AICN Work Item Discussion

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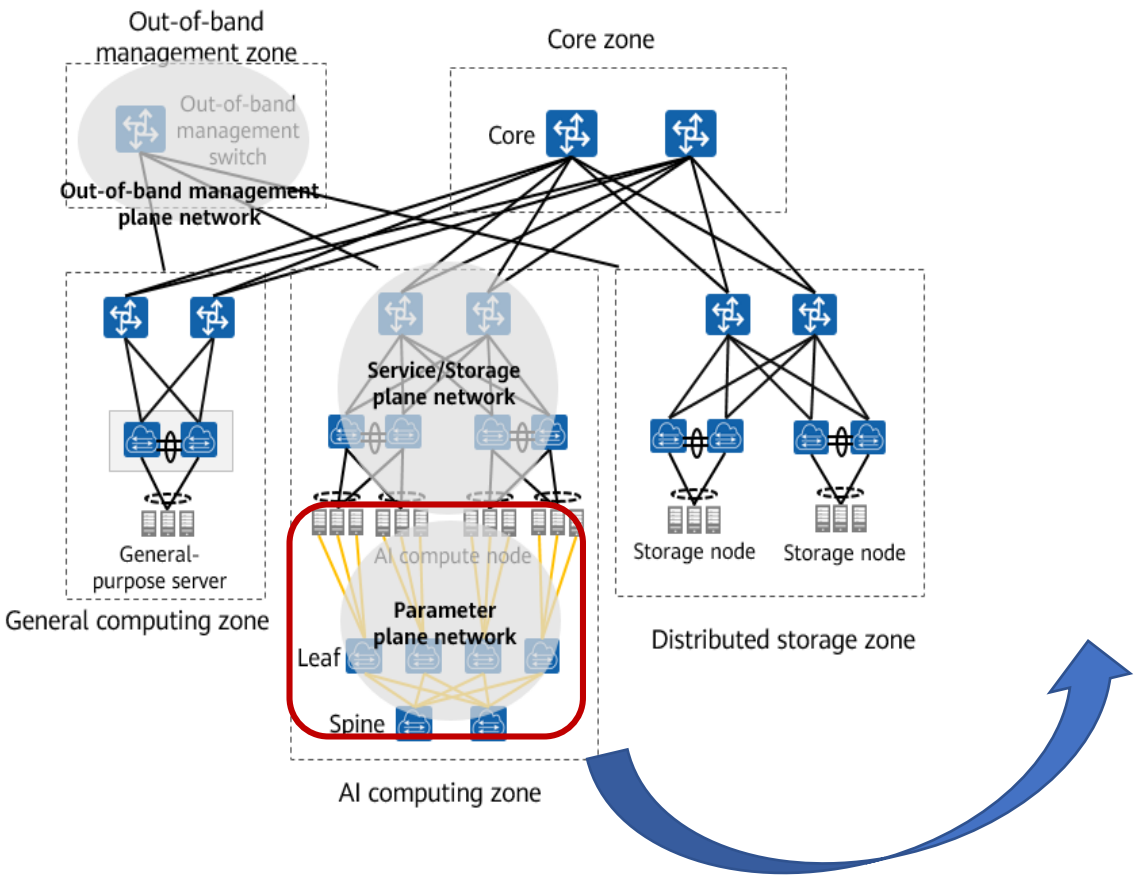
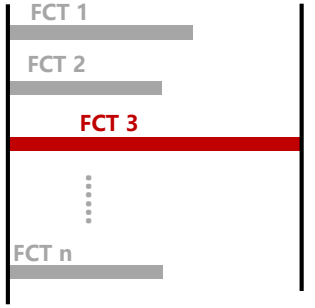
What is AICN?

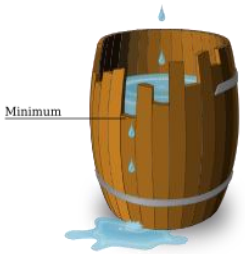
Typical datacenter deployment



AI traffic characteristics

- Data and compute-intensive workloads
- Traffic pattern consisting of a large portion of elephant flows
- Progression of all nodes held back by any delayed flow





AICN requirements

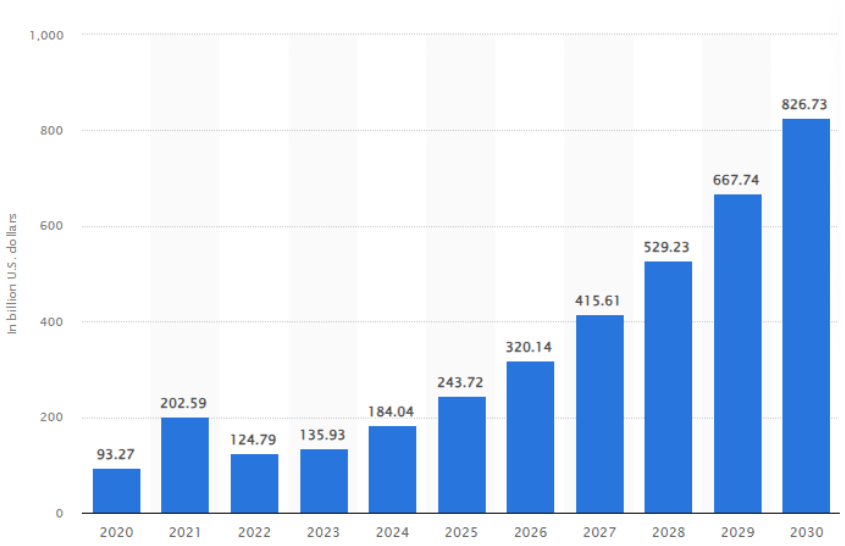
High-speed, low tail latency, scalable

From Dell'Oro Group's speech on OCP 2023 summit,

- The average cluster size is growing
  - AI models growing 1000x every 3 years
  - Cluster size quadrupling every 2 years
- Network bandwidth per accelerator is skyrocketing
  - Growing from 200/400/800 Gbps today to more than 1Tbps in the near future

Growth of AI Market Excites AICN

The market size of AI



Source: https://www.statista.com/forecasts/1474143/global-ai-market-size

The market size is expected to show an annual growth rate (CAGR 2024-2030) of 28.46%, resulting in a market volume of US$826.70bn by 2030.

The rapid growth of AI market and new demands on the network inspire the construction of AICN.

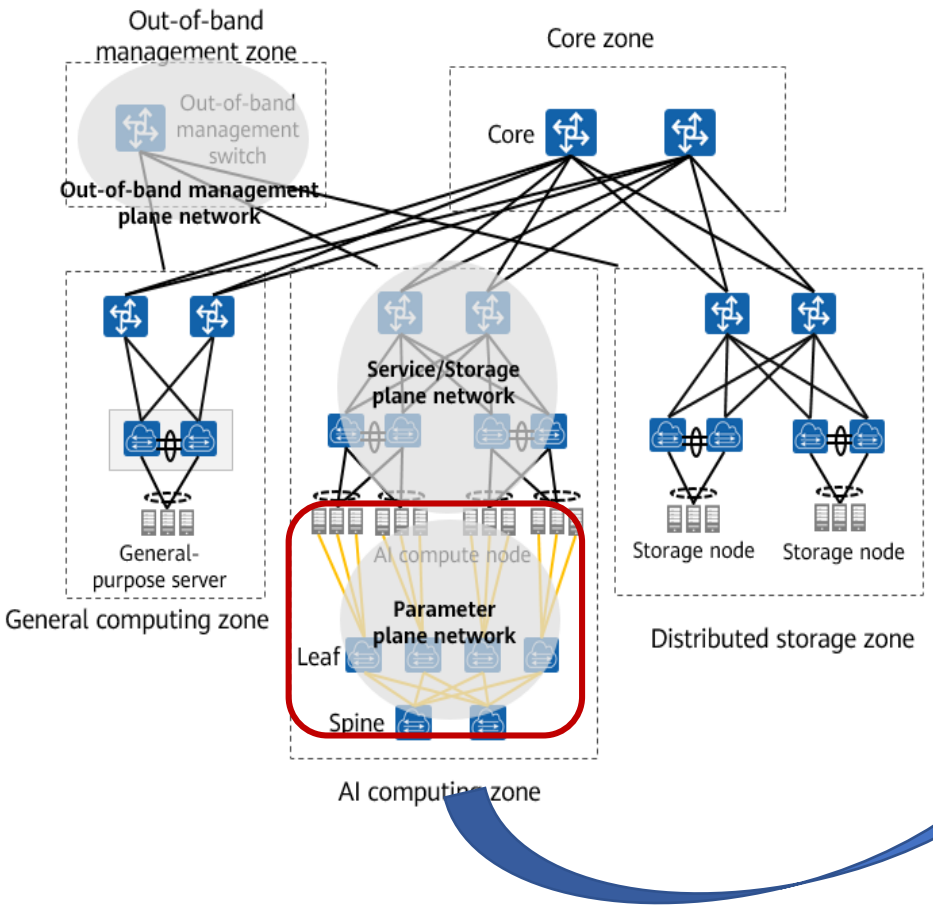
"The AI networking market, which is estimated to be **about 10%-15% of the total AI infrastructure budget, will certainly be billions of dollars,** but it is starting from a low level. Arista Networks CEO Jayshree Ullal is on the record expecting $750 million networking revenue directly connected to AI buildouts in the next year, but that number **is expected to grow fast.**"

Source: https://www.forbes.com/sites/rscottraynovich/2024/07/23/how-ai-has-made-the-networking-market-exciting-again/

"According to the new AI Networks for AI Workloads report by Dell'Oro Group, the trusted source for market information about the telecommunications, security, networks, and data center industries, spending on switches deployed in AI back-end networks **is forecast to expand the Data Center Switch Market by 50 percent.** Current data center switch market spending is on front-end networks used primarily to connect general-purpose servers. **AI workloads will require a new back-end infrastructure buildout.** "

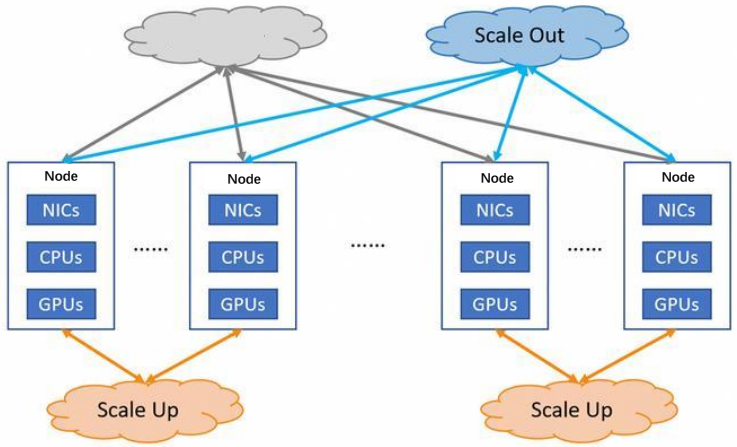
Source: https://www.delloro.com/news/ai-workloads-require-new-network-buildouts-expanding-data-center-switch-market-by-50-percent/

AICN Development



Scale-out network: horizontal expansion to connect more nodes

- **Infiniband, Ethernet**
- 1000s~10K+ accelerators
- High bandwidth (1x) and low latency (ms)
- Message semantic (RDMA)
- PP, DP



EtherNET vs EtherNOT … again?

- **Moderator:** Fabrizio Petrini, Intel
- **Panelists:**
  - Darius Bunandar (Lightmatter)
  - Brad Burres (Intel)
  - Larry Dennison (NVIDIA)
  - Frank Helms (AMD)
  - Torsten Hoefler (ETH Zurich)
  - *Tina Tsou (Arm)* -> Arm IPO

HOTI 2023 - Day 1: Session 4: Panel

Scale-up network: vertical expansion to enhance single node (super-node) capability

- **NVLink, PCIe, CXL**
- 10~1000s of accelerators
- Ultra high bandwidth (10x) and extreme low latency (us)
- Memory semantic (load/store)
- TP， EP

Industry Interest in AICN

Industry shows great interest in enhancing ethernet-based network for scale-out domain.

UEC（Ultra Ethernet Consortium）

- Founded in the year 2023
- More than 100 members, including world-wide leading cloud service providers, semiconductor manufactures and system providers.
- Aim to deliver an Ethernet based open, interoperable, high performance, full-communications stack architecture to meet the growing network demands of AI & HPC at scale
- Whitepaper containing motivation and scope of UEC was published. https://ultraethernet.org/wp-content/uploads/sites/20/2023/10/23.07.12-UEC-1.0-Overview-FINAL-WITH-LOGO.pdf
- Speed toward UEC specification 1.0 (plan to be released in Q3,2024), which includes,
  - Software
  - Transport
  - Congestion control
  - IN-network collectives
  - Security
  - Link Layer (introducing LLR as the new feature)

IETF activities/discussions (IETF117~120)

- Series of AIDC side meetings, covering AI background, routing, congestion control, topology, architecture etc.
  - Due to high interest, RTGWG chair setup AIDC mailing list
- Start CCWG (congestion control WG) , data center is new added scenario in charter.
- More and more drafts submitted, focusing on problem statement and framework currently

IETF drafts
draft-wh-rtgwh-adaptive-routing-arn
draft-lyu-rtgwg-coordinated-cm
draft-xu-idr-fare
draft-xu-lsr-fare
draft-wang-rtgwg-dragonfly-routing-problem
draft-cheng-rtgwg-adaptive-routing-framework
draft-liu-rtgwg-adaptive-routing-notification
draft-xiao-rtgwg-rocev2-fast-cnp
draft-hcl-rtgwg-osf-framework

Industry Interest in AICN

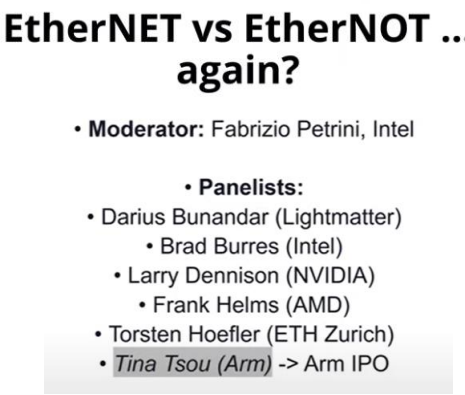
Scale-up domain tends to use open-standard interconnect technologies, but NOT Ethernet .

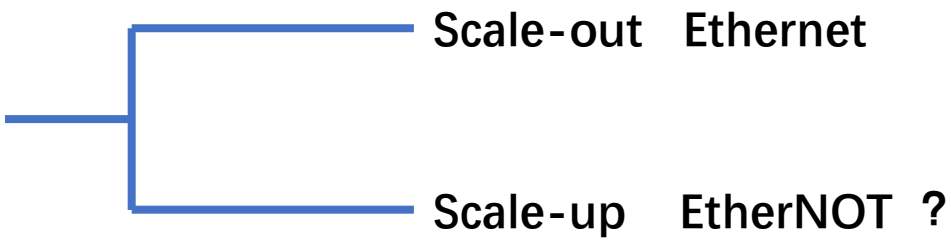
UALink（Ultra Accelerator Link Consortium）

- Founded in the year 2024
- The initial group includes AMD, Broadcom, Cisco, Google, Hewlett Packard Enterprise (HPE), Intel, Meta, and Microsoft
- Dedicated to high-speed and low-latency communication for scale-up AI Accelerators
- The 1.0 specification is expected to be available in Q3 of 2024
  - 1024 accelerators
  - direct loads and stores between the memory attached to accelerator

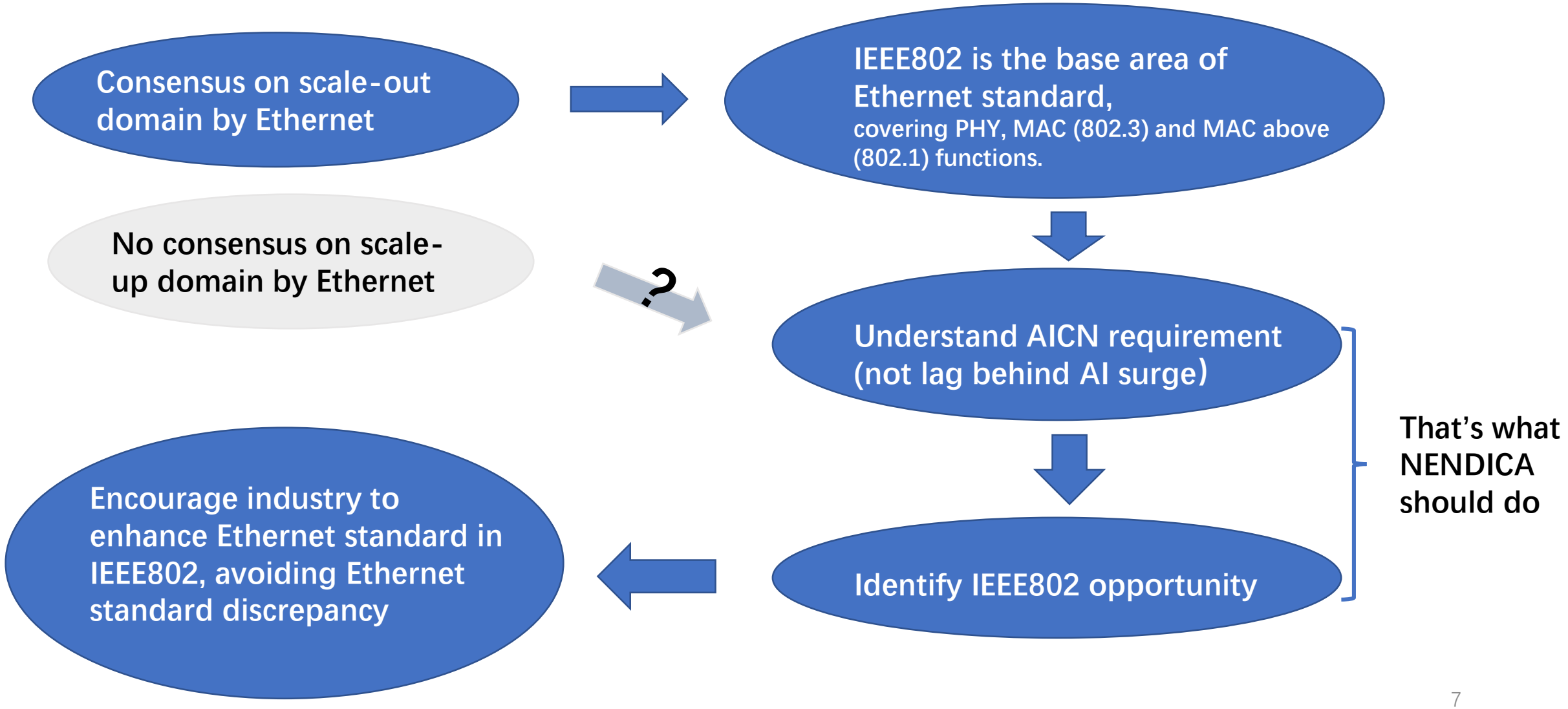
PCIe

CXL





What is the Role of IEEE802?



What We Have Done?

AICN study item website： https://1.ieee802.org/nendica-aicn/

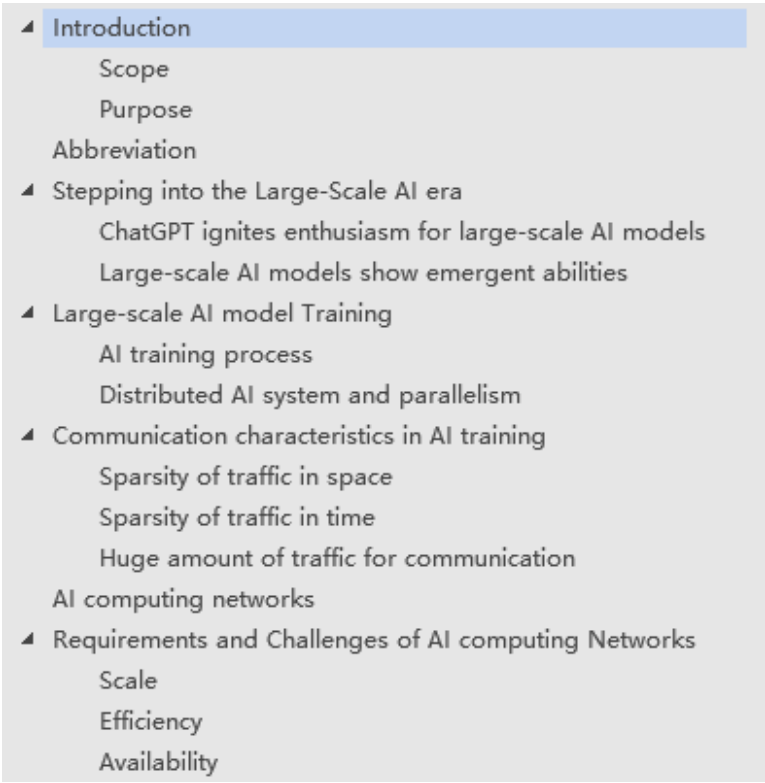
IEEE 802 Nendica Initiating Motion (2024-03-14)

- To initiate a Nendica Study Item on AI computing network

Contributions discussion:

- Contributed text: Load balancing requirements and challenges
  - Experiment data to support the presented view
- Contributed text: Scale requirements and challenges
  - Data and some concepts clarification(AZ, convergent points)
- Contributed text: Availability requirements and challenges
  - Clarify scope of availability

Report draft discussion:



- **Discussion in study item is mainly for AI background and identified network requirement based on the understanding of AI.**
- **Report content does not have to be part of work item delivery, but a place to record study item discussions.**

AICN Work Item Proposal

Purpose:

- Understand the requirement of network for AI computing
- Look for potential standardization opportunity in IEEE802

Scope:

- Analyze the major challenges for AICN, focusing on scale-out domain
- Investigate future network technologies
- Identify potential standard work

Deliverables:

- An Nendica report, including
  - Background/Use cases
  - AI computing network requirements and challenges
  - Potential technologies
  - Standardization considerations

Thanks!