Advanced Networking and Intelligent Systems Engineering
Advanced Networks

• Network are fast and ubiquitous, and most computing environments depend on networking in some way.
• Despite continued advances in network technology – interconnects, protocols, APIs – network performance is still an issue.
• Bandwidth can be solved with costs:
  • Increase link speed
  • Add more parallel “lanes”
• Latency is more difficult:
  • Physical propagation time, software overheads, ...
  • And as soon as there is signaling, latency impacts effective bandwidth!
• Teasing performance and efficiency out of a networked system involves techniques that span the various architectural layers and components of the system.
Intelligent, Integrated Hardware and Software Systems

- A common theme in our work is programmable, adaptable networks
  - There is often a tradeoff between generality and efficiency
- Software Defined Networks, Smart Network Interfaces, Network Processing elements and Field Programmable Gate Arrays (FPGAs)
- Each allows greater efficiency and performance
- Realizing these improvements requires customization across layers and components
FPGAs in the Network Data Path

- FPGAs are being increasingly utilized to accelerate network applications
  - Microsoft’s Bing search engine, key-value stores, etc.
- Significant engineering effort to implement and integrate, but tremendous gains are possible
- Our approach “offloads” collective communication in parallel, high-performance computing applications

![Diagram and Graph](image-url)