Realization of a Diffraction-Based 1xN Optical Switch

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Motivation

- Significant growth in data traffic

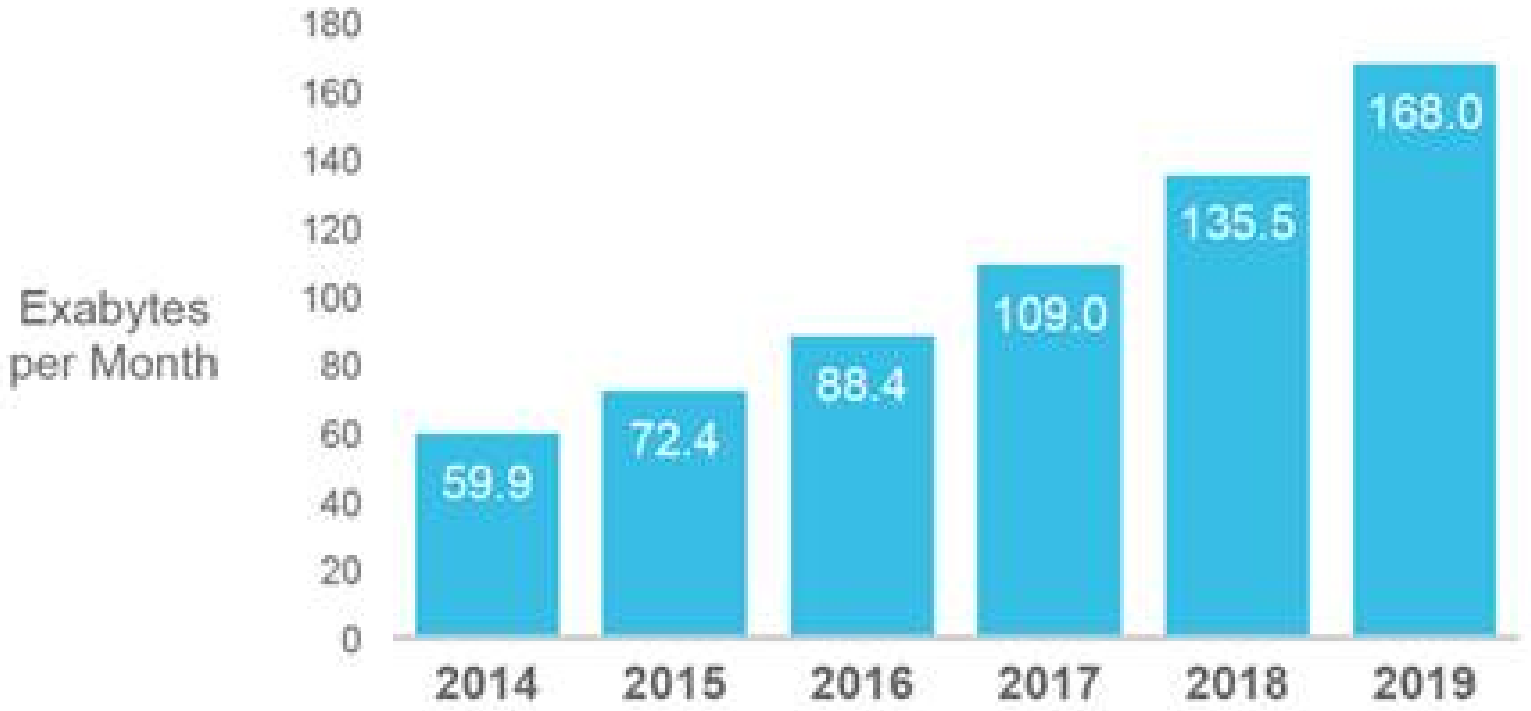


Figure 1: IP traffic per month forecasts [1]

[1] Image courtesy of Cisco Visual Network, Inc

Background

- Information transmitted via optical fibers due to large bandwidth
- Switches: reroute information, connect fibers
- Historically, switches converted optical signal to electrical to optical
  - Bandwidth bottleneck
  - Slow
  - Rigid

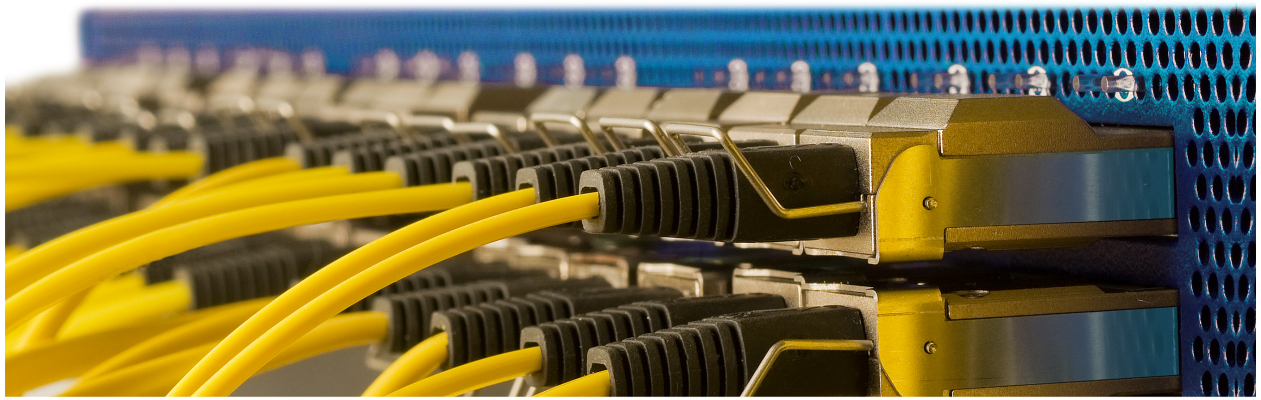


Image courtesy of connector.com

Diffraction-Based Optical Switch

- Protocol- and bandwidth-invariant
- Rapid reconfiguration time
- Easily reconfigured
  - Decouples send- and receive-side components $\rightarrow$ independent scaling of two sections

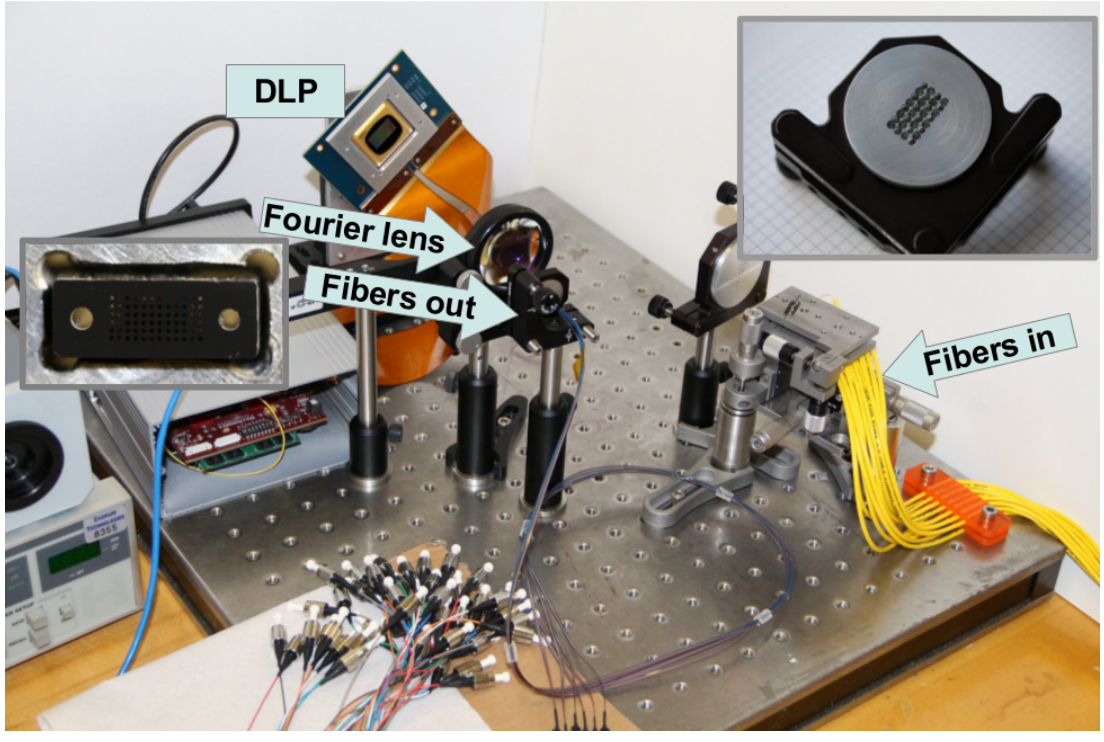


Figure 2: 32 x 32 diffraction-based optical switch

Diffraction-Based Optical Switch

- Use computer generated holograms on DMD to diffract light
- Diffracts into precalculated pattern

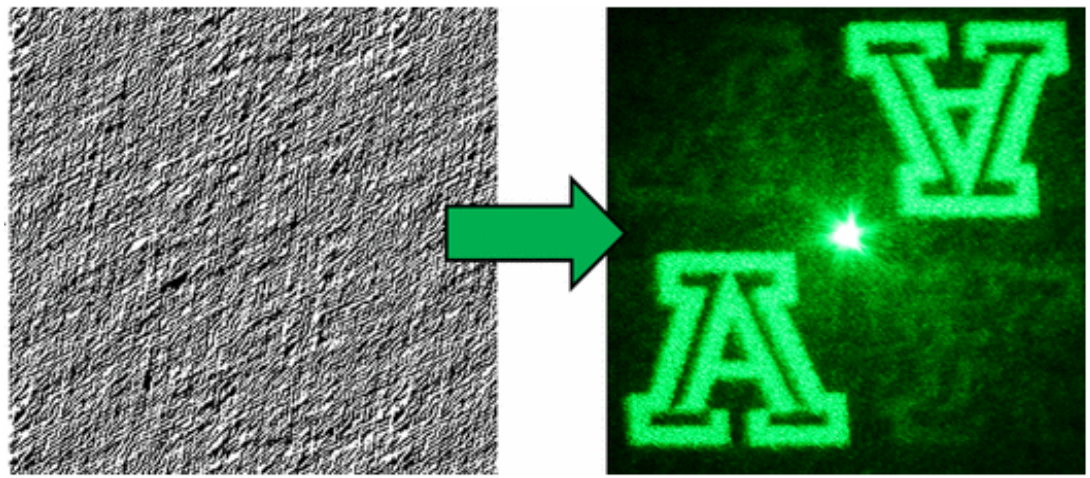


Figure 3: Hologram and diffraction pattern produced when illuminated with laser light

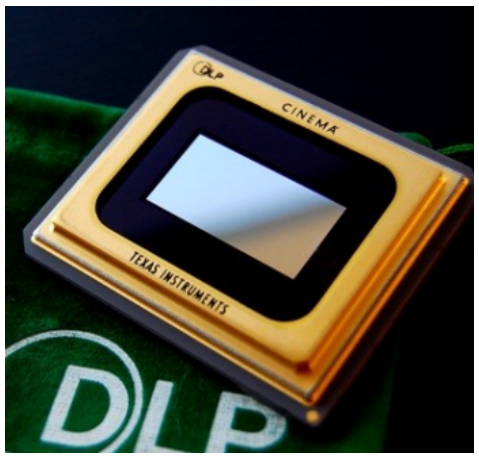


Figure 4: DMD [2]

[2] Image courtesy of Texas Instruments

1xN Diffraction-Based Optical Switch

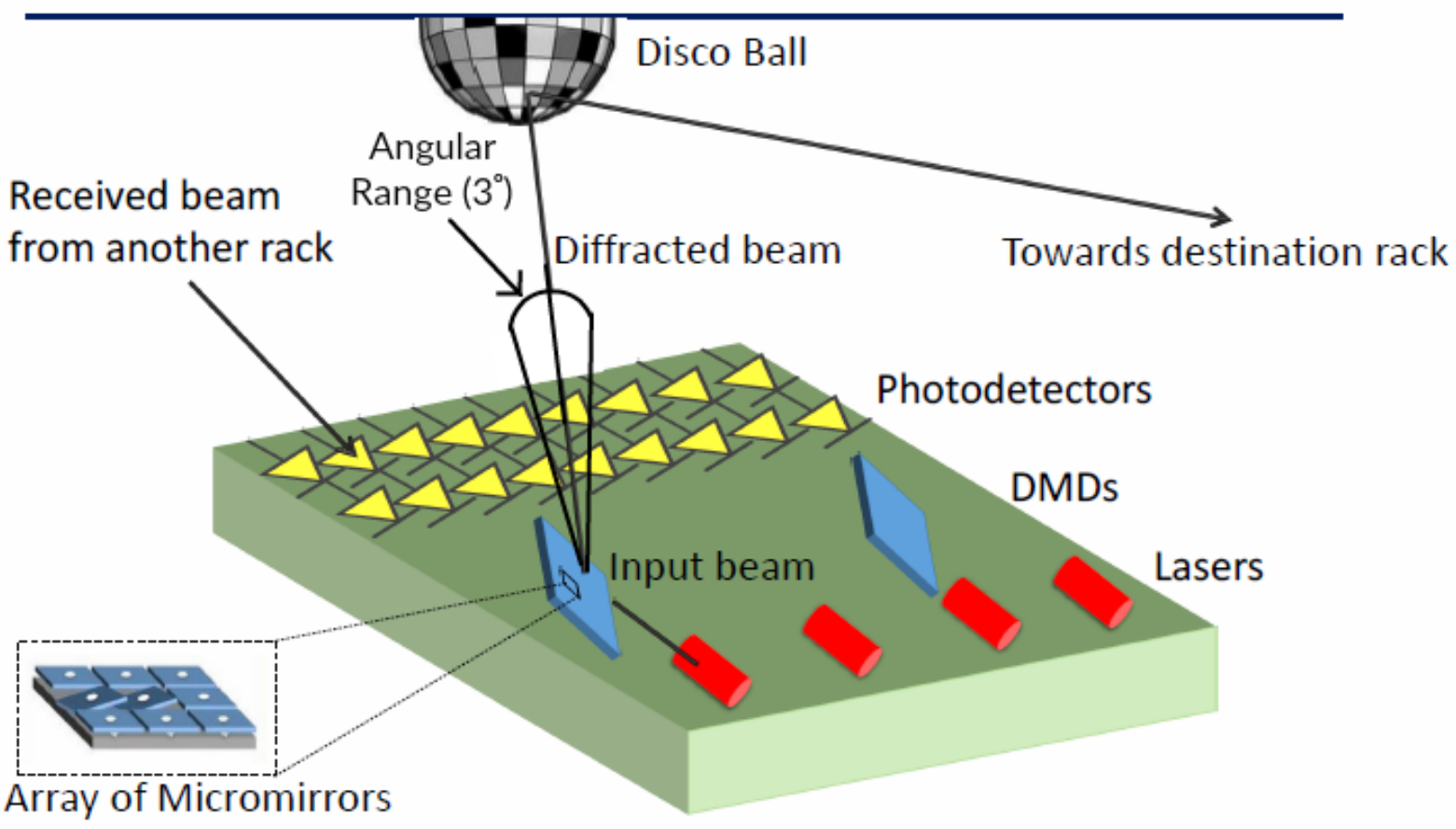


Figure 5: Top of rack within data center

1xN Diffraction-Based Optical Switch II

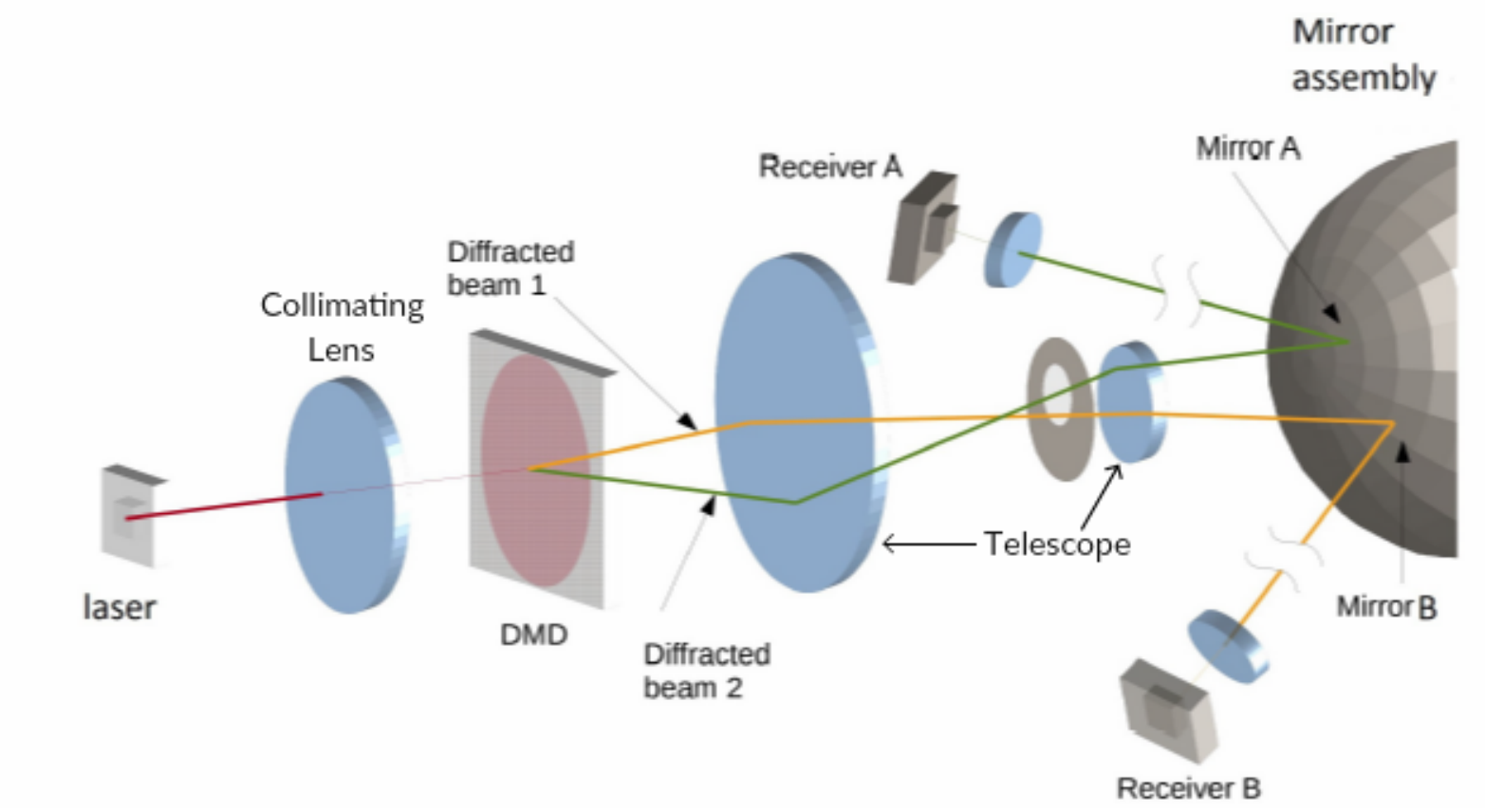


Figure 6: Schematic of 1xN optical switch

Designing the Switch

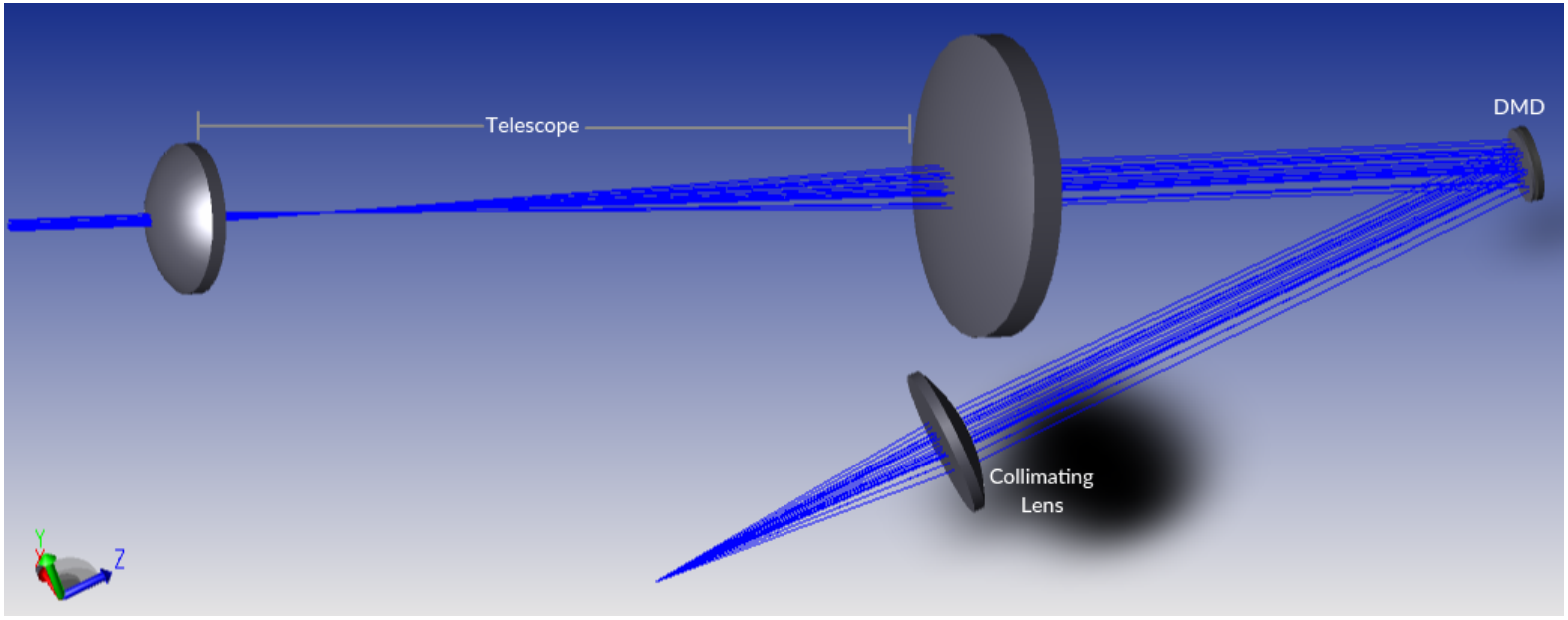


Figure 7: Schematic of 1xN optical switch

Modeling the Switch

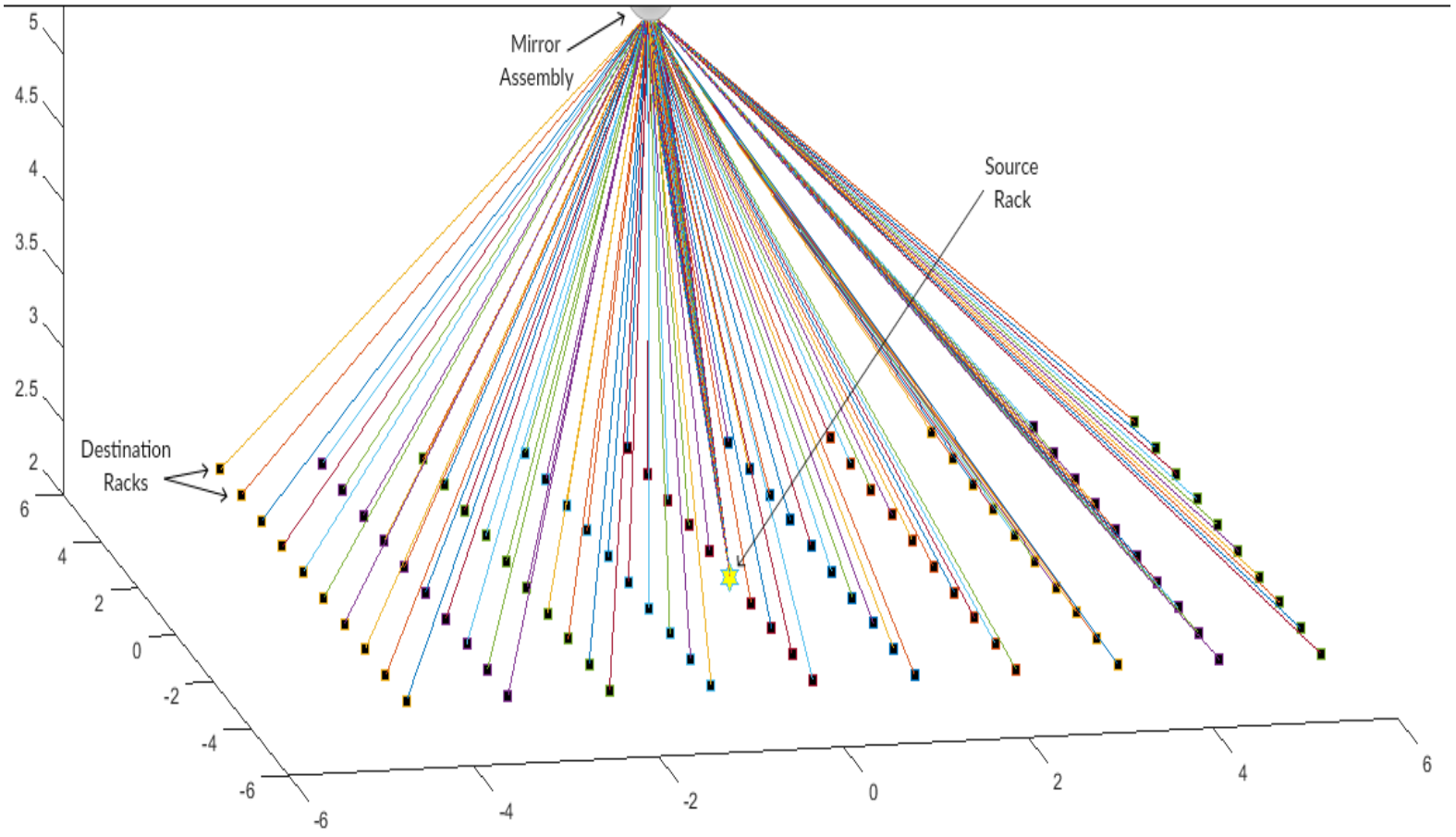


Figure 8: Ray tracing diagram from source rack to destination racks

Number of Accessible Locations

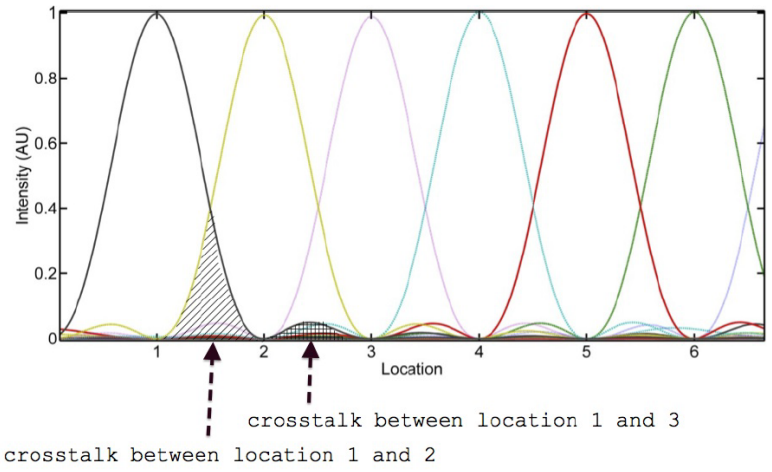
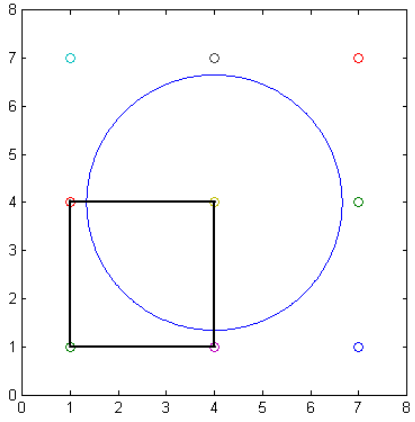
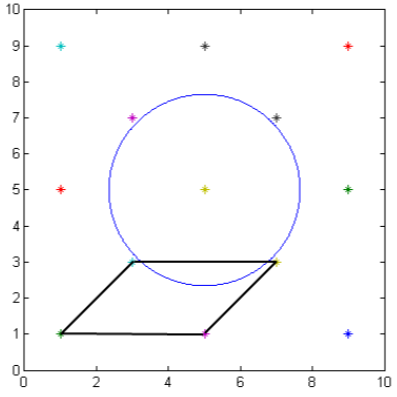


Figure 9: Adjacent beams diffracted from the DMD

- 12.5% increase in accessible locations
- 44 k vs. 50 k points



(a) Square



(b) Parallelogram

Future Plans

- Design mirror assembly in Solidworks and machine
- Experimentally test design
- Increase number of output ports

Acknowledgements

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