Scale Across - A Frontier Domain

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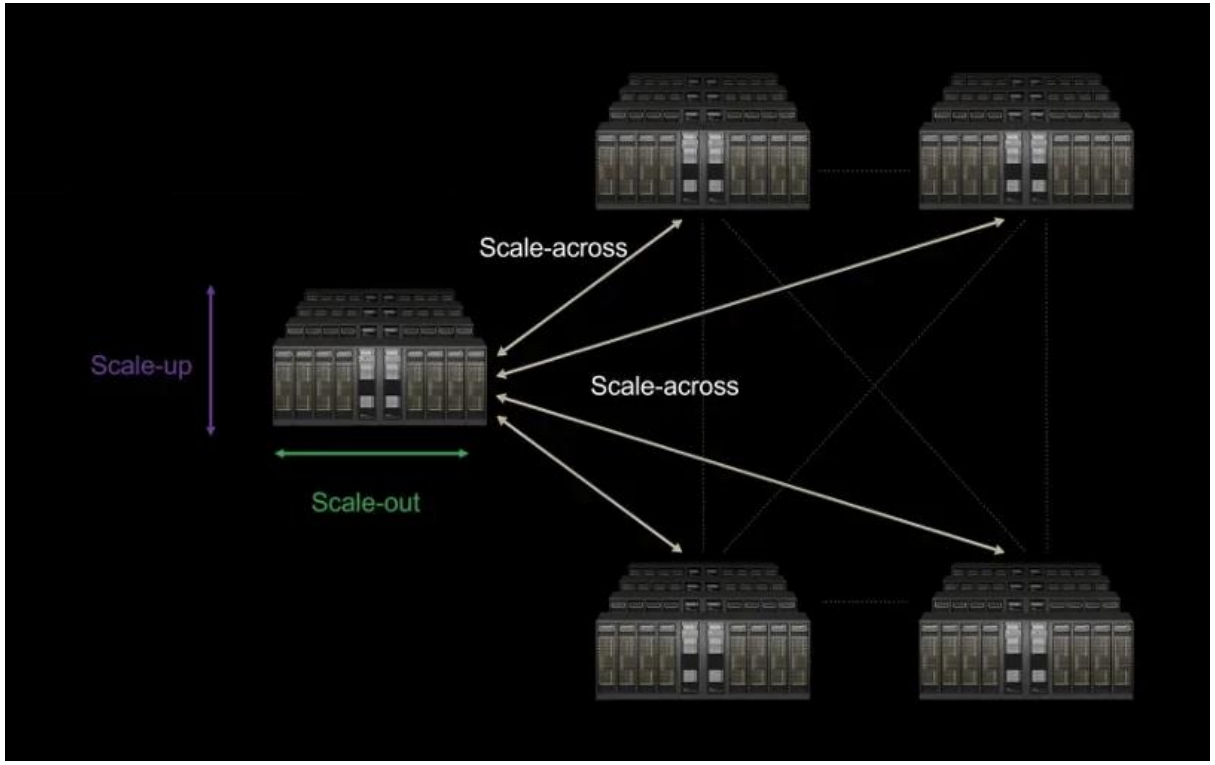
AI Fabric Domains

- Scale Up
  - Scope: Single Server Rack, Racks or Localized POD (< 30 meters)
  - Topology: Single Hop High Radix switch connectivity, DAC
  - Focus: Low Latency, Massive Shared Memory Pool
- Scale Out
  - Scope: >1K GPUs across Racks
  - Topology: Multi Plane Flat DC. RAIL optimized 2 or 3 Tier Leaf-Spine
  - Focus: Maximize Aggregate BW, Lossless Transport
- Scale Across
  - Scope: Physically separated data center campuses and regions (hundreds of km)
  - Topology: Routed Metro/Regional WAN with DCI
  - Focus: Avoiding timeout errors, Resolving strict packet loss and synchronization challenges over extremely long distances.



Challenges

Large delay long distance DCI links creates interesting problems

- In-cast like scenario at the DCI link
- Impacts congestion control algorithm (CCA) for DC local traffic and DC remote traffic
- DC remote traffic gets unfair share of delay by the sender based CCA
- Characterization of congestion state and path failure are different in local and remote DC
- FCT and Tail Latency gets impacted adversely by large delay links

Existing Solutions and Shortcomings

- TRIM provides forward notification for queue congestion drop but fail to respond for queue congestion thresholds and path failures
- CSIG provides signal values (though aware of long-distance links between sender and receiver) from network to receiver but fails to address forward path failures or congestion related drops
- No distance affinity for notifications
  - E.g. TRIM in local DC will send the TRIM notification to remote DC that will reflect it back to the sender in local DC. Extremely inefficient and introduces large delay of traversing the expensive DCI link
- Congestion Control Algorithms are expecting homogenous fabric in terms of RTT delay and incast points
  - There are two different RTT delay profiles in Scale Across
  - In-cast is not just experienced at the last hop but is also experienced at the DCI link
  - Path Failures are not accounted for and usually are handled using timeouts

IEEE 802 ITU

Requirements for End Points

- Need to know the reason in fabric
  - Queue congestion threshold breach
  - Queue congestion drop
  - Path failure
- Associated information
  - Port, Queue number
  - Device Information
  - Port loading and Queue depth
- Transport Context
  - Truncated packet
- No impact to transport header
- No impact L3 or compressed header
- No flow state maintenance at switch

Questions To Be Answered

- Same packet experiencing congestion at multiple hops in the path – How to deal with it?
- Same packet experiencing congestion may get dropped at subsequent hop in the path.
- How to generate distance aware notifications in the reverse direction?
- If these notifications are a new packet, how to rate control them to consume less fabric bandwidth?
- Who performs the rate limited, sender or the switch generating the notifications?
- How does the CCA consume two disparate type of notifications i.e. DC local and DC remote?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