FSO-based Reconfigurable Networks in Data Centers (DCs) and Picocell Backhaul

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FSO-based DC Network (FireFly [Sigcomm-14])

- Current DC Networks: Wires and switches.

- FSO-based DC Network (FireFly):

  - Many (40-60) <u>steerable</u> FSO links on each rack.

  - Links steered in real-time, based on traffic.

  - Near-optimal performance possible.

 - Benefits: <u>No wires</u>, incremental expansion, possible lower cost.

Ceiling mirror

Controller

Steerable FSOs

ToR switch

Racks

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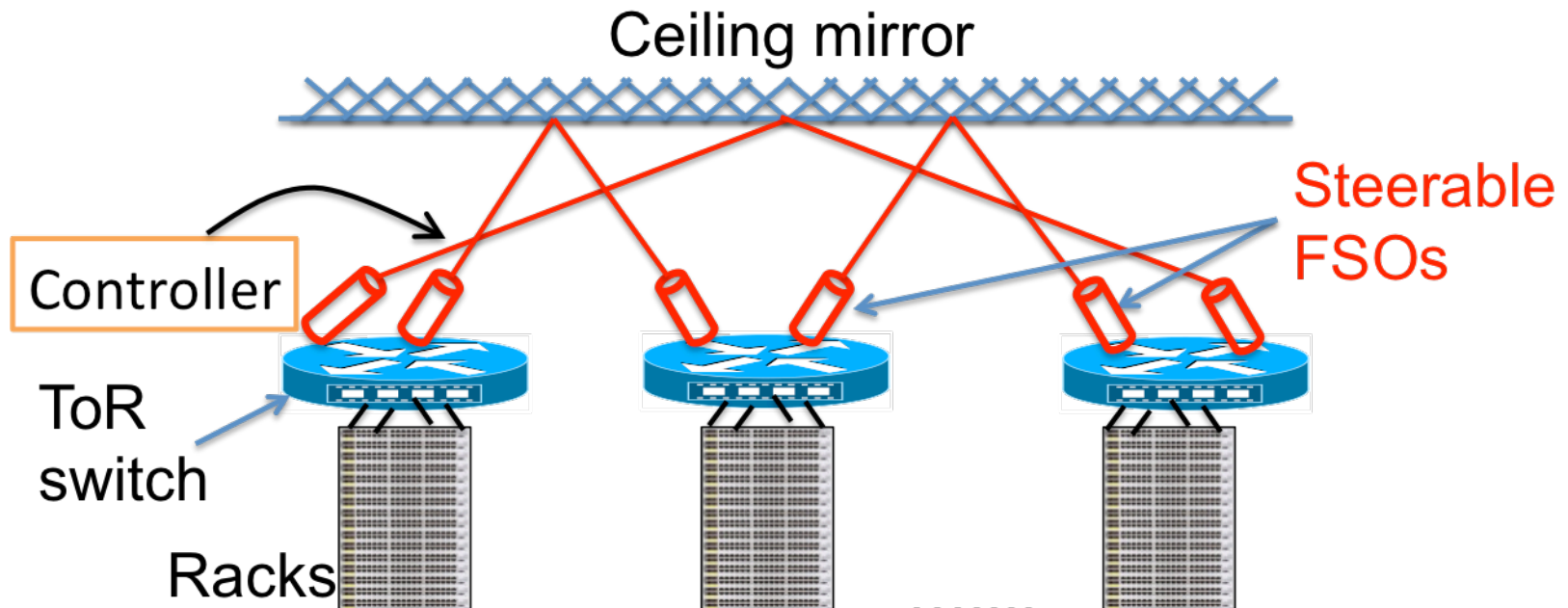
FSO in DCs: Key Challenges

- Small and low-cost <u>steerable</u> FSO devices.
  - Including ATP (to handle rack vibrations and auto-deployment). Indoors; Link range is only 25-50m.
- Line of sight: Alternative to a ceiling mirror (e.g., devices on poles over racks [ICC 2016])
- Auto deployment: # of "links" is huge (100-500k).
  - Ideally, an integrated board with 40-60 FSO devices, capable of auto-acquisition and alignment, for a rack.
- Network management challenges are tractable.

FSO for Picocell Backhaul (FSONet [MobiCom '17])

- Picocells = small-cell cellular networks; 100-200m range.

- Backhaul network: connects picocells to "hubs." Wireless solution is desired.

- FSONet Architecture: Reconfigurable network based on steerable FSO links.
  - Embeds redundancy in network (instead of singular links)
  - Key idea: Switch between "high-capacity less-reliable" and "low-capacity very-reliable" subnetworks, based on traffic and weather conditions.
  - In adverse conditions, use only short links (< 100m). Ensure many short links; they do arise naturally here.

Full Reconfigurable network

Backbone Subnetwork

🔴 Gateways
— Short robust links
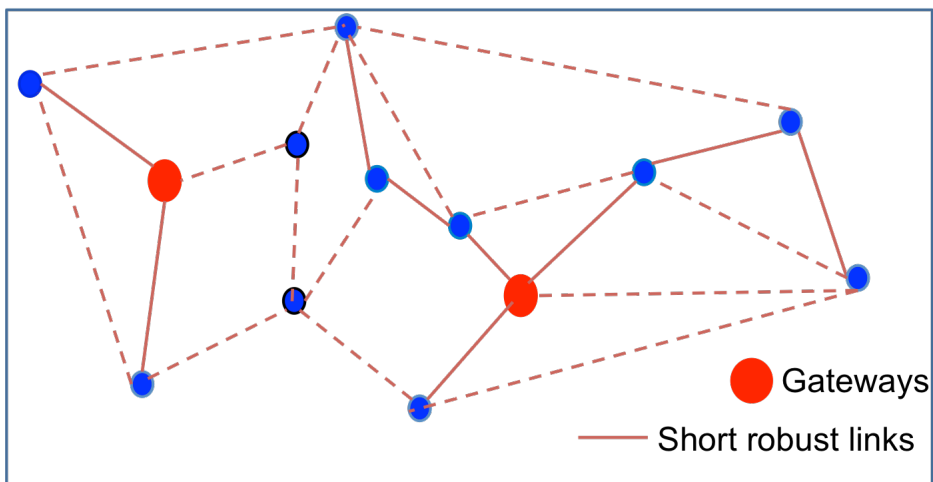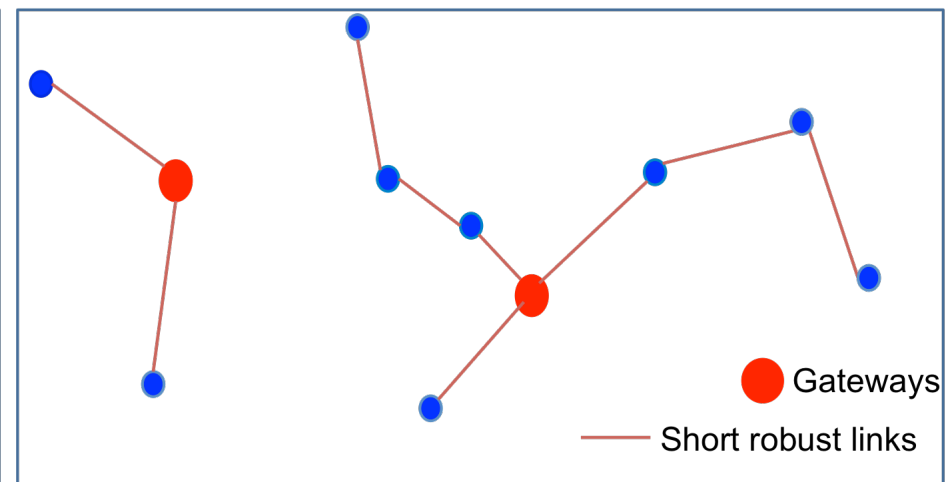
FSO Network Architecture Challenges

- One way to handle outdoor effects at smaller (100-500m) ranges: Embedding redundancy at network-level. E.g.,

  - Have multiple paths (some using shorter links)

  - Reconfigurable networks that "adapt" to weather.

  - Networks tailored for expected weather and traffic

  - Multi-tier networks (FSONet is 2-tier).

  - Other creative possibilities?

Thanks for your attention.