CN7000 Solution and Feature Matrices

Scale-Out Solutions

Feature Category	Sub-Feature	Small-Medium Scale	Large Scale	Hyperscalar
Protocols	Primary	UE+, UE, Ethernet	UE+, UE, Ethernet	UE+, UE, Ethernet
	Secondary	RoCE (interop)	RoCE (interop)	RoCE (interop)
	Dynamic Select	✓ (UE+, UE, Ethernet, RoCE)	✓ (UE+, UE, Ethernet, RoCE)	✓ (UE+, UE, Ethernet, RoCE)
Transports (UE)	PDS Modes	RUD, ROD, RUDI, UUD	RUD, ROD, RUDI, UUD	RUD, ROD, RUDI, UUD
	SES	Tagged Send, RMA, Atomic, Deferrable Send	Tagged Send, RMA, Atomic, Deferrable Send	Tagged Send, RMA, Atomic, Deferrable Send
	CMS	NSCC, RCCC	NSCC, RCCC	NSCC, RCCC
Scale	Max Endpoints	≤10K (≤1.25K/ rail)	10K-93K (1.25K-11.6K/rail)	100K-1.44M (12.5K-180K/rail)
	Topology	Fat-Tree or Fat-Tree Rail	Fat-Tree Rail	Fat-Tree Rail
Interoperability	Mode	Homogeneous	Homogeneous or Heterogeneous (island)	Heterogeneous (island)
	Ethernet Compat	UE standard compliant	UE standard compliant	UE standard compliant
Value-Add: Performance	Link Behavior	Lossless (CBFC, LLR)	Lossless (CBFC, LLR)	Lossless (CBFC, LLR)
	Message Rate	4B msgs/sec bidi	4B msgs/sec bidi	4B msgs/sec bidi
	Latency (hop)	≤250ns	≤250ns	≤250ns
Value-Add: Routing	SDR/Packet Spray	✓	✓	✓
	FGAR	✓	✓	✓
	ECAR	✓	✓	✓
	Dynamic Route Recovery	✓	✓	✓
Value-Add: Congestion Mgmt	ECN	✓ (UE, Ethernet, RoCE)	✓ (UE, Ethernet, RoCE)	✓ (UE, Ethernet, RoCE)
	NSCC	✓ (lossless, lossy)	✓ (lossless, lossy)	✓ (lossless, lossy)
	RCCC	✓	✓	✓
	CSIG/CSIG+	✓	✓	✓

Value-Add: Collective Accel	In-Network	✓ (homogeneous/ island)	✓ (homogeneous/ island)	✓ (homogeneous/ island)

Scale-Out AI Workload Solutions {#tbl:scale-out-ai}

Feature Category	Sub-Feature	Small Scale	Medium Scale	Large Scale
Protocols	Primary	OPA 16B, UE+, UE	OPA 16B, UE+, UE	OPA 16B, UE+, UE
	Secondary	Ethernet, RoCE	Ethernet, RoCE	Ethernet, RoCE
	Dynamic Select	✓ (OPA, UE+, UE, Ethernet, RoCE)	✓ (OPA, UE+, UE, Ethernet, RoCE)	✓ (OPA, UE+, UE, Ethernet, RoCE)
Transports (UE)	PDS Modes	RUD, ROD, RUDI, UUD	RUD, ROD, RUDI, UUD	RUD, ROD, RUDI, UUD
	SES	Tagged Send, RMA, Atomic, Deferrable Send	Tagged Send, RMA, Atomic, Deferrable Send	Tagged Send, RMA, Atomic, Deferrable Send
	CMS	NSCC, RCCC	NSCC, RCCC	NSCC, RCCC
Scale	Max Endpoints	≤5K (≤625/rail)	5K-10K (625-1.25K/rail)	10K-93K (1.25K-11.6K/rail)
	Topology	Fat-Tree or Fat-Tree Rail	Fat-Tree or Fat-Tree Rail	Fat-Tree Rail
Interoperability	Mode	Homogeneous	Homogeneous	Homogeneous or Heterogeneous (island)
	Ethernet Compat	UE standard compliant	UE standard compliant	UE standard compliant
	CN5000/CN6000	No	No	No
Value-Add: Performance	Link Behavior	Lossless (CBFC, LLR)	Lossless (CBFC, LLR)	Lossless (CBFC, LLR)
	Message Rate	4B msgs/sec bidi	4B msgs/sec bidi	4B msgs/sec bidi
	Latency (hop)	≤250ns	≤250ns	≤250ns
Value-Add: Routing	SDR/Packet Spray	✓	✓	✓
	FGAR	✓	✓	✓
	ECAR	✓	✓	✓
	Dynamic Route Recovery	✓	✓	✓

Value-Add: Congestion Mgmt	ECN	✓ (UE, Ethernet, RoCE)	✓ (UE, Ethernet, RoCE)	✓ (UE, Ethernet, RoCE)
	NSCC	✓ (lossless, lossy)	✓ (lossless, lossy)	✓ (lossless, lossy)
	RCCC	✓	✓	✓
	CSIG/CSIG+	✓	✓	✓
Value-Add: Collective Accel	In-Network	✓ (homogeneous/ island)	✓ (homogeneous/ island)	✓ (homogeneous/ island)
Value-Add: Advanced Topo	Megafly	Optional	Optional	✓
	Dragonfly	✓	✓	✓

Scale-Out HPC Workload Solutions {#tbl:scale-out-hpc}

Scale-Up Solutions

Feature Category	Sub-Feature	Pod/Rack Scale	Multi-Rack Scale
Protocols	Primary	UALink 200G	UALink 200G
	Secondary	UE (ULN variant)	UE (ULN variant)
	Dynamic Select	N/A	N/A
Transports (UALink)	Semantics	Memory (load/store)	Memory (load/store)
	DL/TL	Fixed 680B payload, VC, LLR, CBFC	Fixed 680B payload, VC, LLR, CBFC
	Ordering	Same-address ordering	Same-address ordering
Transports (UE/ ULN)	PDS Modes	ROD, RUD	ROD, RUD
	CMS	RCCC	RCCC
Scale	Max Endpoints	≤1K accelerators	≤1K accelerators
	Topology	Single-tier (1-hop)	Single-tier (1-4 racks)
	Cable Length	<4m per link	<4m per link
	RTT Target	<1µs	<1µs
Interoperability	Mode	Homogeneous	Homogeneous
	Standards	UALink Consortium spec	UALink Consortium spec
Value-Add: Performance	Link Behavior	Lossless (CBFC or PFC)	Lossless (CBFC or PFC)
	Message Rate	4B msgs/sec bidi	4B msgs/sec bidi

	Latency (RTT)	Sub-µs target	Sub-µs target
	Bandwidth/XPU	1.6T (8x200G lanes)	1.6T (8x200G lanes)
Value-Add: Routing	SDR/Packet Spray	N/A	N/A
	FGAR	N/A	N/A
	ECAR	N/A	N/A
	Dynamic Route Recovery	N/A	N/A
Value-Add: Congestion Mgmt	ECN	N/A	N/A
	NSCC	N/A	N/A
	RCCC	✓ (UE/ULN)	✓ (UE/ULN)
	CSIG/CSIG+	N/A	N/A
	Flow Control	PFC or CBFC	PFC or CBFC
Value-Add: Collective Accel	In-Network	Optional	Optional
Value-Add: Advanced Topo	Megafly	No	No
	Dragonfly	No	No

Scale-Up AI Workload Solutions {#tbl:scale-up-ai}

Note: Cornelis does not currently have a scale-up NIC or embedded accelerator HFI. Scale-up solutions assume different endpoint vendors connecting to Cornelis switches.

Feature Category	Sub-Feature	Pod/Rack Scale	Multi-Rack Scale
Protocols	Primary	UE (ULN)	UE (ULN)
	Secondary	OPA (homogeneous)	OPA (homogeneous)
	Dynamic Select	✓ (OPA, UE, Ethernet, RoCE)	✓ (OPA, UE, Ethernet, RoCE)
Transports (UE/ ULN)	PDS Modes	ROD, RUD	ROD, RUD
	SES	RMA, Tagged Send	RMA, Tagged Send
	CMS	RCCC, NSCC	RCCC, NSCC
Scale	Max Endpoints	≤1K compute nodes	≤1K compute nodes
	Topology	Single-tier, all-to-all	Single-tier, 1-4 racks
	Cable Length	<4m	<4m
	RTT Target	<1µs	<1µs
Interoperability	Mode	Homogeneous	Homogeneous
	Standards	UE HPC profile	UE HPC profile

Value-Add: Performance	Link Behavior	Lossless (CBFC, LLR)	Lossless (CBFC, LLR)
	Message Rate	4B msgs/sec bidi	4B msgs/sec bidi
	Latency (RTT)	Sub-µs target	Sub-µs target
	Bandwidth/Node	1.6T (aggregated)	1.6T (aggregated)
Value-Add: Routing	SDR/Packet Spray	N/A	N/A
	FGAR	N/A	N/A
	ECAR	N/A	N/A
	Dynamic Route Recovery	N/A	N/A
Value-Add: Congestion Mgmt	ECN	✓	✓
	NSCC	✓ (lossless, lossy)	✓ (lossless, lossy)
	RCCC	✓	✓
	CSIG/CSIG+	Optional	Optional
Value-Add: Collective Accel	In-Network	✓ (homogeneous/ island)	✓ (homogeneous/ island)
Value-Add: Advanced Topo	Megafly	No	No
	Dragonfly	No	No

Scale-Up HPC Workload Solutions {#tbl:scale-up-hpc}

Note: Cornelis does not currently have a scale-up NIC or embedded accelerator HFI. Scale-up solutions assume different endpoint vendors connecting to Cornelis switches.

Feature Coexistence Rules

Scale-Out Mandatory Combinations:

1. **UE+ Protocol** ⟶ Requires: CBFC + LLR + (NSCC or RCCC) + CSIG capability
2. **Large Scale Deployments** ⟶ Requires: FGAR + CSIG+ + Fat-Tree Rail topology
3. **Heterogeneous (island) Interop** ⟶ Requires: Standard UE (not UE+) + UE-compliant congestion control
4. **Dynamic Protocol Selection** ⟶ Requires: Homogeneous Cornelis deployment

Scale-Up Mandatory Combinations:

1. **UALink (Scale-Up AI)** ⟶ Requires: CBFC (or PFC) + LLR + Single-tier topology + Memory semantics
2. **UE/ULN (Scale-Up HPC)** ⟶ Requires: RCCC + Sub-µs RTT + CBFC + Single-tier topology
3. **Collective Acceleration** ⟶ Requires: Homogeneous/island deployment

Mutually Exclusive Configurations:

- **Scale-Out** ⊕ **Scale-Up** on same switch instance (different deployment models)
- **Dynamic protocol selection** ⊕ **Heterogeneous (island)** (dynamic selection only for homogeneous Cornelis)

- **Advanced Topologies (Megafly/Dragonfly)** ⊕ **Scale-Up** (Scale-Up uses single-tier only)
- **Advanced Topologies (Megafly/Dragonfly)** ⊕ **Scale-Out AI** (HPC only)

Feature Applicability by Solution

Feature Category	Sub-Feature	Scale-Out AI	Scale-Out HPC	Scale-Up AI	Scale-Up HPC
Protocols	UE+, UE, Ethernet	✓	✓	—	✓ (ULN)
	OPA 16B	—	✓	—	✓
	UALink	—	—	✓	—
	RoCE	✓ (interop)	✓ (interop)	—	✓ (interop)
	Dynamic Select	✓	✓	—	✓
Transports (UE)	PDS Modes	✓	✓	✓ (subset)	✓ (subset)
	SES	✓	✓	—	✓ (subset)
	CMS	✓	✓	✓ (RCCC)	✓
Transports (UALink)	Memory Semantics	—	—	✓	—
Scale	>10K Endpoints	✓	✓	—	—
	≤1K Endpoints	✓	✓	✓	✓
	Multi-tier Topology	✓	✓	—	—
	Single-tier Topology	✓	✓	✓	✓
Interoperability	Homogeneous	✓	✓	✓	✓
	Heterogeneous (island)	✓ (Large+)	✓ (Large)	—	—
Value-Add: Performance	Lossless (CBFC, LLR)	✓	✓	✓	✓
	4B msgs/sec bidi	✓	✓	✓	✓
	≤250ns hop latency	✓	✓	—	—
	Sub-µs RTT	—	—	✓	✓
Value-Add: Routing	SDR/Packet Spray	✓	✓	—	—
	FGAR	✓	✓	—	—
	ECAR	✓	✓	—	—

	Dynamic Route Recovery	✓	✓	—	—
Value-Add: Congestion Mgmt	ECN	✓	✓	—	✓
	NSCC	✓	✓	—	✓
	RCCC	✓	✓	✓	✓
	CSIG/CSIG+	✓	✓	—	Optional
Value-Add: Collective Accel	In-Network	✓	✓	Optional	✓
Value-Add: Advanced Topo	Megafly	—	✓	—	—
	Dragonfly	—	✓	—	—

Feature Applicability by Solution {#tbl:feature-applicability}

Key Differentiators by Solution Type

Dimension	Scale-Out AI	Scale-Out HPC	Scale-Up AI	Scale-Up HPC
Primary Goal	Maximize GPU utilization, collective performance	Balanced latency/ bandwidth/ message rate	Ultra-low latency, memory semantics	Low-latency RDMA within pod
Primary Protocol	UE+, UE, Ethernet	OPA 16B, UE+, UE	UALink	UE (ULN)
Packet Size	Variable MTU	Variable MTU	Fixed 680B (UALink)	Variable MTU
Max Scale	1.44M endpoints	93K endpoints	≤1K accelerators	≤1K compute nodes
Topology	Fat-Tree, Fat-Tree Rail	Fat-Tree, Fat-Tree Rail, Megafly, Dragonfly	Single-tier	Single-tier
Routing Complexity	High (multi-tier, adaptive)	High (multi-tier, adaptive)	None (single-tier)	None (single-tier)
Congestion Strategy	NSCC + RCCC	NSCC + RCCC	RCCC (UE/ULN)	NSCC + RCCC
Telemetry	CSIG/CSIG+	CSIG/CSIG+	N/A	Optional

Collective Offload	✓ (homogeneous/ island)	✓ (homogeneous/ island)	Optional	✓ (homogeneous/ island)
Interoperability	Homogeneous or Heterogeneous (island)	Homogeneous or Heterogeneous (island)	Homogeneous	Homogeneous

Key Differentiators by Solution Type {#tbl:key-differentiators}

References: - CN7000 Switch Requirements (Landing Zone) - CN7000 HFI Requirements (Landing Zone)
- UEC Transport Specifications (PDS, SES, CMS) - UALink Consortium

Specifications - CN7000 Features Documentation

Glossary

bidi - Bidirectional. Indicates that a metric (e.g., message rate) applies to both transmit and receive directions combined.

CBFC - Credit-Based Flow Control. A lossless flow control mechanism that uses credits to manage buffer space and prevent packet drops.

CMS - Congestion Management Service. UE transport layer service for congestion detection and response.

CSIG/CSIG+ - Congestion Signaling. Telemetry mechanism for communicating congestion state (2B/4B/6B variants).

ECAR - Entropy Controlled Adaptive Routing. Routing algorithm that uses entropy-based path selection to balance load.

ECN - Explicit Congestion Notification. Standard mechanism for signaling network congestion to endpoints.

FGAR - Fine-Grained Adaptive Routing. Telemetry-based adaptive routing for optimal path selection.

LLR - Link-Level Retry. Mechanism for retransmitting corrupted or lost packets at the link layer.

NSCC - Network-Side Congestion Control. Congestion control mechanism supporting both lossless and lossy modes.

OPA - Omni-Path Architecture. Cornelis proprietary high-performance fabric protocol.

PDS - Packet Delivery Service. UE transport layer service defining delivery semantics (RUD, ROD, RUDI, UUD).

RCCC - Receiver Credit-based Congestion Control. Congestion control using receiver-side credit management.

RMA - Remote Memory Access. One-sided communication operations for direct memory access.

ROD - Reliable Ordered Delivery. PDS mode guaranteeing in-order packet delivery.

RoCE - RDMA over Converged Ethernet. Standard for RDMA operations over Ethernet networks.

RUD - Reliable Unordered Delivery. PDS mode guaranteeing delivery without ordering constraints.

RUDI - Reliable Unordered Delivery with Immediate data. RUD variant with immediate data support.

SDR - Source-based Deterministic Routing. Static routing determined at the source endpoint.

SES - Send/Event Service. UE transport layer service for messaging semantics (Tagged Send, RMA, Atomic).

UALink - Ultra Accelerator Link. Consortium-defined standard for accelerator interconnect with memory semantics.

UE - Ultra Ethernet. Industry-standard high-performance Ethernet protocol for HPC/AI workloads.

UE+ - Ultra Ethernet Plus. Cornelis-enhanced UE with additional performance features.

ULN - Ultra Local Network. UE variant optimized for scale-up, low-latency deployments.

UUD - Unreliable Unordered Delivery. PDS mode with best-effort delivery semantics.