On the Feasibility of Completely Wireless Datacenters

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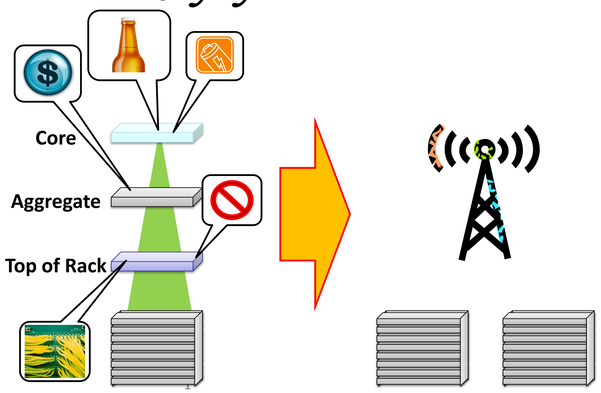
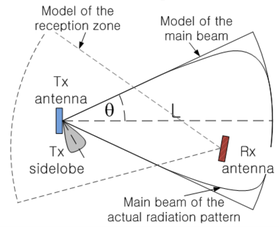
From Wired to Wireless Opportunities: Cayley Wireless Datacenters

- Low maintenance cost
  - No hassle maintaining wires
  - No expensive switches
  - Less power consumption
- Performance gain
  - No network oversubscription
  - Multiple redundant paths
- High fault tolerance
  - No single point of failure

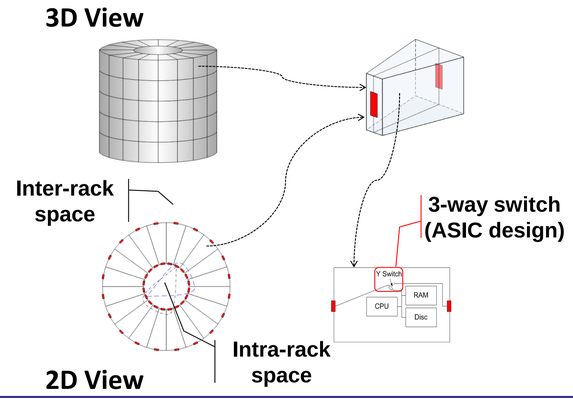


Enabling Technology

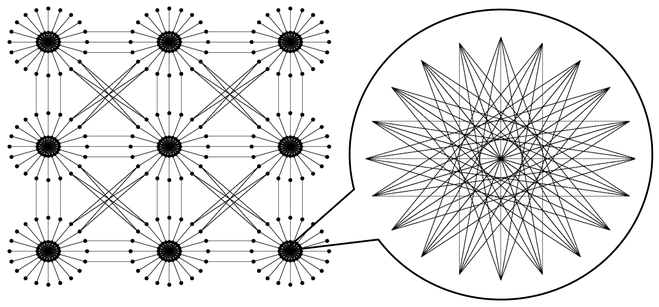
- 60 GHz CMOS Antenna
  - One directional signal
    - *Angle, 25° < θ < 45°*
    - *Range, L < 10 m*
  - Bandwidth < 15Gbps @ 0.3W
    - TDD
    - FDD



Novel Rack and Server Design for Transceiver Placement



Cayley Wireless Datacenter Topology

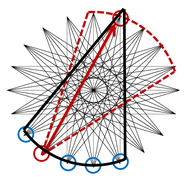


20-node degree-5 Cayley graph

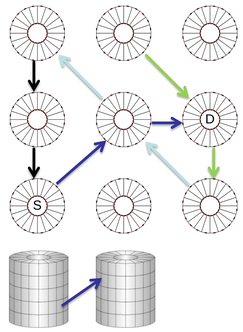
- 3D Mesh of Cayley Graphs
- Cayley topology
  - Strong connectivity
  - Vertex transitivity

MAC and Routing

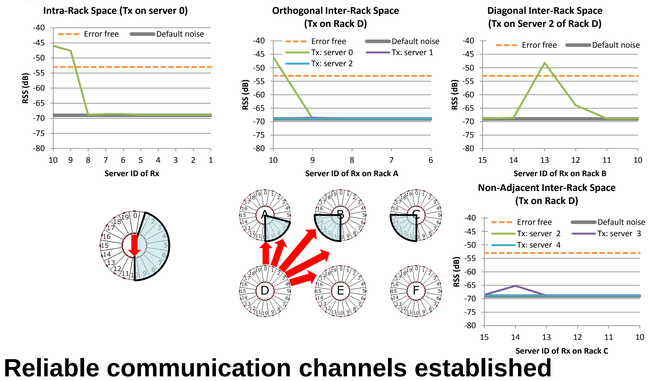
- Dual busy tone multiple access (DBTMA) MAC
  - Out of band tone to suppress hidden terminals
  - Solves masked node problem



- Diagonal XYZ Routing
  - Geographical routing
  - Simple and efficient

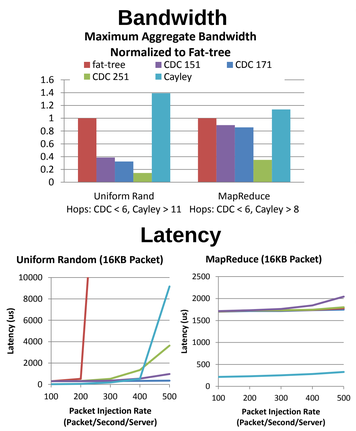


Physical Validation: Interference Evaluation



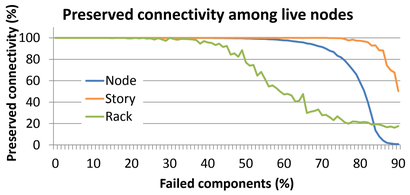
- Reliable communication channels established
- No interference that cannot be overcome
  - Two corner cases (signal forming, conductor curtains)

Performance



Fault Tolerance and Power

- Fault tolerance



- Power consumption (10K nodes)
  - CDC 58KW~72KW vs Cayley DC 6KW
    - Datacenter switches: 170W to 600W
    - 60GHz transceivers: 0.1W to 0.3W
  - Cayley DC consumes 1/10 of CDC power

Conclusion

- Feasible to build wireless datacenters
  - Reliable signal
  - *Negligible interference*
  - *High performance*
  - *High fault tolerance*
  - *Low power* consumption
- Open questions
  - How far can wireless go?
  - Scalability: 1) number of nodes
    2) bandwidth