

Data Centers para Inteligencia Artificial

Luismi Díaz

Desarrollo de Negocio IP/DC

Spain & Cuba

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ES.NOGB4

NOKIA

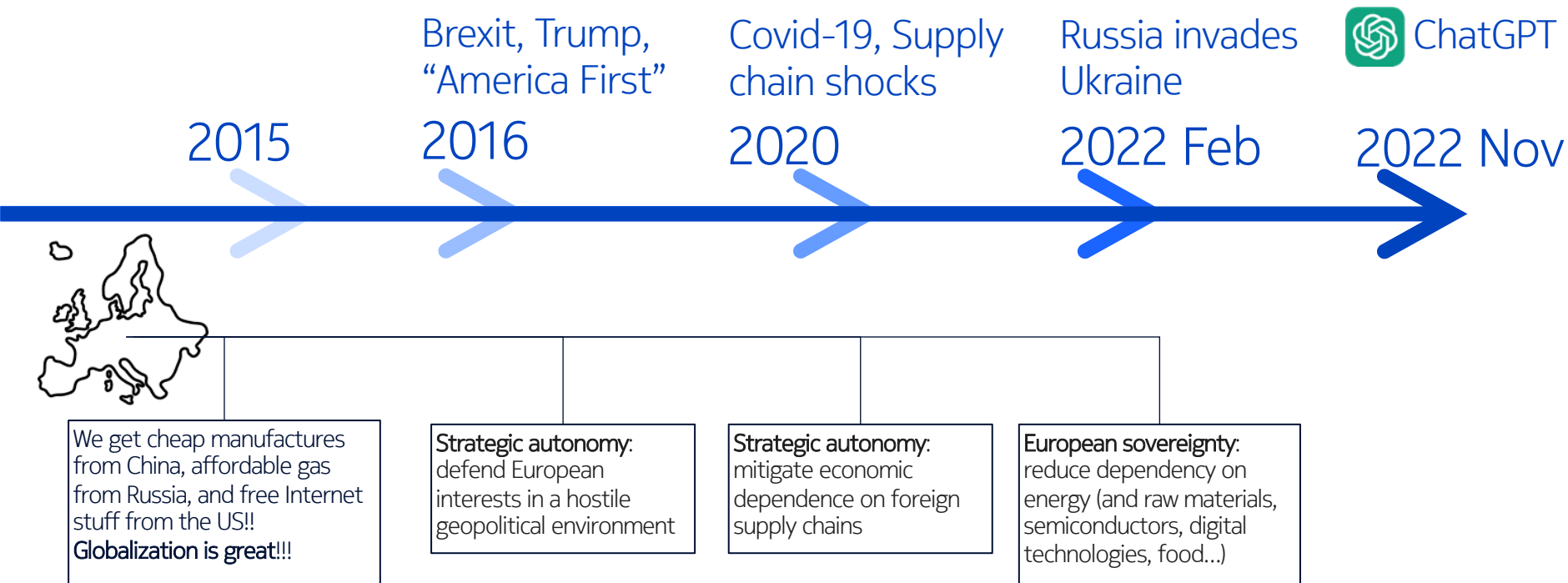
We have digitalized everything...



...and sourced it out of Europe

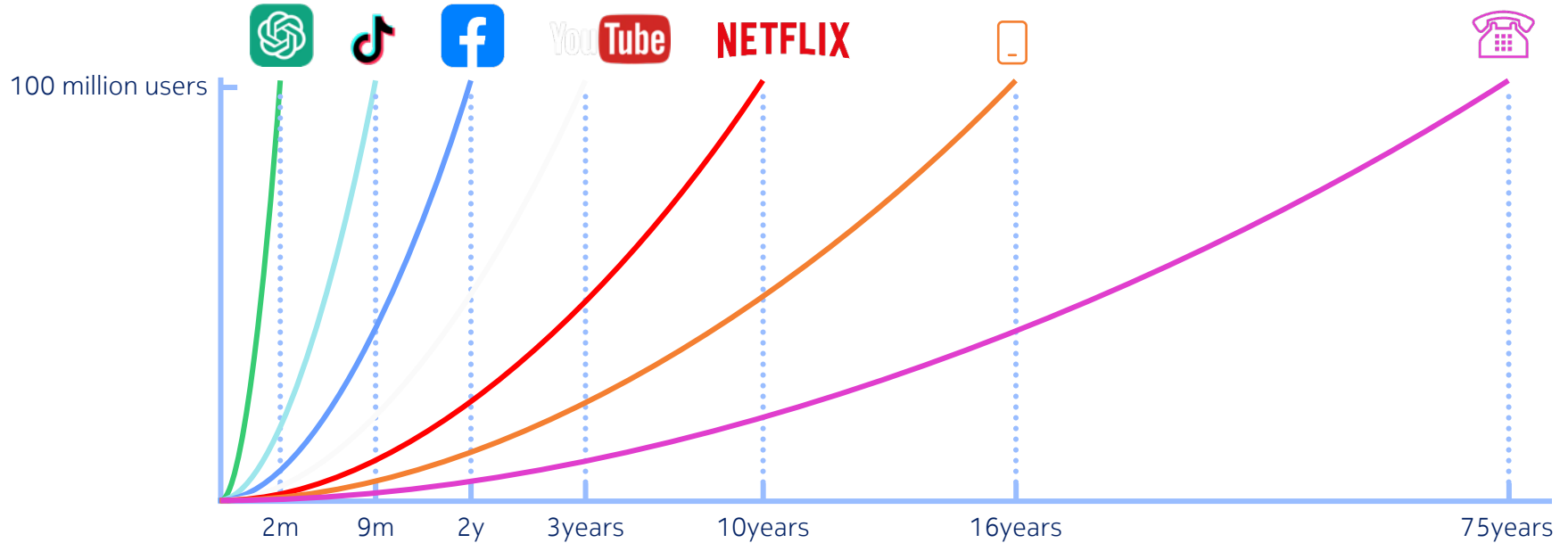


And just like that...

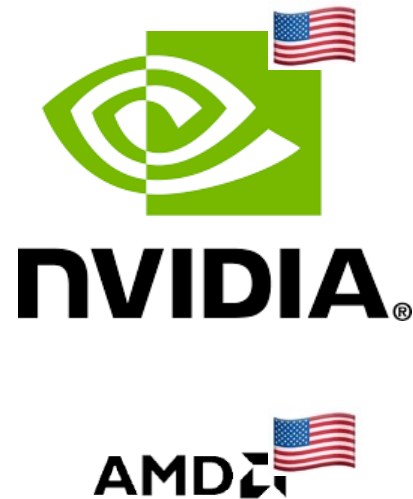


The AI boom

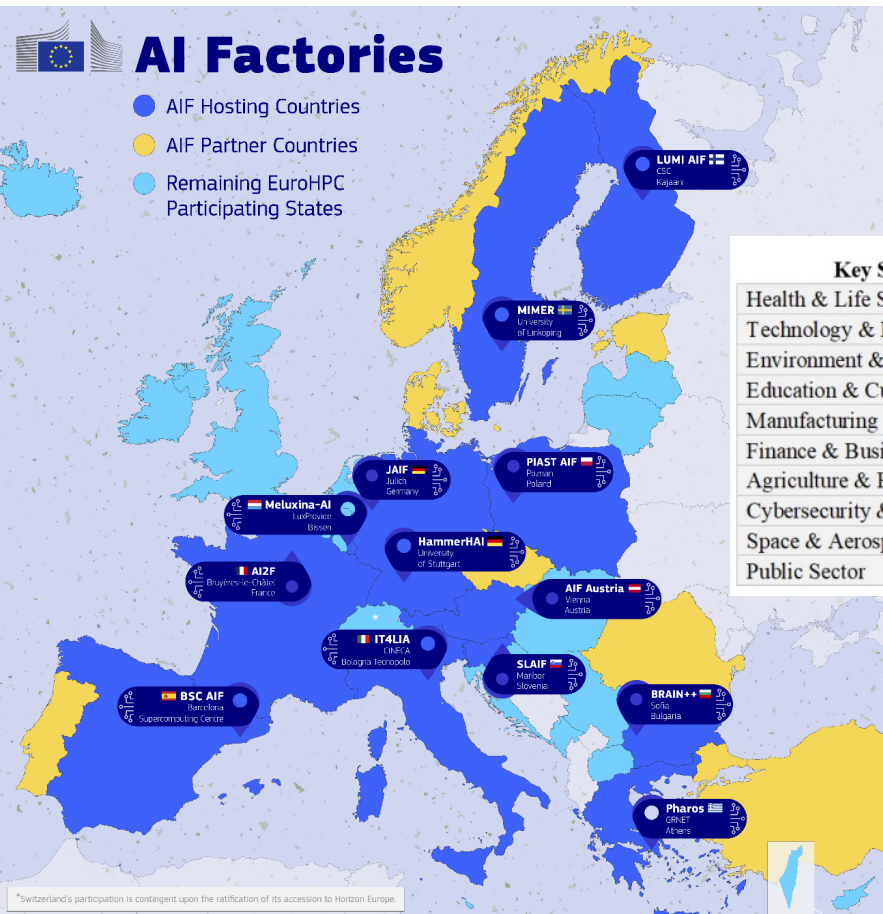
Time to 100 million users



And yet again...



EU had taken some action...



Key Sectors	AT	BG	DE	EL	ES	FI	FR	IT	LU	PL	SE	SI
Health & Life Sciences	●		●	●	●	●	●	●		●	●	●
Technology & Digital		●		●	●	●	●	●	●	●	●	●
Environment & Sustainability		●	●	●	●		●	●	●	●	●	●
Education & Culture	●	●	●	●	●		●	●			●	●
Manufacturing & Engineering	●	●	●			●	●				●	●
Finance & Business	●		●		●		●	●	●		●	
Agriculture & Food	●				●		●	●			●	●
Cybersecurity & Dual use							●	●	●			
Space & Aerospace		●					●		●	●		
Public Sector	●		●		●					●		

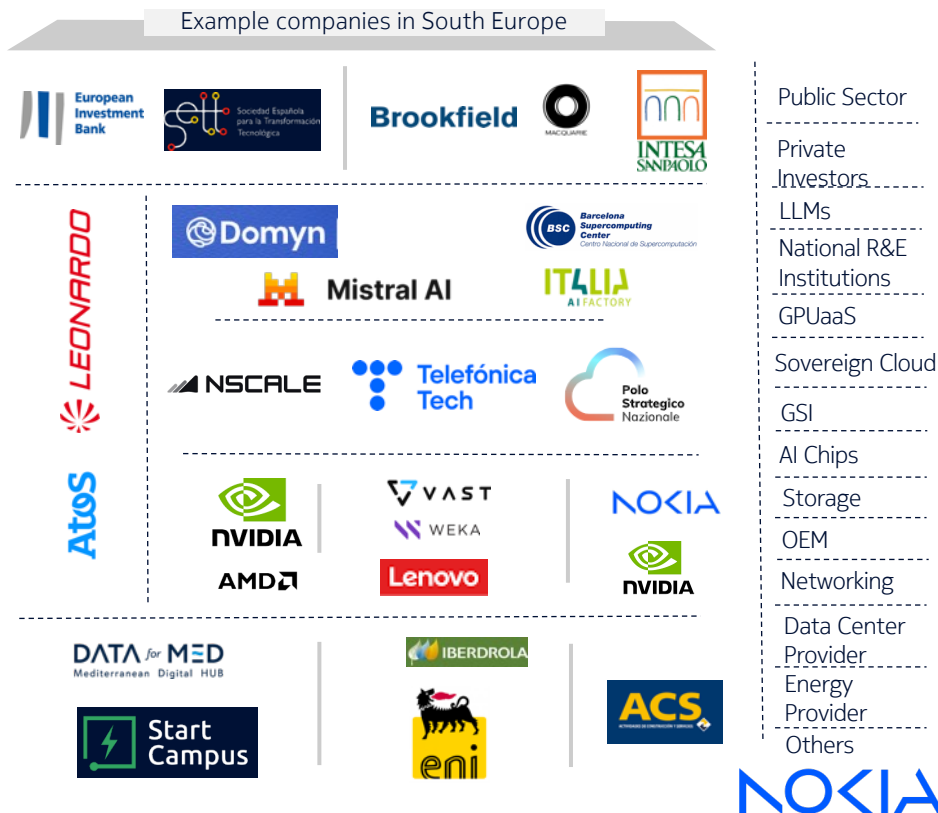
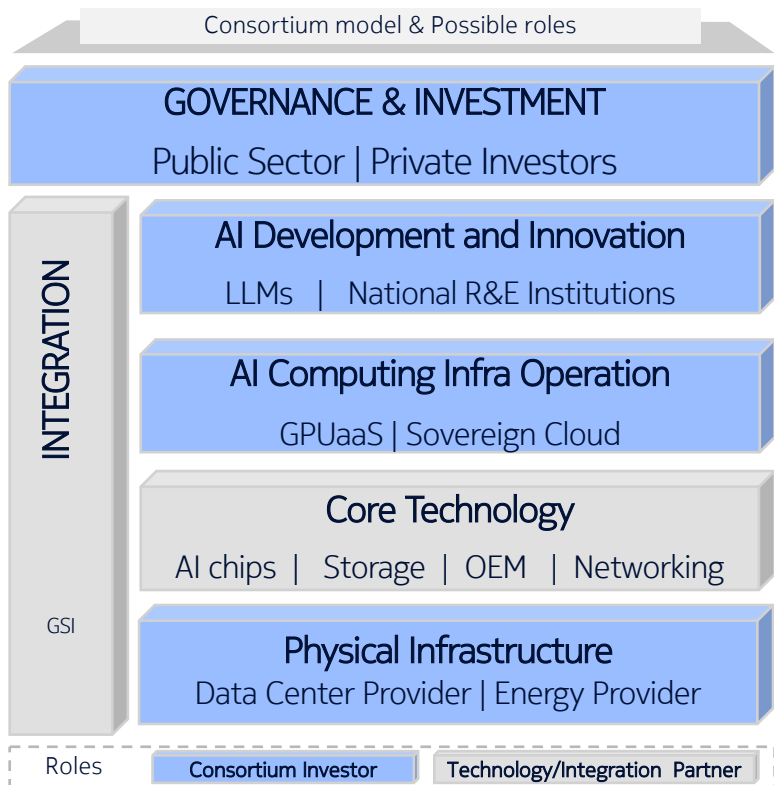
...where AI GigaFactories play a key role...



AI Gigafactories

- **Objective:** train and develop complex AI models
 - 4x more powerful than AI Factories
 - €20 billion mobilised by InvestAI
 - Deploy up to 5 Gigafactories
-
- The AIGF initiative is a once-in-a-generation chance for Europe to establish world-leading AI infrastructure. By building facilities with **100,000+ advanced AI processors**, Europe can match or surpass global leaders, securing **strategic autonomy** and reducing reliance on foreign technology.
 - It strengthens Europe's ability to independently develop, deploy, and regulate advanced AI systems, ensuring **alignment with European values** and regulatory frameworks.
 - The establishment of a single AI Gigafactory is estimated to require significant investments, encompassing both capital expenditures and operational expenses. Given the magnitude of the necessary investment, these AI Gigafactories will be implemented through **public-private partnerships** and innovative funding mechanisms.

How do you build an AI Gigafactory



What's the Problem?

AI and HPC networks are different

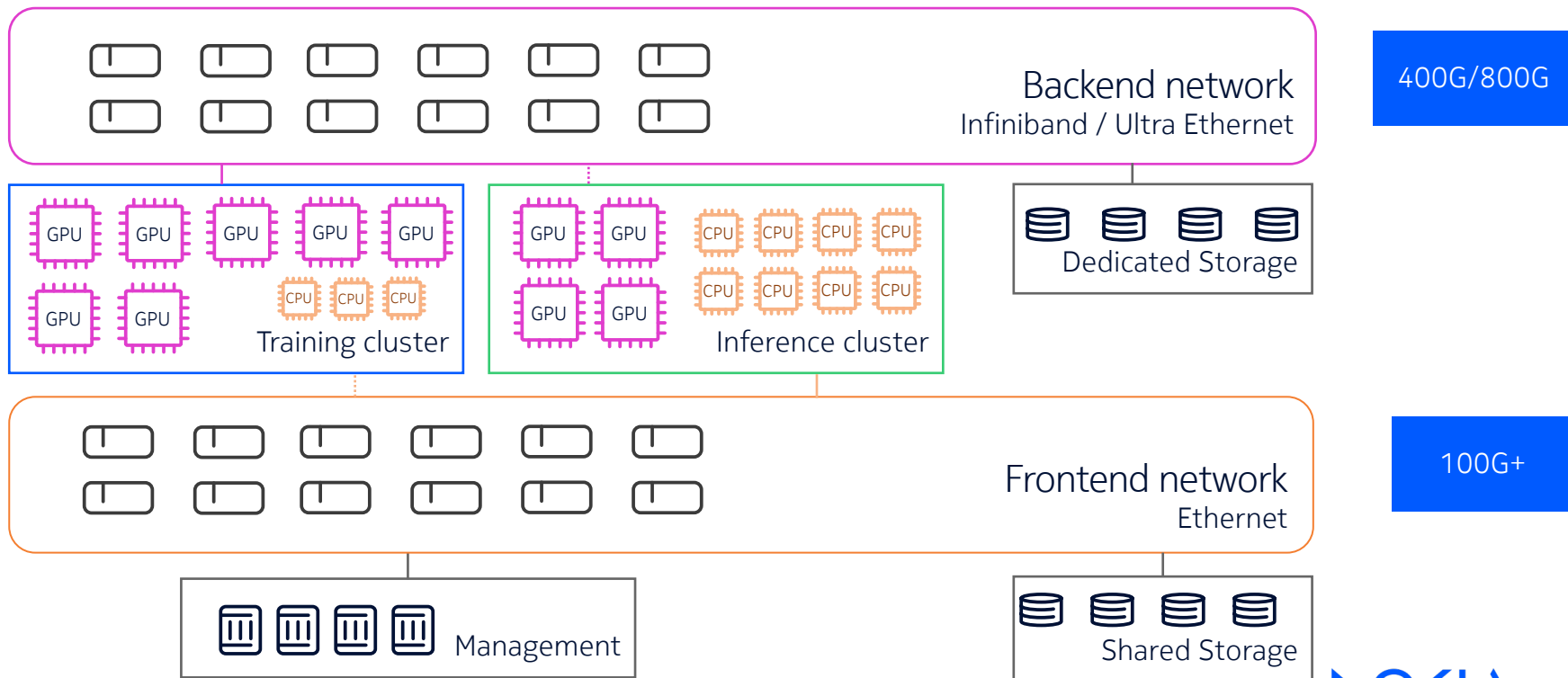
- Endpoints are fast, load is high
- Flows are few and high bandwidth
- RTTs are short
- Flows are synchronized
- Completion time determined by slowest flow



Vanilla networking doesn't meet the needs

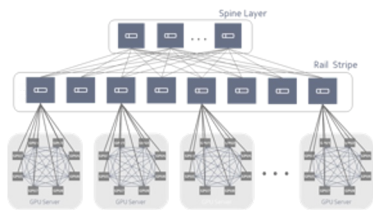
Networking in an AI Gigafactory

AI clusters



CLOS vs rail-optimized vs rail-only

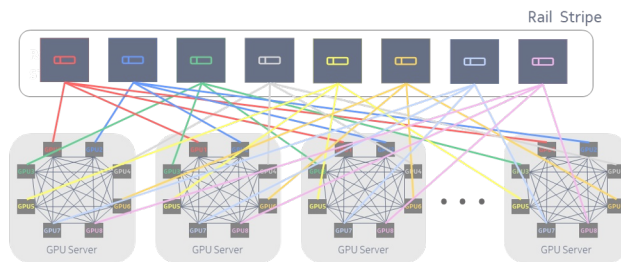
CLOS



Due to nature of traffic patterns of AI models not fit for modern AI back-end (but it does for Front-end and Storage)

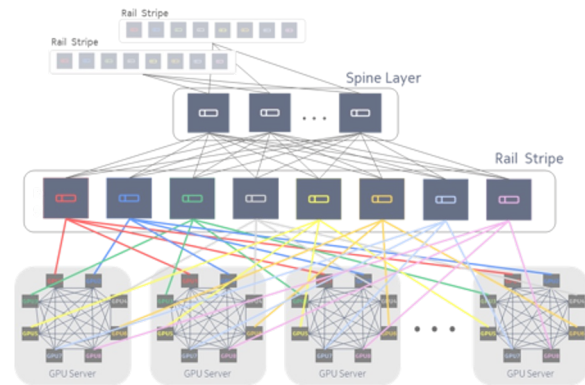
Rail-only

Uplinks to spines re-purposed to connect more GPU servers (times 2 vs rail-optimized)

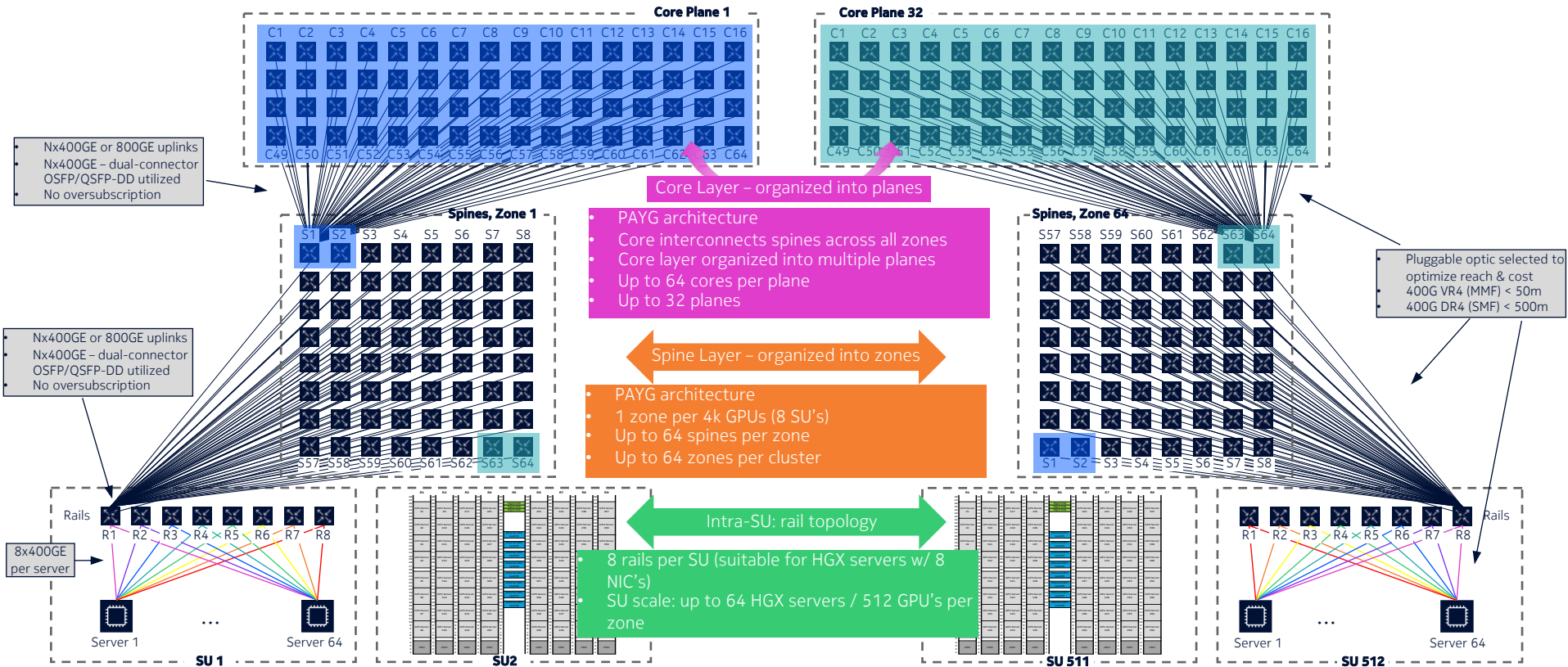


Meta/MIT Rail-only paper

Rail-optimized



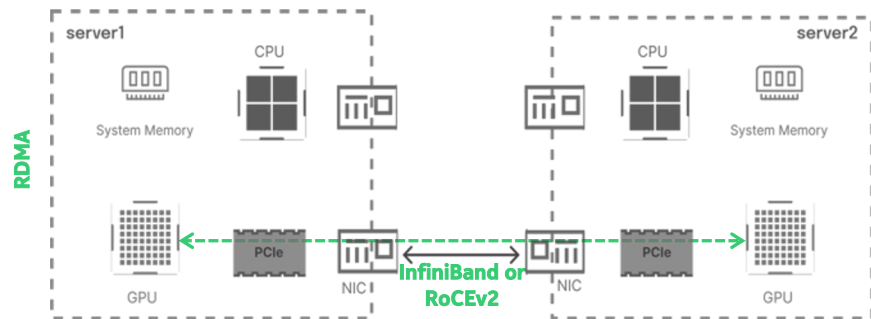
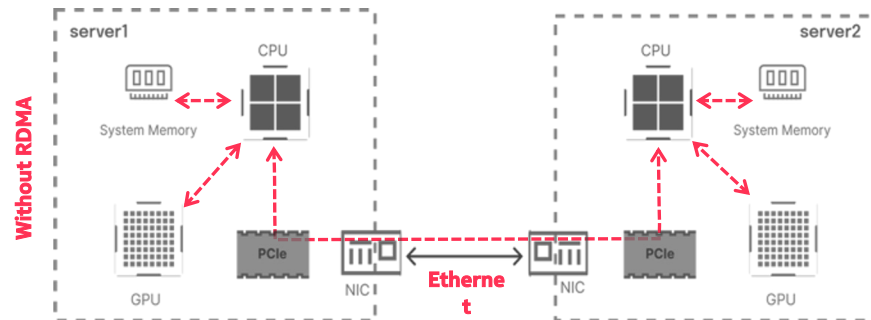
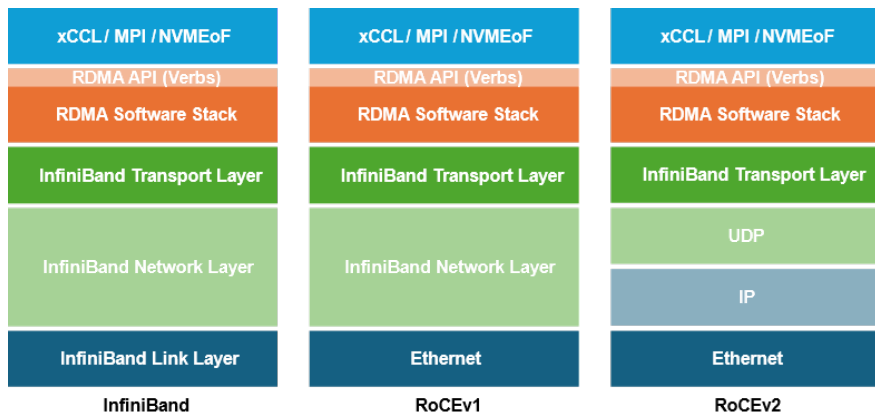
Rail-Optimized Fabric: Scaling up to 262,144 GPU's



RDMA is a great concept

Remote Direct Memory Access

- RDMA enables direct access/transfer to/from memory
 - CPU kernel bypass, zero-copy
 - HW loss detection, retransmission, loss recovery
- Infiniband (IB) and RDMA over IP (RoCEv2) are RMA implementations
 - IB proprietary and limited nr of endpoints (16 bits – reserved address spaces)
 - Nvidia also offering RoCEv2 via Spectrum-X platforms



bits	31-24		23-16			15-8	7-0
bytes	0-3	VL	LVer	SL	Rsv2	LNH	Destination Local Identifier
4-7	Reserve 5		Packet Length (11 bits)			Source Local Identifier	

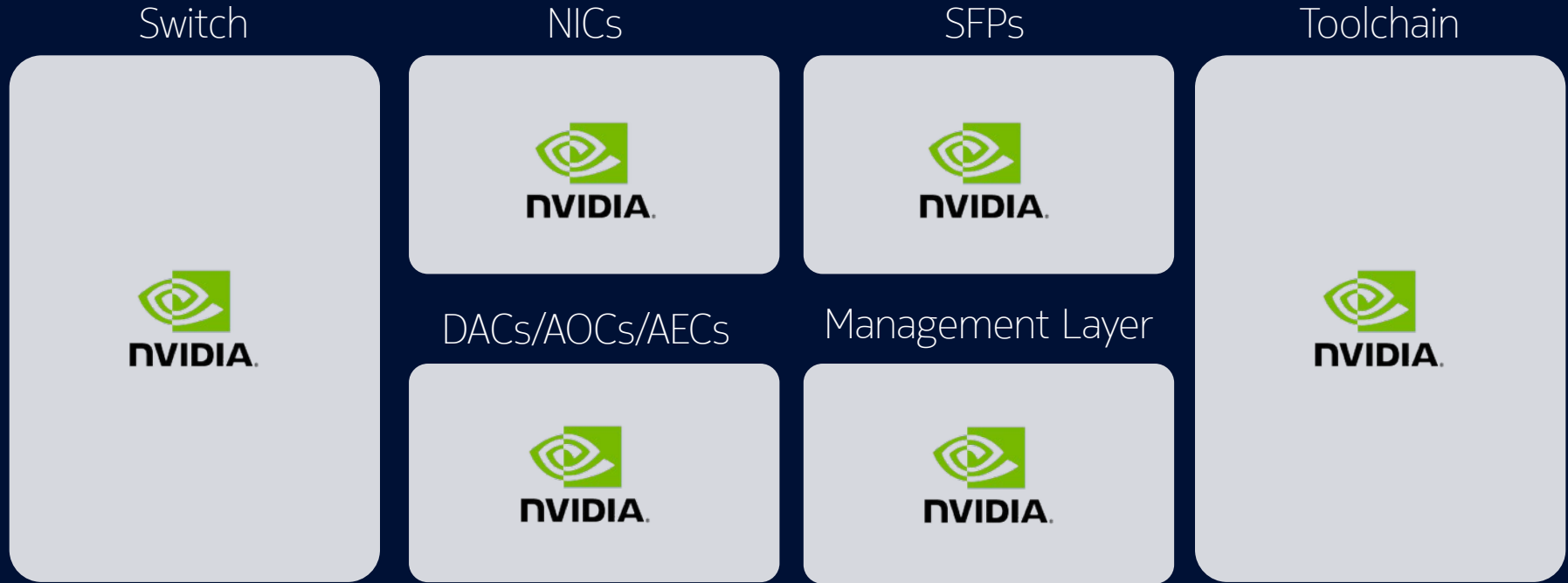
IB link layer

A Tale of Two Technologies

Ethernet vs. InfiniBand

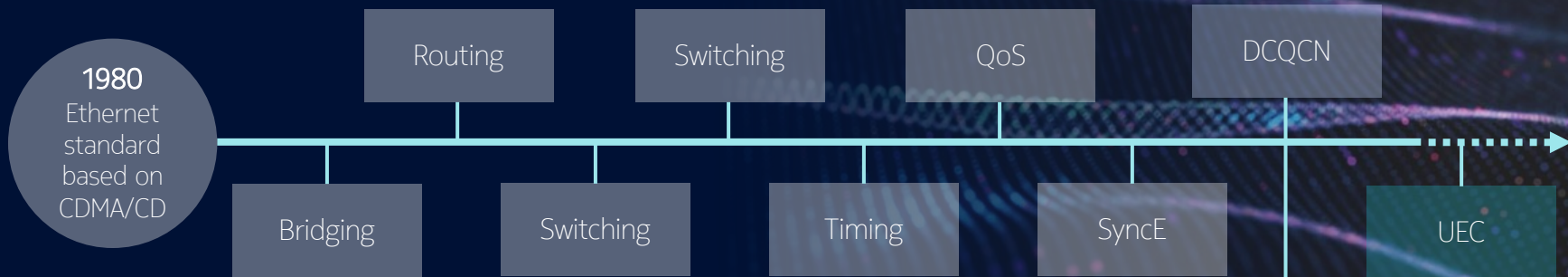
	Ethernet RoCEv2	InfiniBand	Ethernet Advantages
<i>Max Bandwidth</i>	800 gbps and beyond (1.6T planned for 2026)	800 gbps	<i>Faster technology iterations</i> on Ethernet in collaboration with standard bodies and large industry support.
<i>MTU</i>	9216 bytes	4096 bytes	Less transport overhead for efficient bandwidth utilization .
<i>Layer 3 Support</i>	Yes	Yes – recent development	Highly scaled network fabric allowing ease of operations, monitoring, and advanced features like multi-tenancy.
<i>Delivery</i>	Best Effort, enhanced to lossless	Credit-Based	Flexible transport – can scale from best-effort to lossless
<i>Load Balancing</i>	Load Aware	Deterministic	Similar performance giving full utilization of all available network bandwidth .
<i>Security</i>	MACsec, IPsec, multiple built-in encryption mechanisms	No integrated encryption	Ethernet is preferable for secure data center needs
<i>Failover & Resiliency</i>	Fast distributed failover, 20-30× faster path restoration	Centralized subnet manager slows recovery and re-routing	Ethernet excels in rapid recovery scenarios .
<i>Congestion Management</i>	Yes (ECN + PFC)	Yes	Leverages widely adopted Ethernet mechanisms (ECN, PFC) providing similar performance to InfiniBand .
<i>Interoperability</i>	Open and standards based	Closed ecosystem	Open system allows more vendor options and better price bargains .
<i>Management SW</i>	Open source and vendor specific options available	Vendor specific	Broad vendor ecosystem enables flexible management strategies using both open-source and commercial solutions.
<i>Skillset and Toolchain Ecosystem</i>	Broad talent pool, DevOps-friendly tools	Niche expertise- small pool, limited tools	Large pool of highly skilled Ethernet engineers as well as 30+ years of extensive toolchain ecosystem .
<i>Investment Protection</i>	Specialized backend gear can be repurposed to other parts of the network.	No protection	Protects long-term investment by enabling hardware reuse across network tiers.

The InfiniBand Lock-in Problem

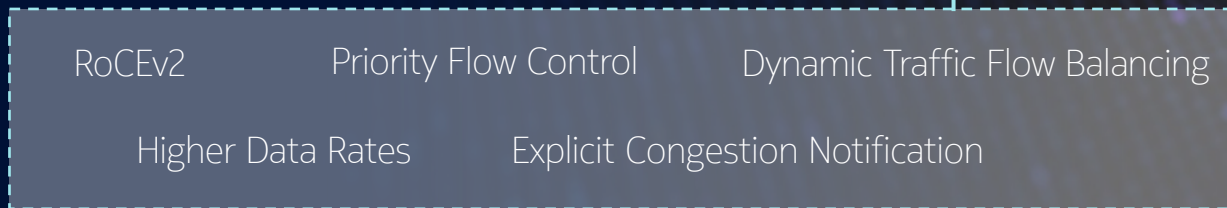
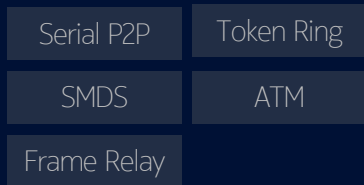


Ethernet has a long history of winning...

... and is evolving for AI/HPC workloads



Meanwhile competing technologies faded away despite technology advantages:



Evolution for AI/HPC Workloads

But RDMA as implemented today has restrictions

...and UEC transport addresses these challenges

Infiniband / ROCEv2

- UDP -> no reliability or ordering
 - In-order packet delivery requirement is limiting multi-pathing option
 - Lossless network requirement forced because of Go-back-N recovery
- Congestion control (DCQCN) hard to tune, does not interop with application level
- Lack of integrated security
- Scale requirement increasing
 - RDMA over Infiniband only supports a few 1000s of endpoints

Ultra Ethernet

- Multipathing RDMA
- Relaxed delivery ordering
- Rapid loss recovery
- Modern Congestions control for DC
- Rapid startup/slowdown
- Multi-path aware
- Run on IPv4/v6 and Ethernet
 - Lossy and Lossless operation
 - Ordered and Unordered delivery
- Integrated security

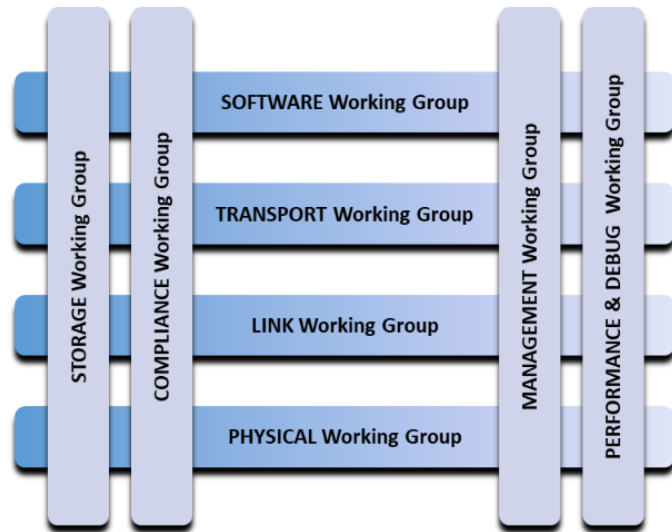
UEC background



Mission: Deliver an Ethernet based open, interoperable, high performance, full-communications stack architecture to meet the growing network demands of AI & HPC at scale



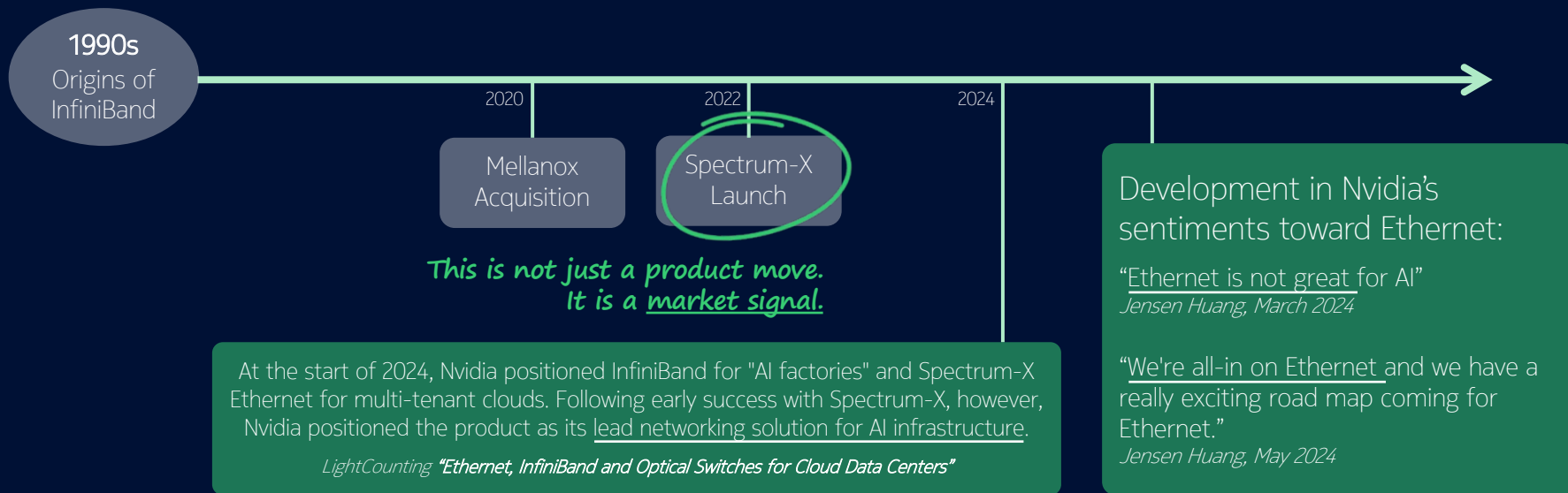
- > 120 member companies
- > 1550 individual contributors



UEC specification 1.0 (11/6/2025)

NVIDIA's Quiet Admission

Even the InfiniBand leader is betting on Ethernet



Even NVIDIA is hedging its InfiniBand bets with Ethernet.
What should the rest of the industry be doing?

Ethernet's Ecosystem Advantage

XPU/CPU



...

NICs



DACs/AOCs/AECs

Vendor Cables +
3rd Party Cables

SFPs

Vendor SFPs +
3rd Party SFPs

Management Layer

Vendors Platforms +
Open-Source and 3rd Party
Management Tools

Switch



Hewlett Packard
Enterprise

Toolchain



netbox



Terraform



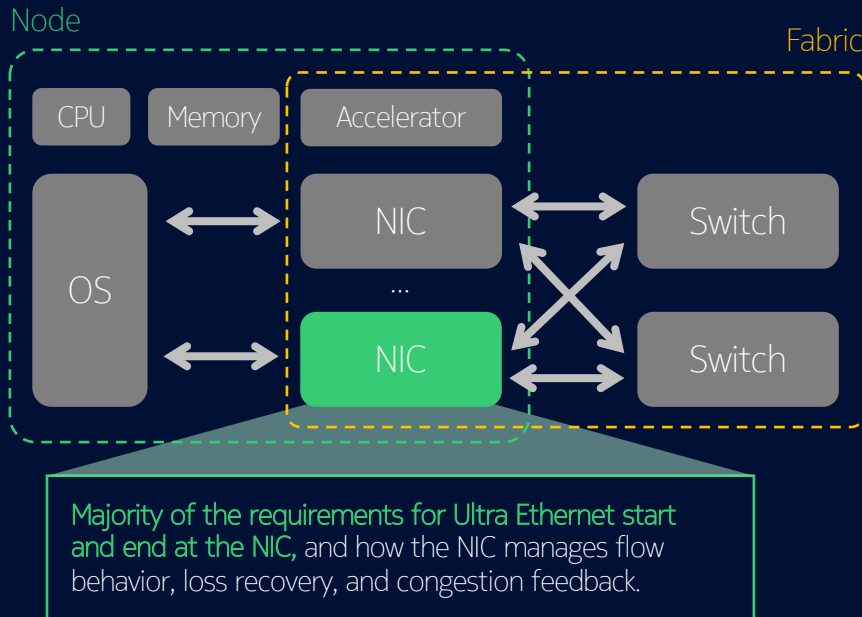
MuleSoft



From Today's Ethernet to Tomorrow's Ultra Ethernet

End-to-end developments starting at the NIC

UE brings **unprecedented performance, scalability and simplicity** to HPC. Start your UE journey today with traditional ethernet switches.



No need for a forklift upgrade to deploy a **next-gen transport**. UE-ready fabrics are built on lossless ethernet features that are widely supported today.

Call to action

The AI race is far from over

But Europe needs to take action to deliver on “Thrustworthy AI” promise

We need to invest efficiently

Networking choices will dictate openness

To make Europe successful

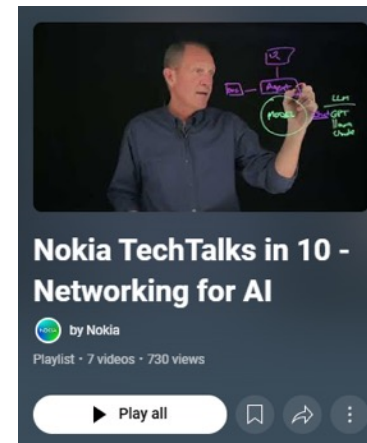
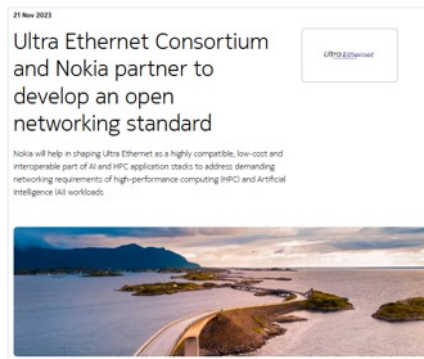
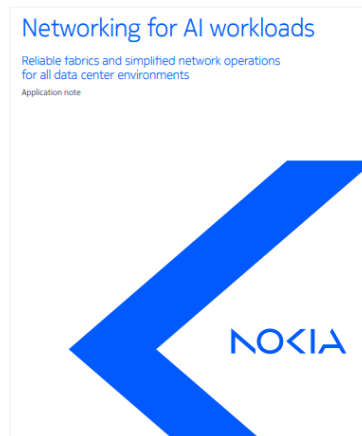
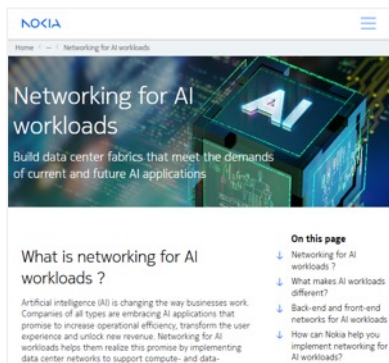
By nurturing a European AI ecosystem

Networking for AI workloads

Available collateral

Collateral

- [Application note](#)
- Videos –External – [TechTalks in 10-Networking for AI](#)
- Podcast: [Packet Pushers](#)
- Press release: [Nokia joins Ultra Ethernet Consortium \(UEC\)](#)
- [Web page – Networking for AI workloads](#)



The image features a stylized representation of the Earth as a globe, showing continents and oceans. Overlaid on the globe is a complex network of glowing orange and yellow lines that arc across the surface, representing global telecommunications or data networks. The lines originate from various points on the globe and connect to other points, creating a web-like structure. The background is a deep blue, suggesting the night sky. The Nokia logo is prominently displayed in the center of the image, overlaid on the globe and network lines.

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