The New Middle Mile

Observations on a changing landscape

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Defining the Middle Mile – A Network Perspective

First Mile

Backbone infrastructure connecting large regional data centers operated by web-based businesses, hyperscalers, and other data center operators.

Last Mile

Wireline and wireless infrastructure that provides connectivity to business and consumer: fiber-to-the-premises (FTTx), cable, xDSL, satellite, fixed wireless, mobile wireless.

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Defining the Middle Mile – A Network Perspective

The Middle Mile

First Mile

Backbone infrastructure connecting large regional data centers operated by web-based businesses, hyperscalers, and other data center operators.

Leased dark fiber, interoffice transport, backhaul, carrier-neutral internet exchange facilities, carrier-neutral submarine cable landing stations, undersea cables, transport connectivity to data centers, special access transport;

Wired or private wireless broadband infrastructure, including microwave capacity, radio tower access, and other services or infrastructure for a private wireless broadband network, such as towers, fiber, and microwave links.

(source: S.2473 - Middle Mile Broadband Deployment Act, United States Congress)

Last Mile

Wireline and wireless infrastructure that provides connectivity to business and consumer: fiber-to-the-premises (FTTx), cable, xDSL, satellite, fixed wireless, mobile wireless.

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Characterizing the Middle Mile – A Network Perspective

Hyper-scaler Cloud

Hyper-distributed Hyper-fragmented

Hyper-local Edge
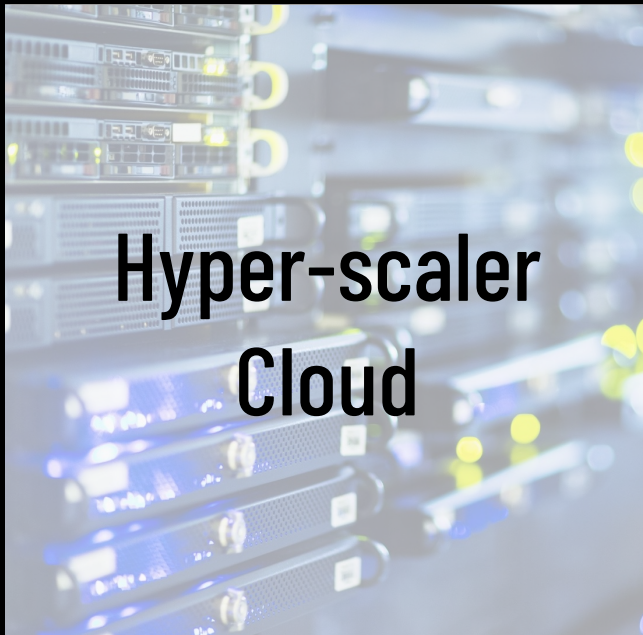
Global Scope
Few Players

National and Regional Scope
Many Players

Local Scope
Limited Players per Locale

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Network Perspective Alone No Longer Sufficient

Connectivity-only approach cannot address today's business and consumers demand for quality of service (QoS) and experience (QoE) of applications
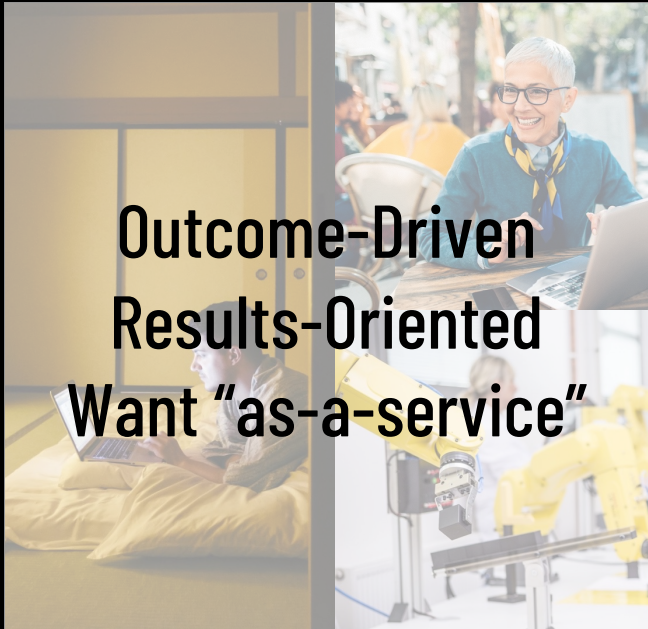
Application-Centric Full-Stack Experience

Outcome-Driven Results-Oriented Want "as-a-service"

Computing and Storage Infrastructure

+

Networking Infrastructure

Business and consumer pressure will force convergence of computing and networking within the middle mile

Defining the (New) Middle Mile – A Holistic Perspective

Cloud

Edge

Compute and Storage Resources

Computing Sites

Networking Infrastructure

Computing and storage resources and facilities capable of hosting computing and storage co-located with the infrastructure end-points of the middle mile. Includes local data centers, telco sheds at the base of cell towers, or new carrier-neutral multi-tenant facilities located in semi-permanent structures near fiber aggregation points or radio towers.

Middle Mile Network

The New Middle Mile (NMM)

5 Observations on the New Middle Mile
aka
Reasons to be at MPLS 2023

Application Architecture Evolution and Increasing Use of AI/ML/Analytics Drives Need for NMM

1

Cloud

Edge

Developments in AI/ML mean most consumer and industrial data will be processed by AI-powered analytics across the digital pipeline – from the edge, to the cloud. Both for training, and for inference.

Digitization and IoT adoption results in generation of more digital data, and explosion of data flowing to and from edge devices

Processing of visual data for computer vision, video surveillance, and VR/AR/XR will need nearby computing resources that can offload edge devices - reduce power consumption and increase device battery life
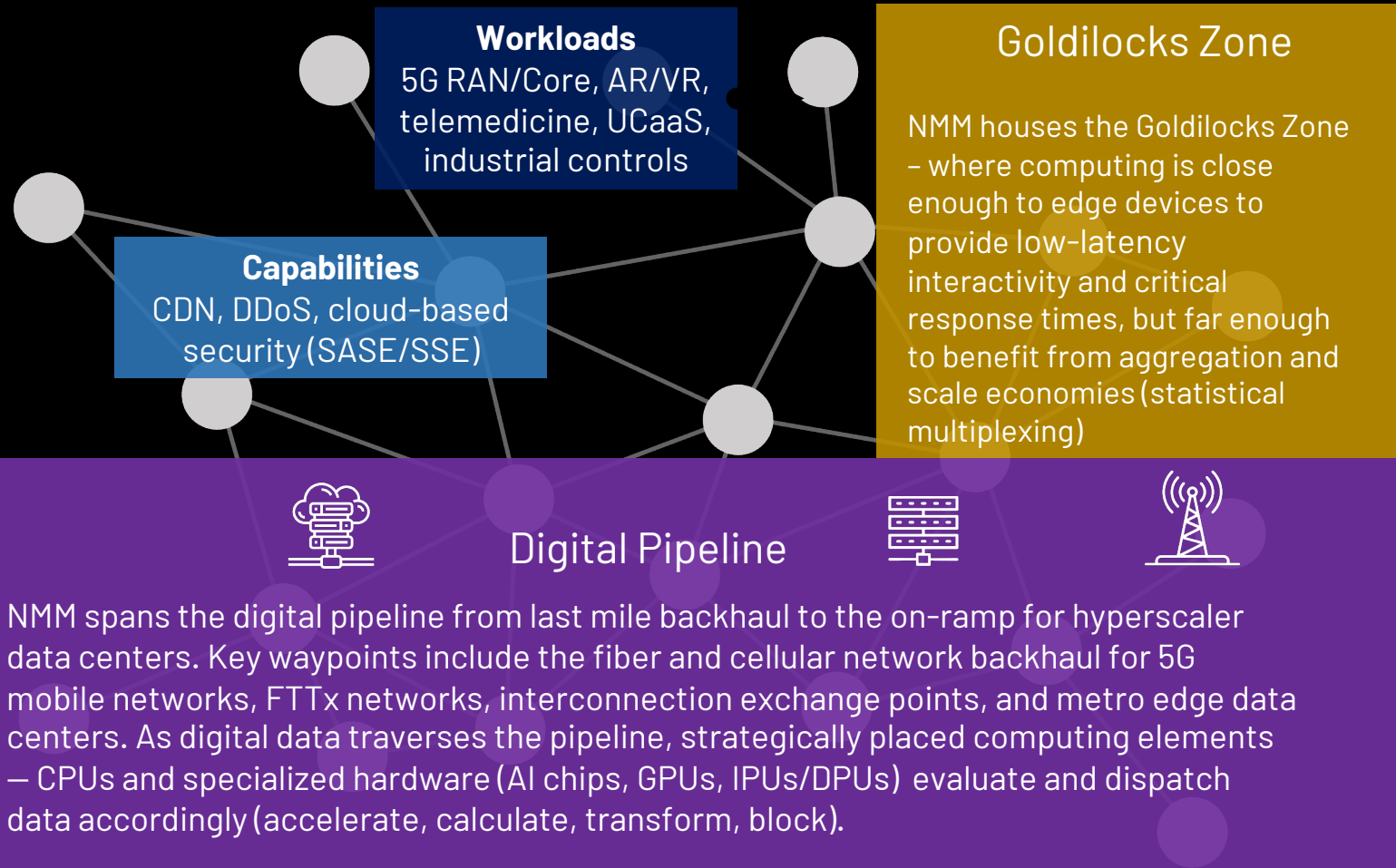
Real-time programmatic controls of manufacturing robots, autonomous industrial vehicles, drones requires low-latency access to computing resources
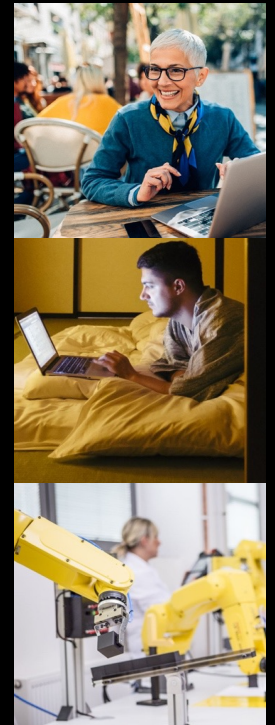
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2

NMM is Critical Part of Digital Pipeline and is the Goldilocks Zone for Modern Workload Placement

Cloud

Edge

Workloads
5G RAN/Core, AR/VR, telemedicine, UCaaS, industrial controls

Goldilocks Zone

NMM houses the Goldilocks Zone – where computing is close enough to edge devices to provide low-latency interactivity and critical response times, but far enough to benefit from aggregation and scale economies (statistical multiplexing)

Capabilities
CDN, DDoS, cloud-based security (SASE/SSE)

Digital Pipeline

NMM spans the digital pipeline from last mile backhaul to the on-ramp for hyperscaler data centers. Key waypoints include the fiber and cellular network backhaul for 5G mobile networks, FTTx networks, interconnection exchange points, and metro edge data centers. As digital data traverses the pipeline, strategically placed computing elements — CPUs and specialized hardware (AI chips, GPUs, IPUs/DPUs) evaluate and dispatch data accordingly (accelerate, calculate, transform, block).

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3

NMM Ecosystem is Diverse and Remains Unconsolidated

Cloud

Edge

High Search and Coordination Costs

Search costs across NMM layers are high, so market will drive aggregation and standardization.

E.g., Deploying communications infrastructure like open RAN requires carriers who don't own all assets to coordinate between towers, fiber, edge computing sites, regional clouds to place RAN components.

Diverse Ecosystem

Firms holding NMM assets include electric utilities co-ops, tower companies, data center companies, co-location providers, fiber backhaul providers, open access providers, vertically integrated telcos.

Fragmented Marketplace

Even on connectivity layer, no single player has full end-to-end across all major interconnection points. Cross-purchasing across the different asset holders is commonplace.
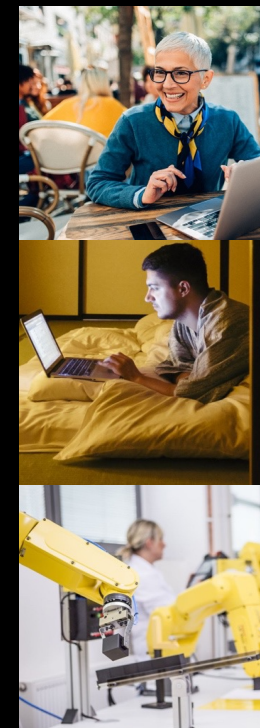
Evolving Last Mile

Assets held by a few vertically integrated national players or regional firms. Tie into MM via internet exchanges.

Telco disaggregation and divestment to focus on services, not infrastructure ownership.

Meanwhile, digital infrastructure firms are buying up infra assets.

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NMM Ecosystem is Diverse and Remains Unconsolidated

Cloud

Edge

Diverse Ecosystem and Fragmented Marketplace
Categories for Investment and Consolidation

Applications

- Edge Analytics
- Edge Orchestration
- High Speed Databases
- Edge Platforms

Security

- Cloud Security Gateways
- Enhanced DDoS
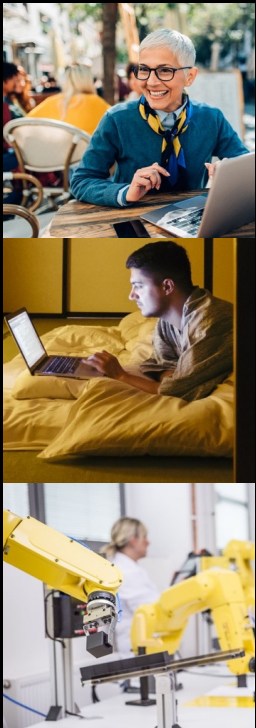- Mobile Security Platforms

Connectivity

- Software-defined Orchestration
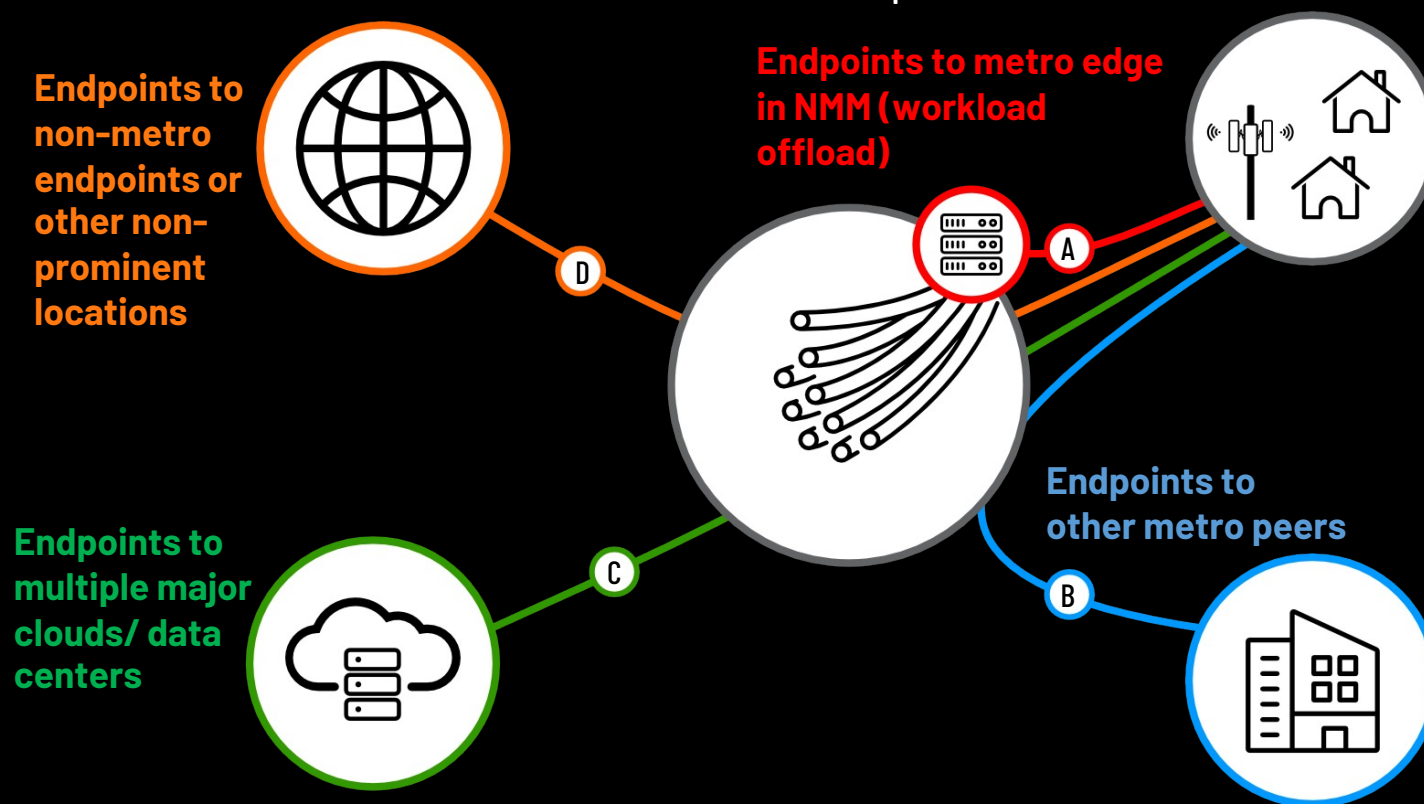- Marketplace (search cost reduction) for last-mile spectrum and middle mile connectivity
- Inter-exchange innovation platforms

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NMM Topology Evolution Mirrors Current Social, Communication Patterns

4

NMM topology is not a hierarchical distribution network. NMM will be dominated by 4 paths that represent mix of centralized and distributed traffic patterns

Endpoints to non-metro endpoints or other non-prominent locations

Endpoints to metro edge in NMM (workload offload)

Endpoints to other metro peers

Endpoints to multiple major clouds/ data centers

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NMM Topology Evolution Mirrors Current Social, Communication Patterns

4

Random Network

Scale-Free Network

The four dominant traffic paths coupled with organic growth that favors attachment to preferential ("already hot" or other "warm") nodes, results in a **scale-free** or **heavy-tail** network topology.

Scale-free networks form around specific hubs – e.g., key connecting points like airports in transportation networks, or influencers on social media. Potential adoption of Web3 reinforces the topology. Scale-free networks can provide resiliency in cyberattacks.

IMPLICATION: Hubs of importance will arise and become critical control and value points in NMM topology

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Technology Trends that Drive and Power the NMM or What You Will Learn at MPLS 2023

5

Optical/IP advancements
- 400Gbps/800Gbps/1.6Tbps
- Pluggable optics – 400ZR/ZR+
- IP/optical convergence – multi-layer

Next-gen networking
- SRv6, SR-MPLS
- Flex Algo
- FlexE

Virtualization and disaggregation
- Disparate components distributed across NMM
- On-demand network services

5G Maturation
- Cloud-native 5G core and RAN
- Disaggregation (where appropriate)
- O-RAN/vRAN/CloudRAN

Orchestration and automation
- Intent-based approaches
- Cross-domain orchestration
- AIOps

Real-time analytics, assurance
- Real-time flow telemetry
- End-to-end visibility
- Intent-based assurance

Software-defined infrastructure
- Fast reconfiguration for optimization, performance, resilience, security

Security
- Zero-trust approaches
- SD-WAN/SASE/ZTNA

NMM is driven by disaggregation and virtualization of communications infrastructure, and enabled by new advances in automation, computing, networking

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Thank You!

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AvidThink's New Middle Mile Report
Now Available at
NextGenInfra.io