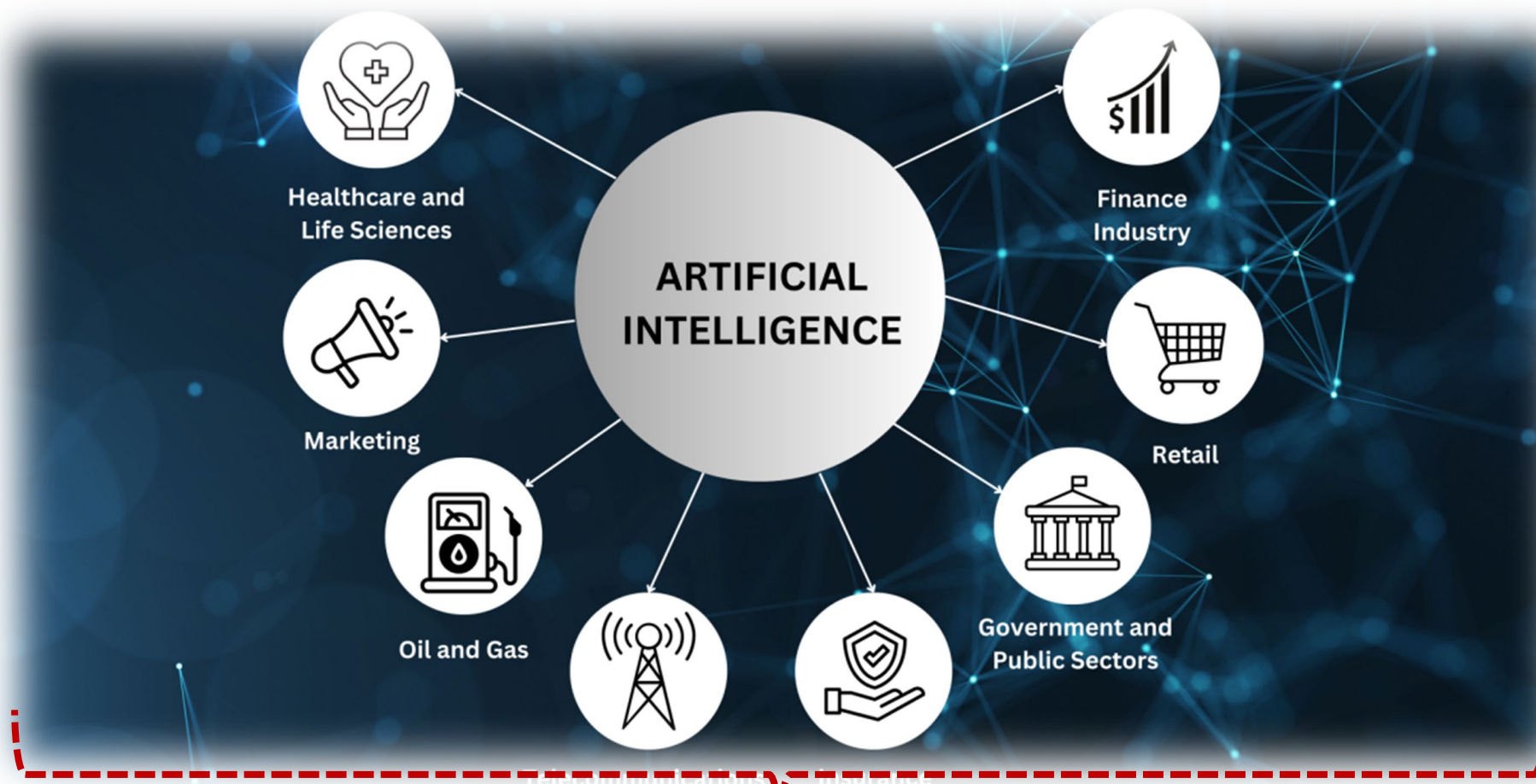


Global Semiconductor Shifts

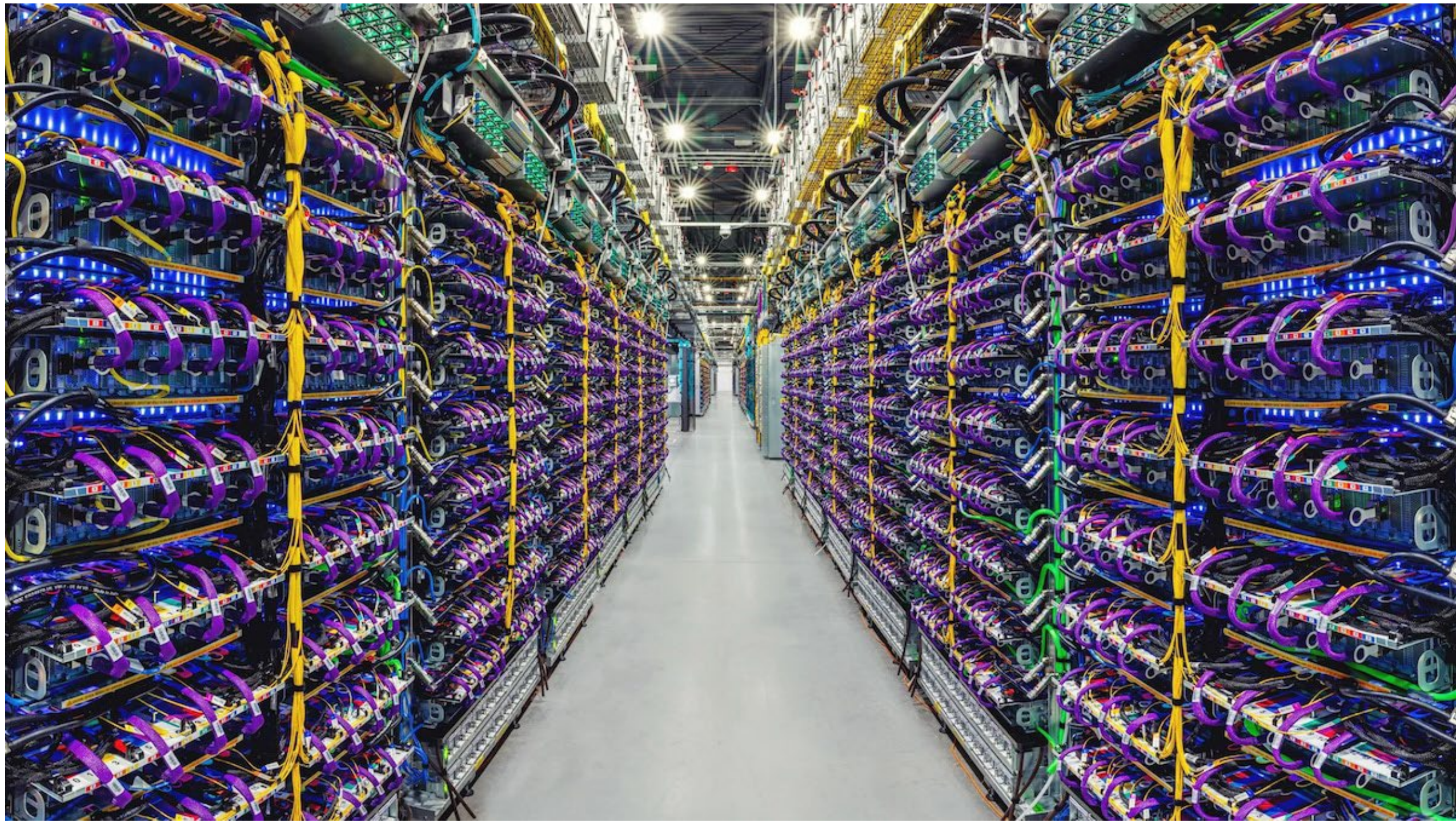
- AI redefines Compute & Communication—Algorithms and Data
- Massive data movement requires innovative solutions driven by stringent latency constraints
- Semiconductor is cornerstone of the AI technological revolution



Intelligent Connected World



Artificial
Intelligence





A new beginning

2023 = Year 0

AI

40G

100G

200G

400G

800G

1.6T

3.2T and beyond

2X every 4 years

2X every 2 years

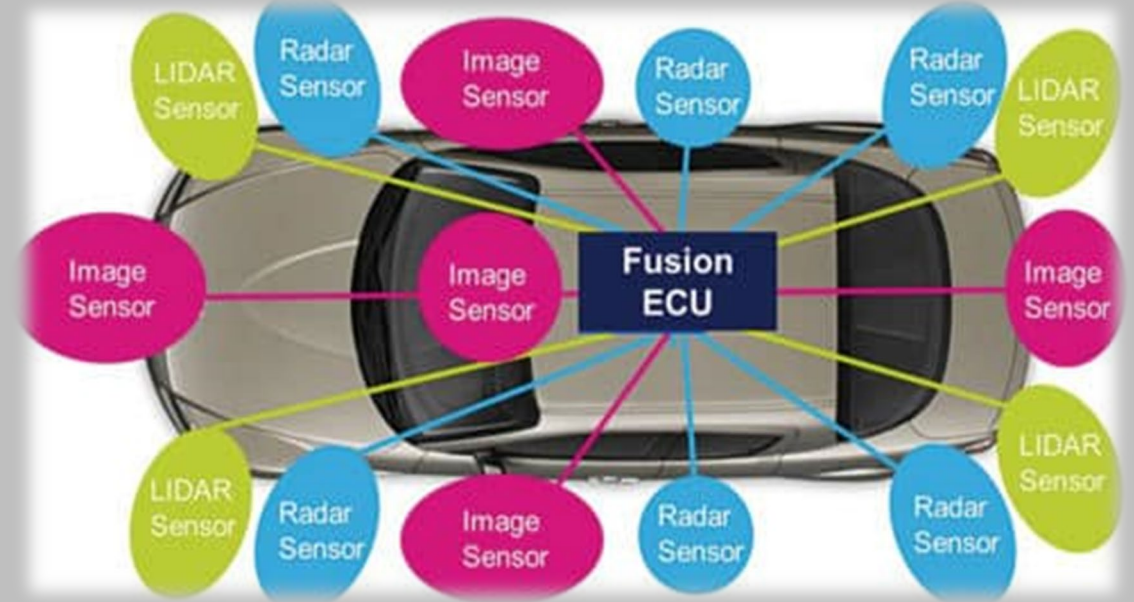
AI doubles interconnect speed in half the time

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MARVELL

Essential technology, done right™

Future Hyperconnected World



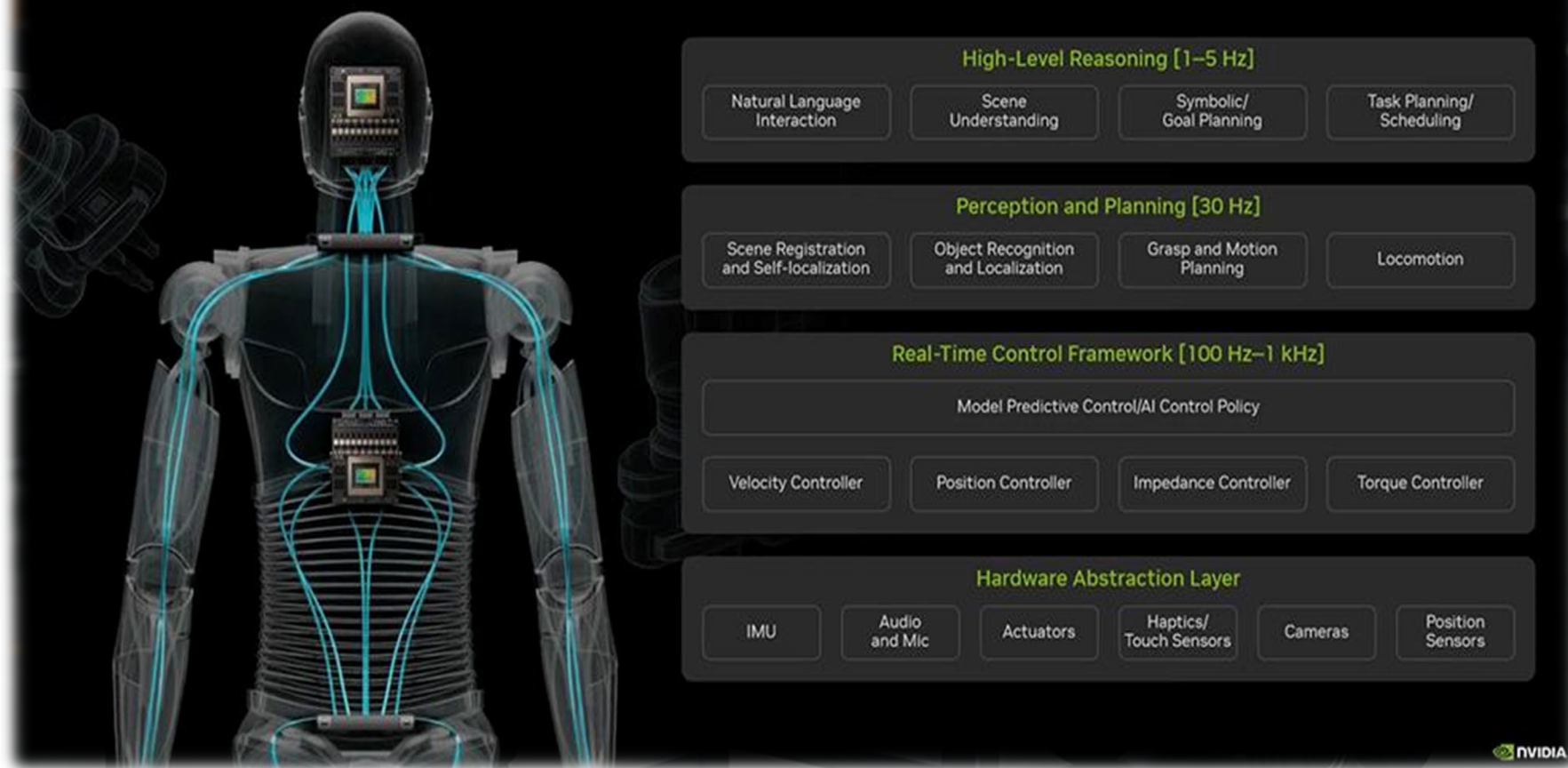
Autonomous Car

Sensor fusion and edge processing for safe driving

Numerous embedded sensors drive massive data (Local and V2X)

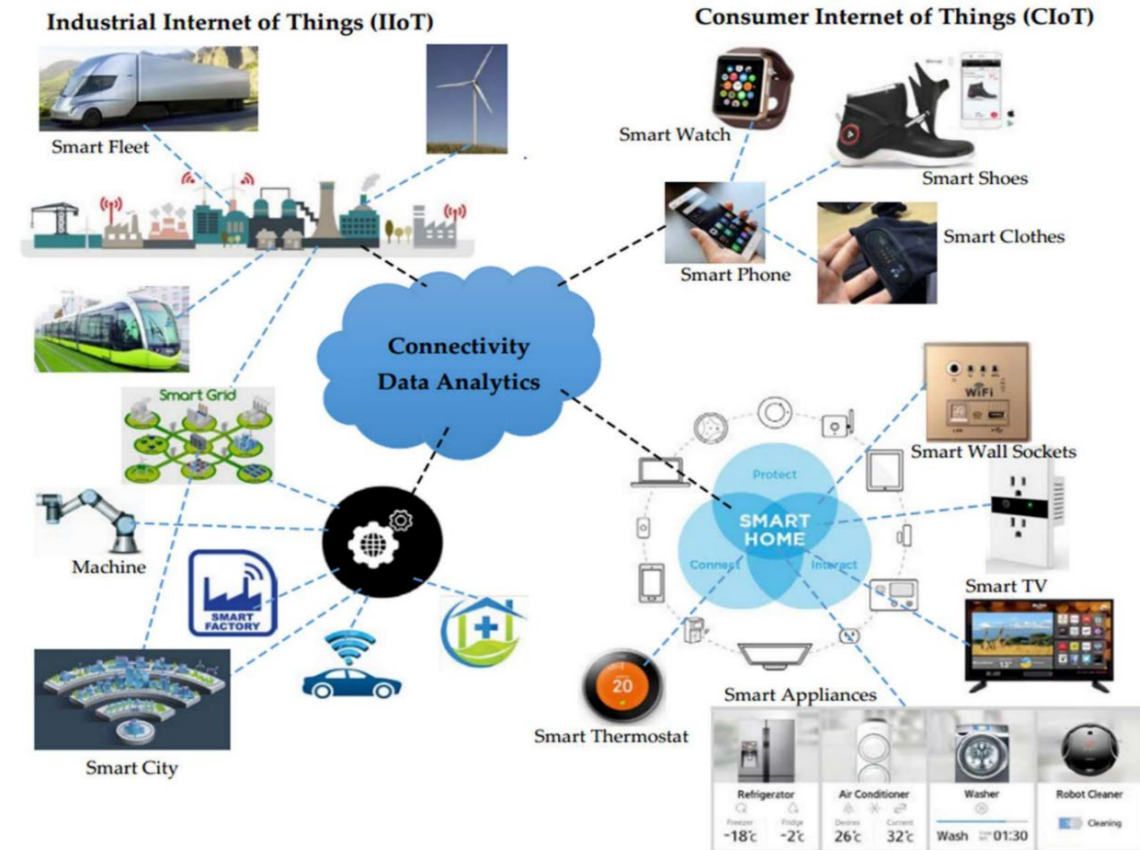
Sensors enable seamless integration of physical environment with digital content

Robotics Demand Rich Sensors and Low-Latency AI Processing

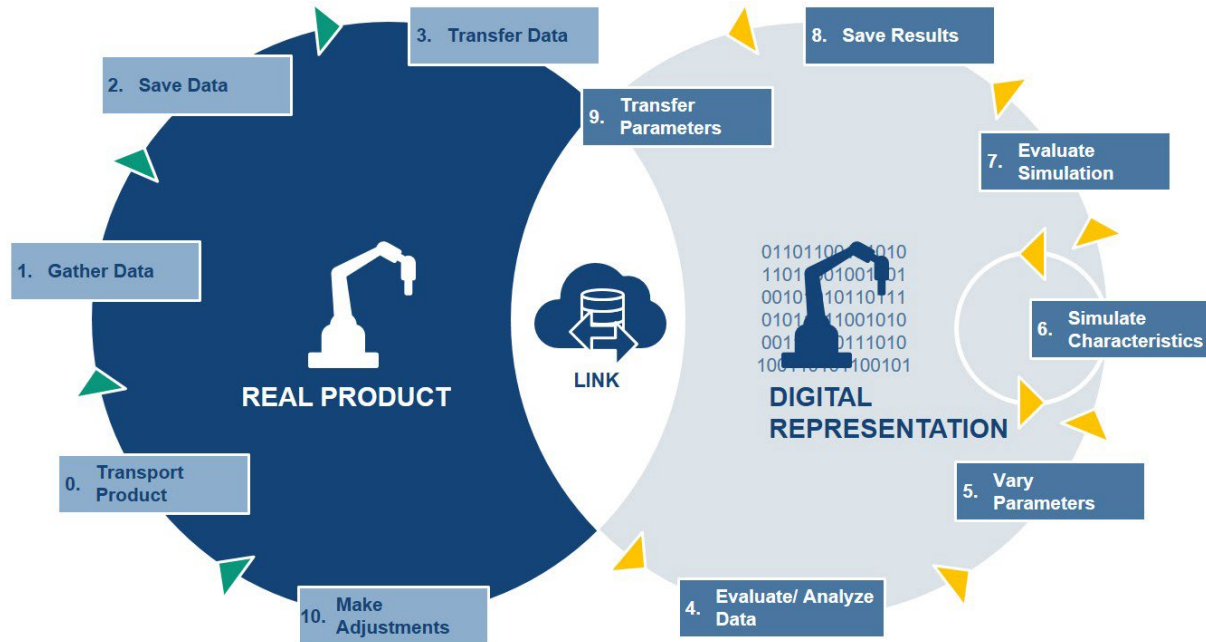


A Hyperconnected World, Integrated Sensing & Communication

-  **Support over 1 million devices per km²**
Orders of magnitude more than the 60,000 devices currently possible
 Cellular
-  **Sensors will become omnipresent**
 Wi-Fi
20.4 billion devices embedded with connected sensors
-  **Definition of scale will change**
The world will support hundreds of billions, or possibly trillions of devices
-  **Intelligence requires massive processing & complex chips**
Different functionalities for difference applications
-  **Coexisting Standards**
Cellular, WLAN, WPAN, Satellite



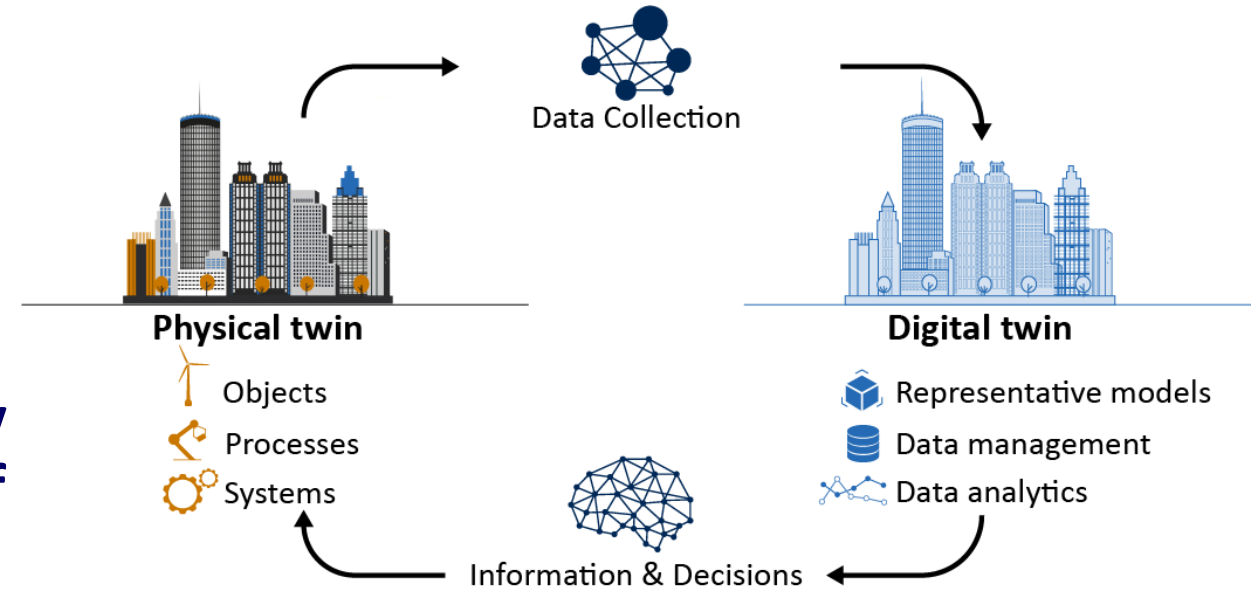
Digital Twins Of Future



Requires high bandwidth with low latency wireless networks and massive number of sensors with significant RF contents

Virtual Reality

- Creating exact image of Physical World
- Increasing efficiency
- Speeding up process



Satellite Communication: New Element of Ubiquitous Communication

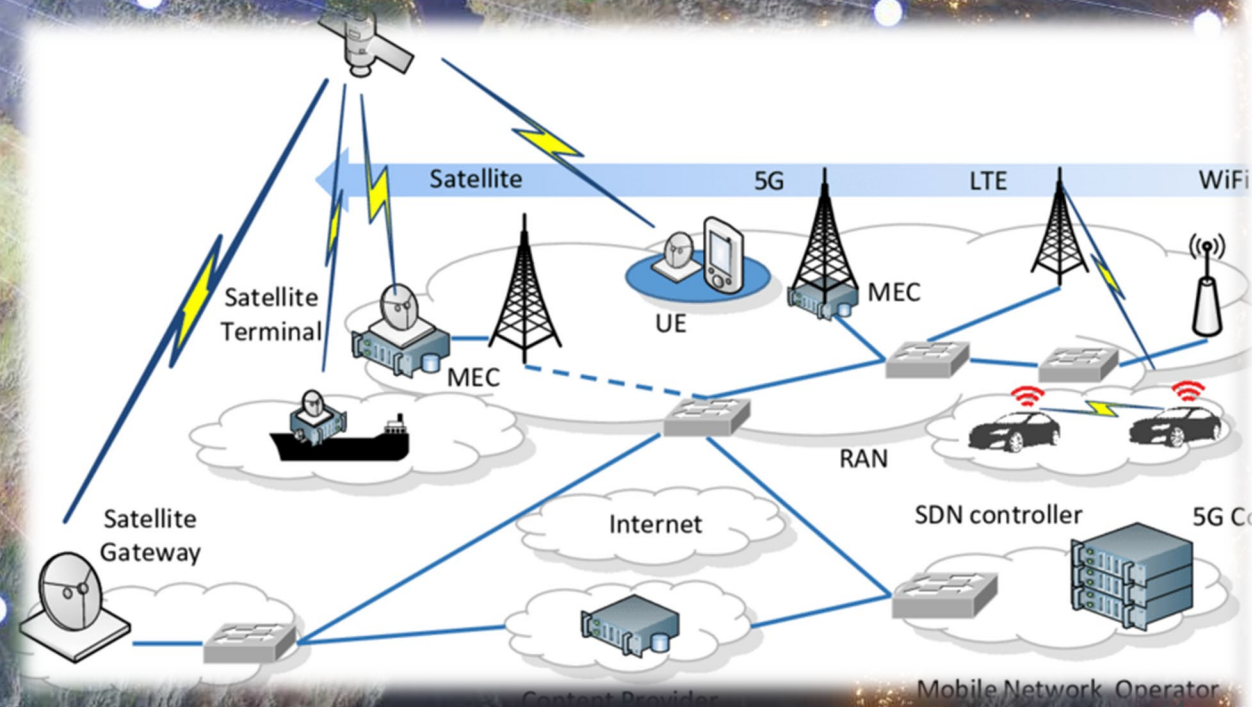
Satellite-terrestrial integrated computing (STC)

Integrates satellites, satellite networks, terrestrial communications systems, and cloud computing

Digital services more accessible and inclusive across the globe

Satellite to devices (low data rate for emergency at low band)

Satellite to Ground terminals for fast broadband access (Ka & KU bands)



Massive Data By AI Creates Challenges



**MULTI-GIGABIT
THROUGHPUT**



**HIGH SPEED SYMMETRICAL
BANDWIDTH**



**LOW LATENCY
(LOW NANO SECONDS)**



**FAST , OPTIMIZED
PROCESSING**



**LOW POWER
(REDUCE ENERGY/HEAT)**

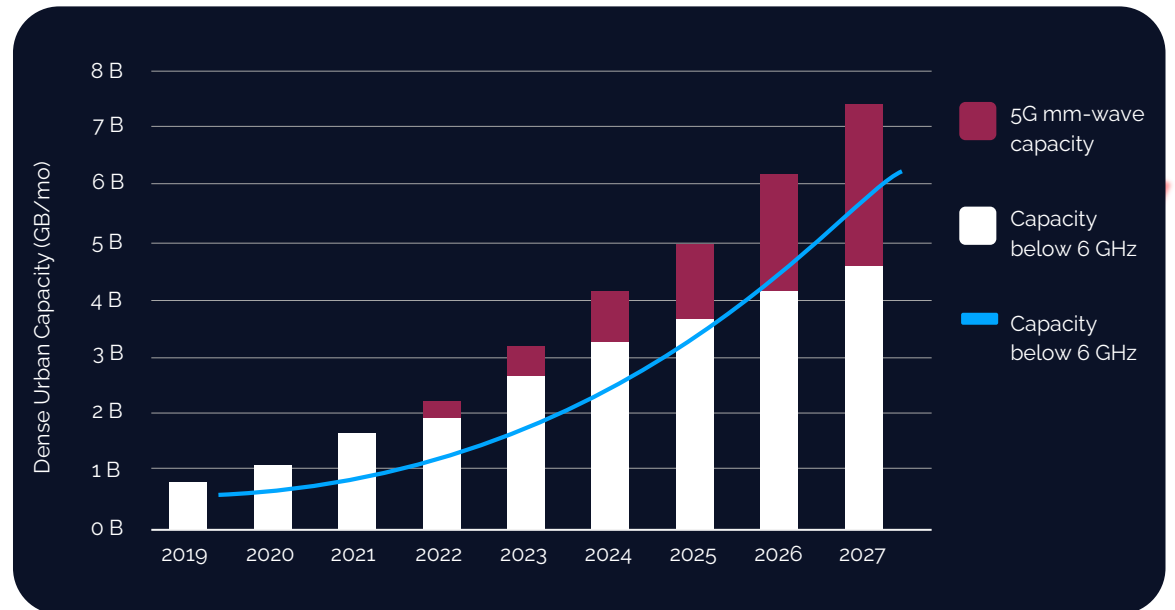
Massive Data Growth, More Demand On Wireless

AI Drives An Explosion In Compute & Data

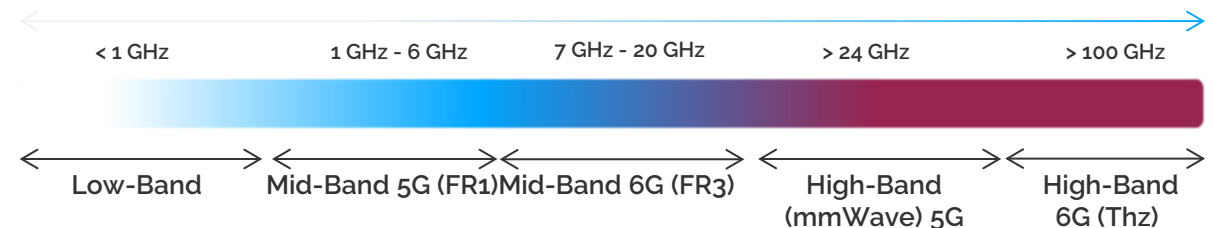
Wireless Network Requirements:

- Significantly higher capacity
- Range
- Higher bandwidth
- Higher SNR
- Higher frequency bands of mmWave and THz
- High speed
- High throughput

RFICs become more critical at higher bands in FR3, mmWave & THz to meet the system performances including SNR, range, and power consumption



Cellular Spectrum



Intelligent Connectivity Drives Coverage / Efficiency

Example: KDDI/Kyocera/Movandi Deployed Repeater Technology (Q2 2025) Dramatically Expanding Coverage

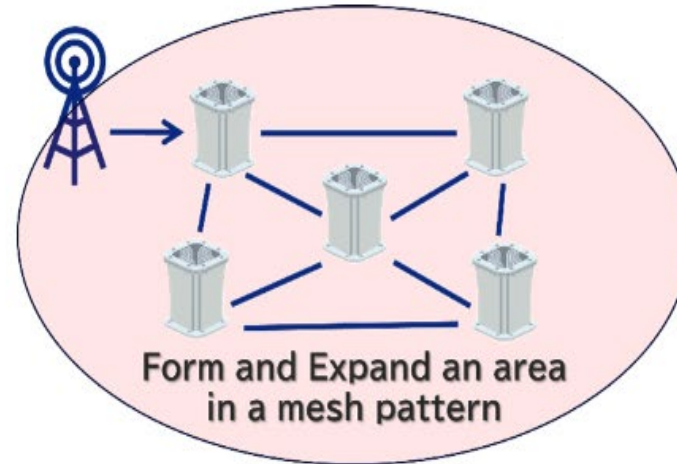
Coverage in the Shinjuku area in Tokyo expanded from 33% to 99%

Autonomous Repeater Mesh network optimizes the Relay Route

Compact and Lightweight with no need for Fiber

Proving low cost, rapid deployment addressing high-capacity mobility & FWA

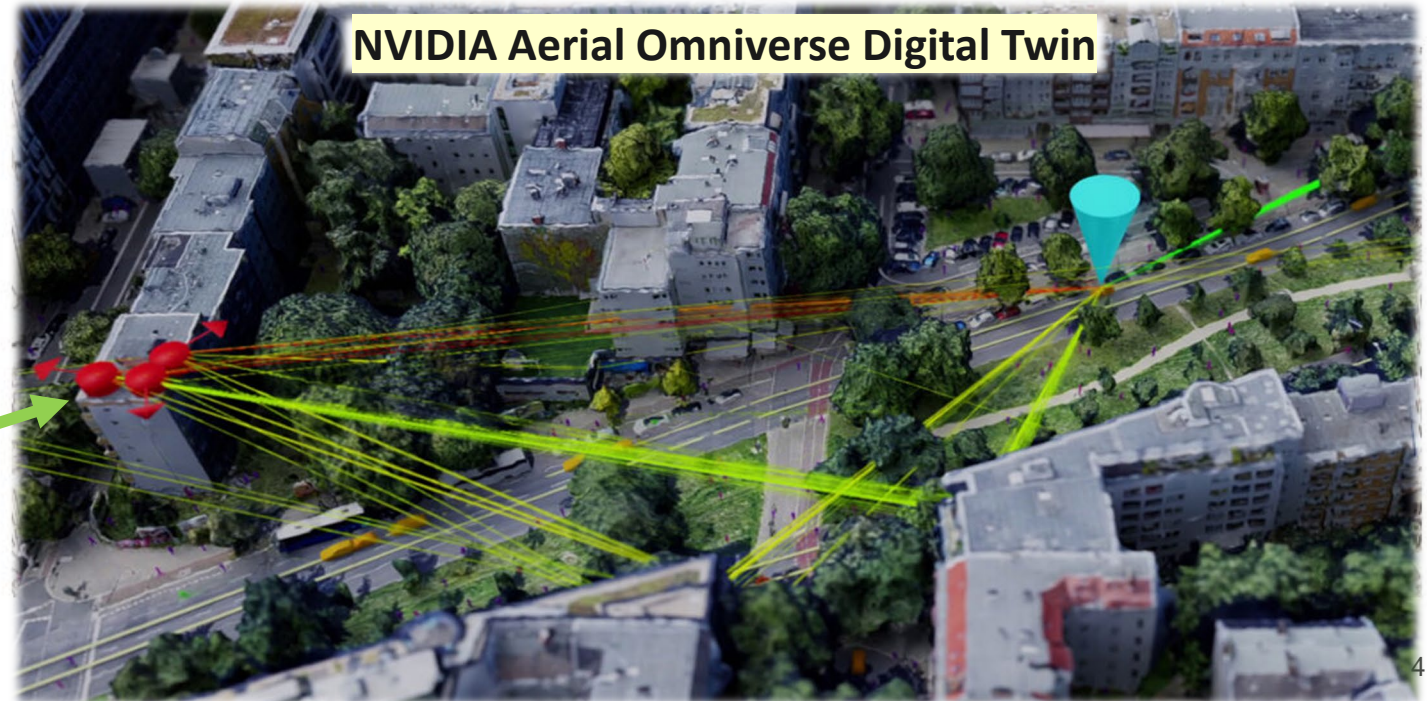
AI can be added to the network for performance optimization



Wireless Relay Technology to Expand Millimeter-Wave Area



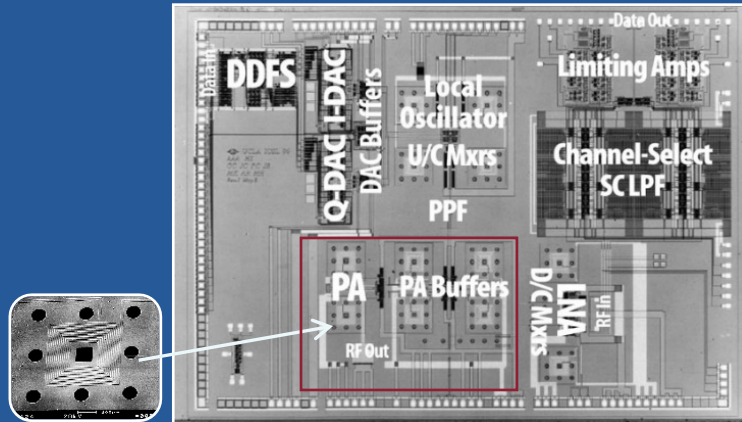
Repeater Installation in Nishi-Shinjuku Area



Nvidia Arial GnodeB with AI

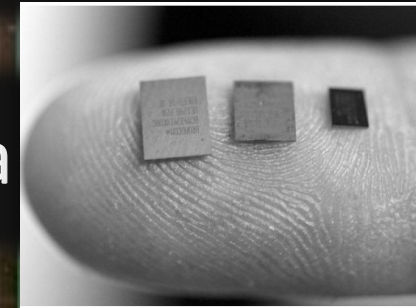
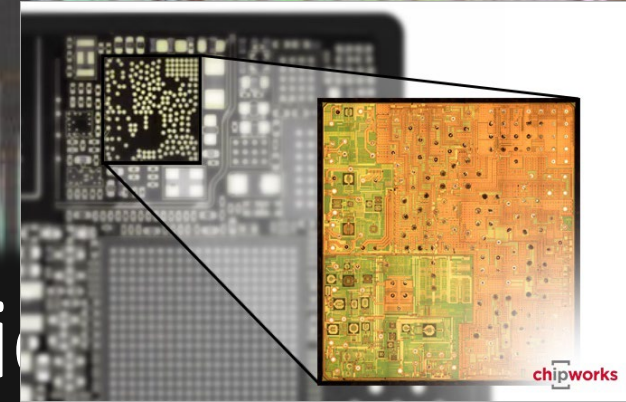
SOC Integration Enabled today's Connected World

900Mhz Spread Spectrum
Radio, 1um bulk digital CMOS



Etched 100nh
Inductor

emio
bling AI



Left: Bluetooth + W
Middle: Bluetooth +
Right: Bluetooth



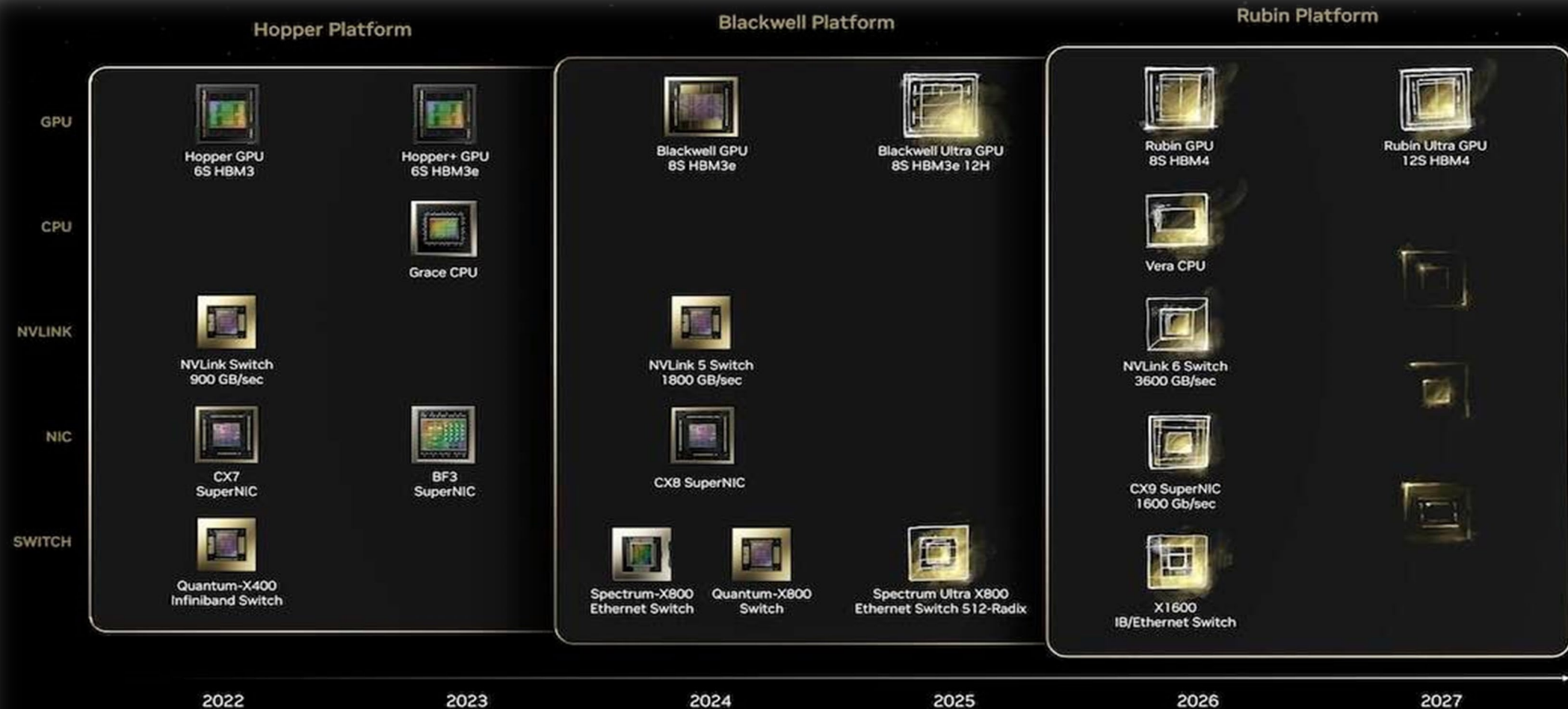
ISSCC, First fully integrated Radio SOC POC, 1995

First Integrated Multi-standard SOC product after 2000

1990

2000s

Advanced High Performing GPUs Enabling AI Applications



Intelligent Connectivity, A New Era, Requires Innovative RFIC

Future Wireless Requires Innovations in

Radio Architecture

- Direct sampling & MIMO in midband
- Phase Arrays and Beamforming in mmWave (digital and Analog Beamforming)

Silicon Architecture

- Fast & High-resolution ADCs/DACs
- Software defined Radios

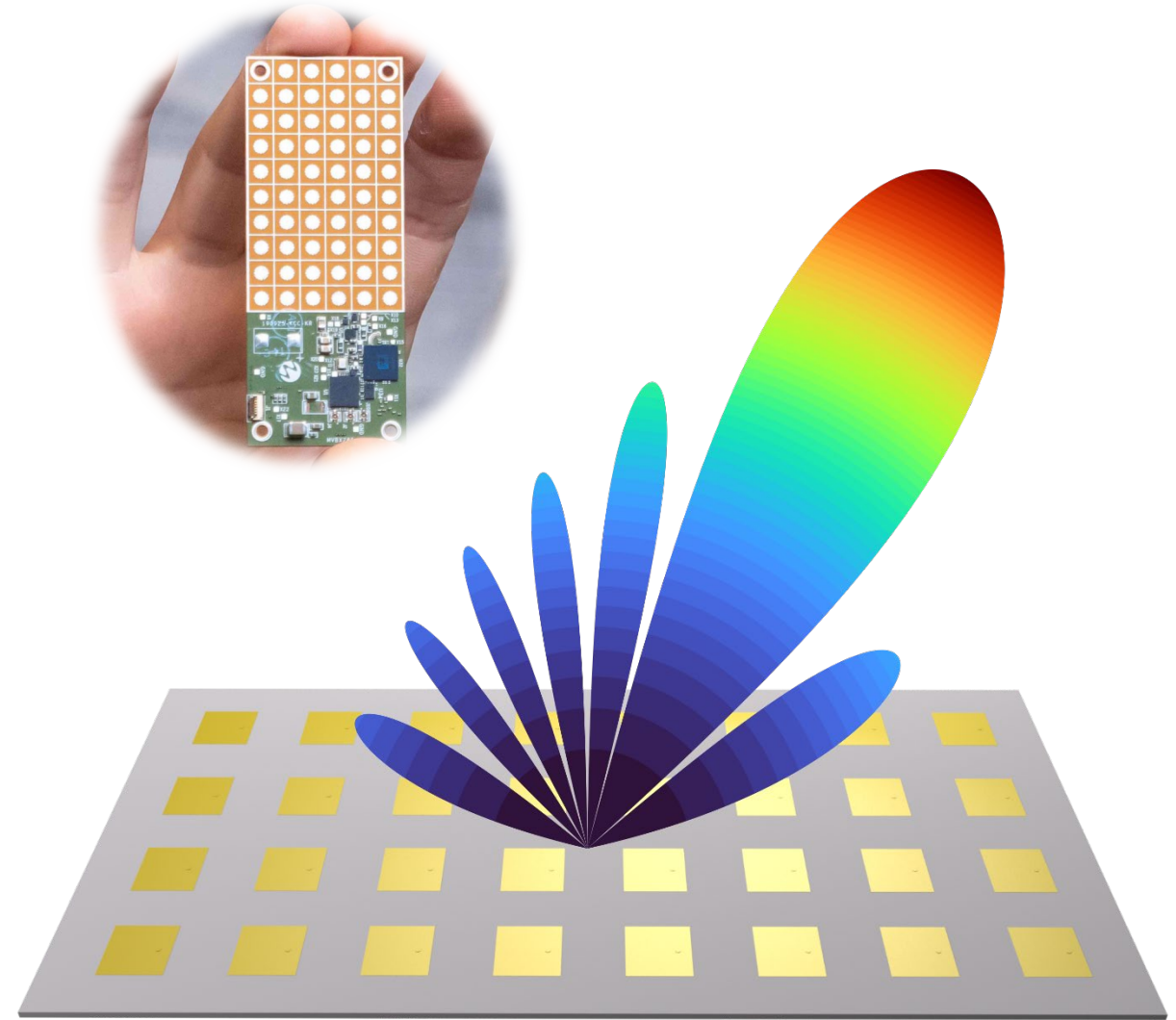
Package & Substrate

Chiplet

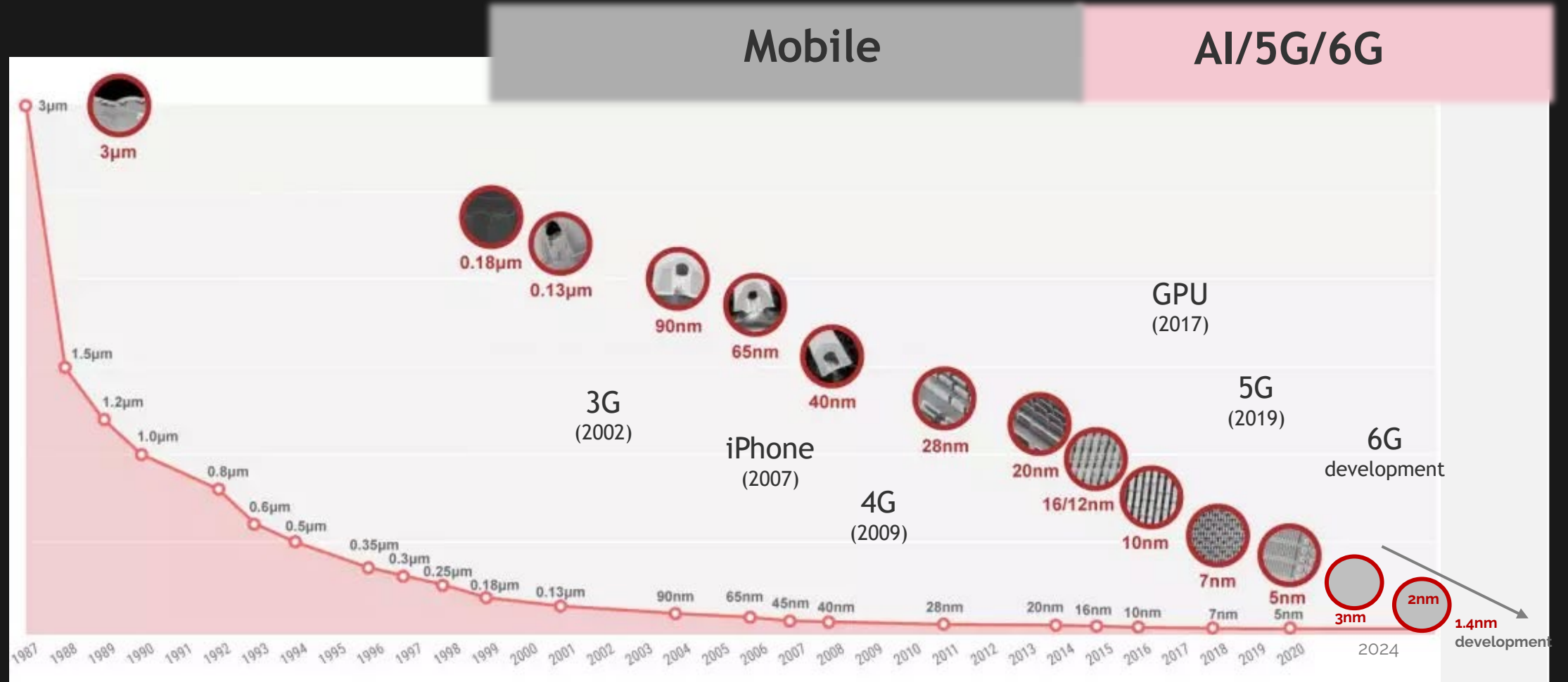
- IC integration in package and modules

Network deployment

- Cost effective deployment



Technology & Applications Drive Semiconductor Evolution



SemiWiki, March 6, 2020

Future Connected World

Future brings an unprecedented level of intelligence in humans' lives driven by AI

AI demands massive computing power and scale with low latency

An intelligent world integrates high performance, robust sensing, wireless, and wired connectivity

Semiconductor ICs are foundational to this vision



THANK YOU