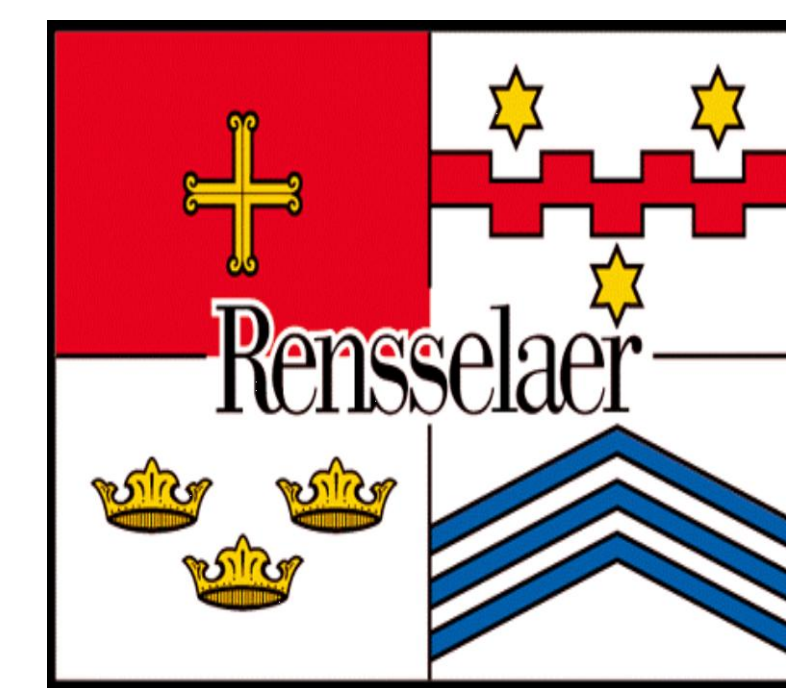


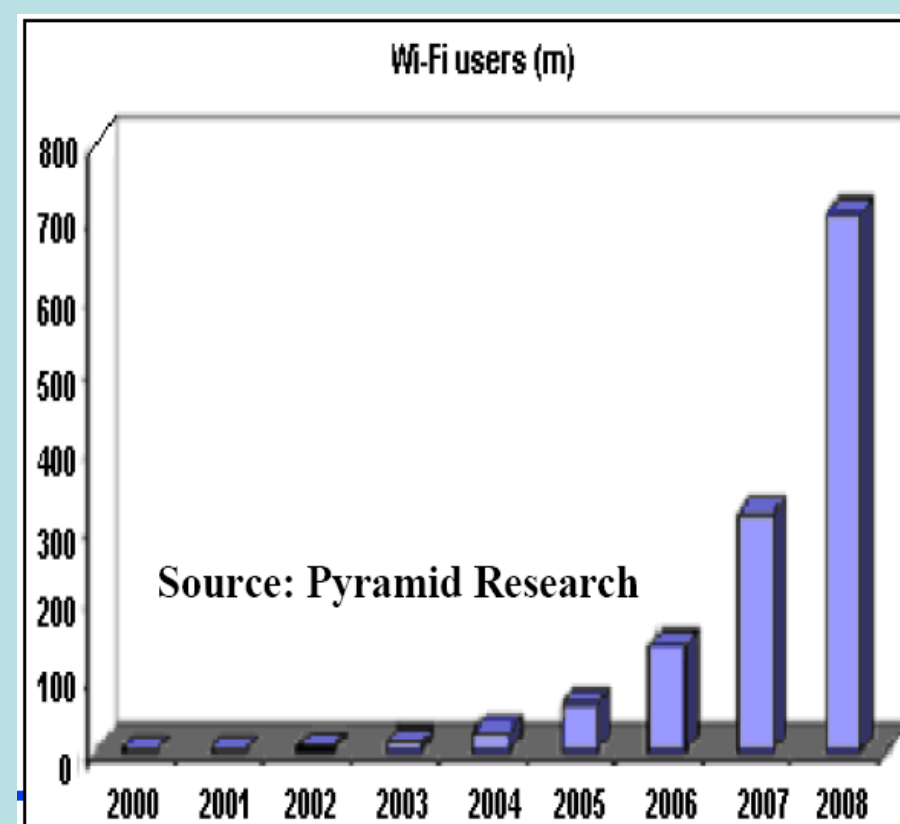
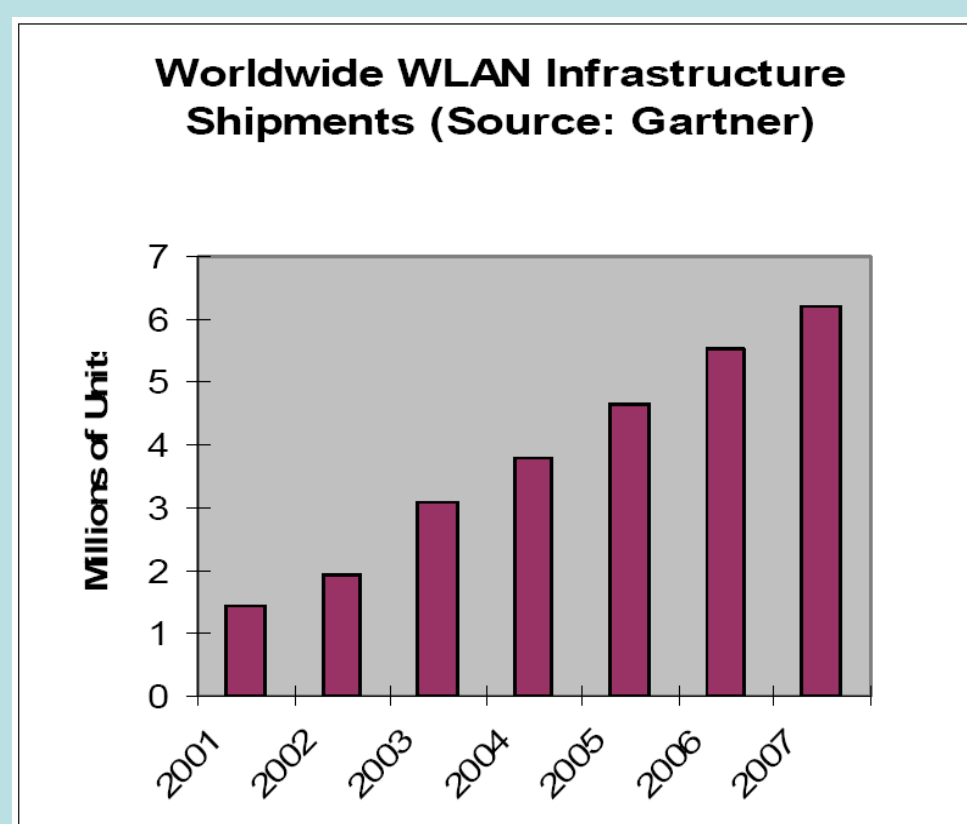
MPLOT: Multi-Path Loss Tolerant Transport Protocol



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Growth of Wireless Networks

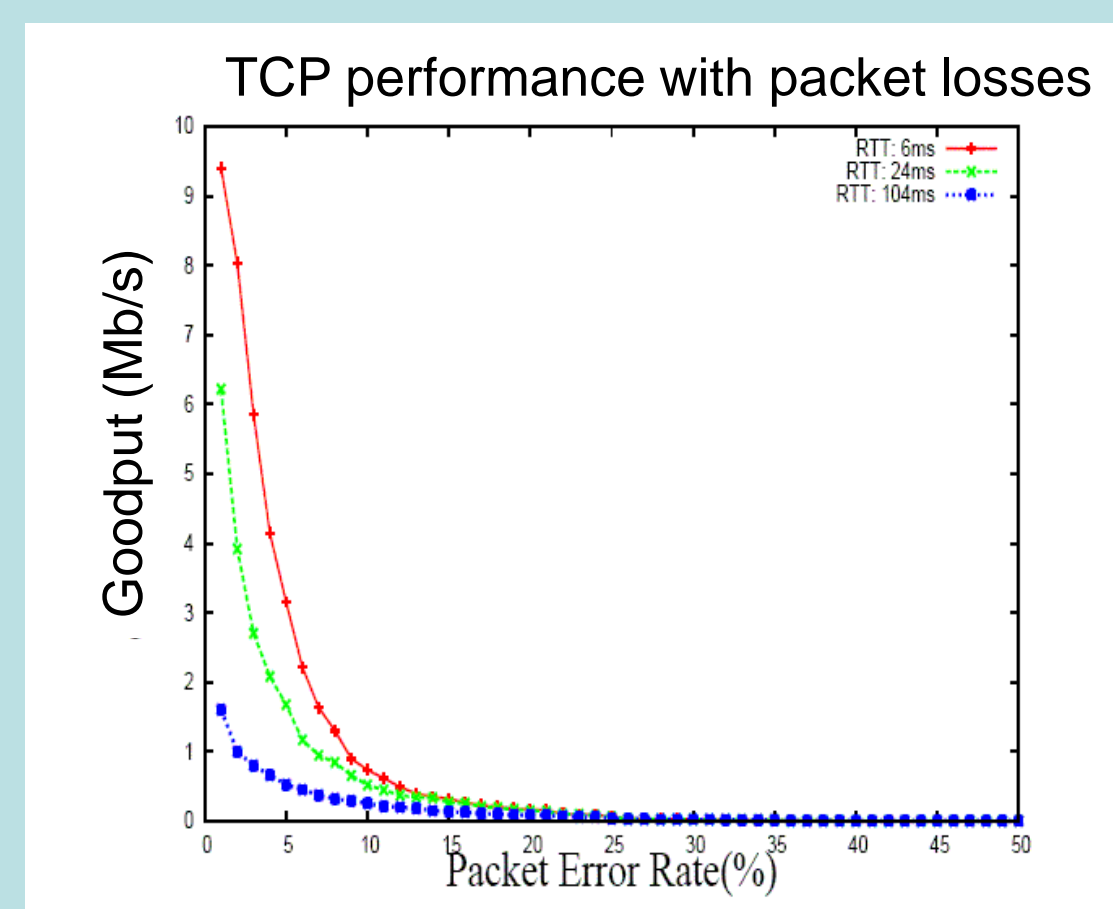
- Wireless mesh networks are becoming increasingly popular.
- Wireless networks are cheaper and easier to set up.
- Several initiatives to set standards have contributed to this growth.
 - IEEE 801.11x and IEEE 802.16 are most popular.
- AT&T Metro WiFi, Google WiFi seek to extend wireless networking to traditional wired backhaul networks.



Transport Protocols and Wireless Networks

- Wireless networks differ significantly from wired networks.
 - Significant Packet losses (> 10%).
 - Variable Bandwidth.
 - High Delay and Jitter.
- Conventional Transport Protocols are extremely sensitive to packet losses.
 - Packet losses interpreted as congestion.
 - Transmission rate reduced upon packet losses.
- Transport Protocols must treat losses from noisy links differently.

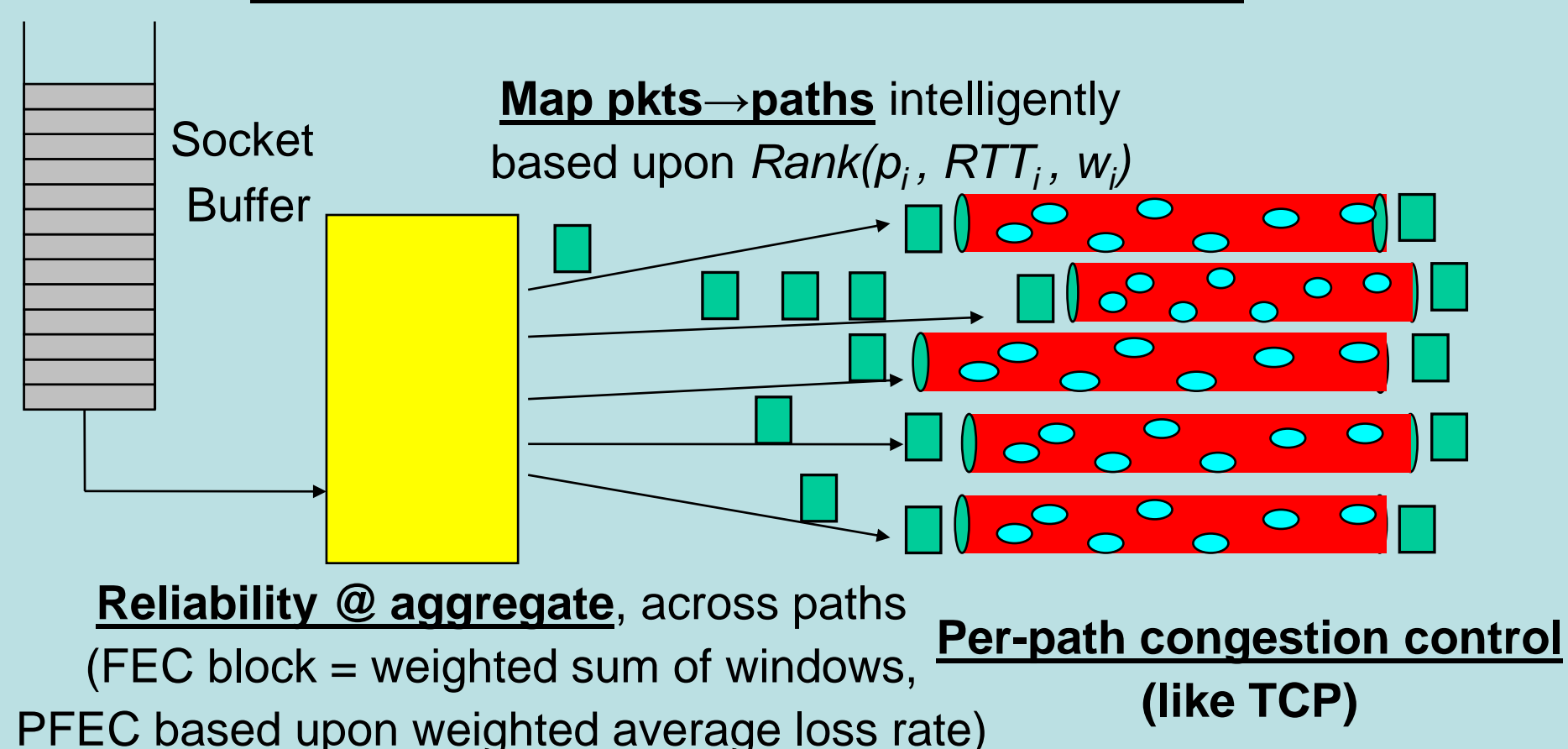
Data rate delivered by TCP reduces exponentially with increasing packet losses



Diversity Gain from Wireless Networks

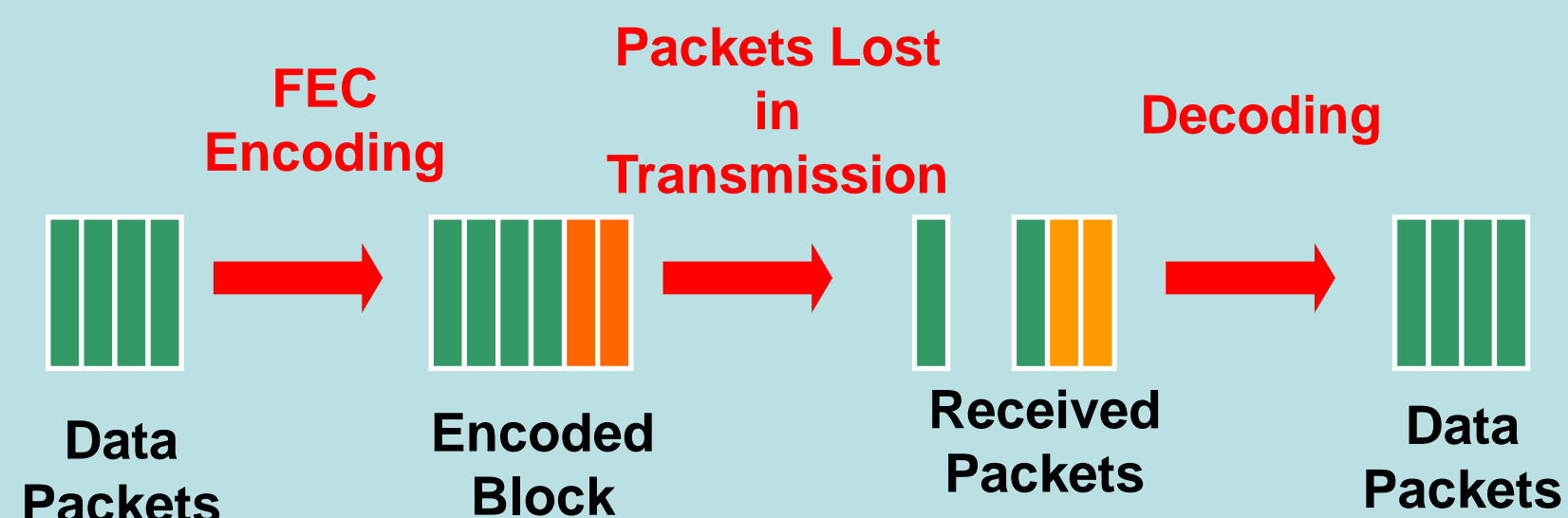
- Wireless networks provide increased opportunity to form multiple paths between source and destination in the network.
 - Do not need new cables to form additional links between network nodes.
- Multiple paths can be used to form a "network tunnel" with a stable, high bandwidth and low delay.
- MPLOT uses multiple paths and Forward Error Correction (FEC) to exploit differences in paths to deliver stable, high data rate and low delay.

MPLOT- Features



- Loss tolerance:** MPLOT employs FEC at the transport layer to counter high packet losses.
- Intelligent Packet-to-Path Mapping:** MPLOT dynamically transmits packets on different paths to match network conditions.
- Separation of Reliability and Congestion Control:** Congestion control is independent for each path *but* reliability is organized across paths. Critical packets can be transmitted on paths experiencing better conditions quickly.
- Diversity Gain:** MPLOT uses different paths intelligently to obtain gains in goodput and reduction in delays more than that would be possible by simple bandwidth aggregation.

MPLOT- Loss Tolerance

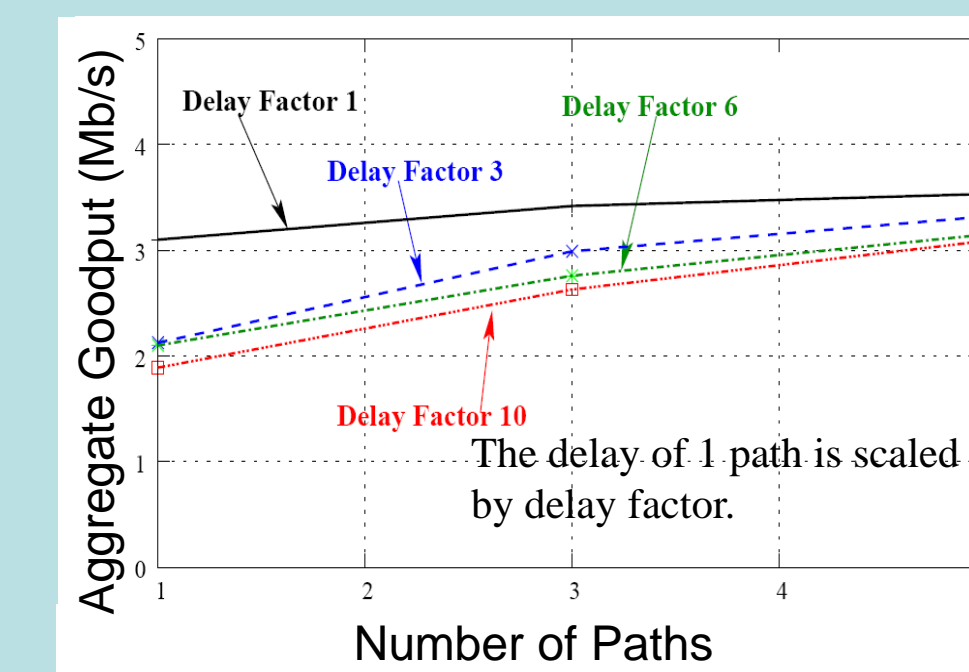
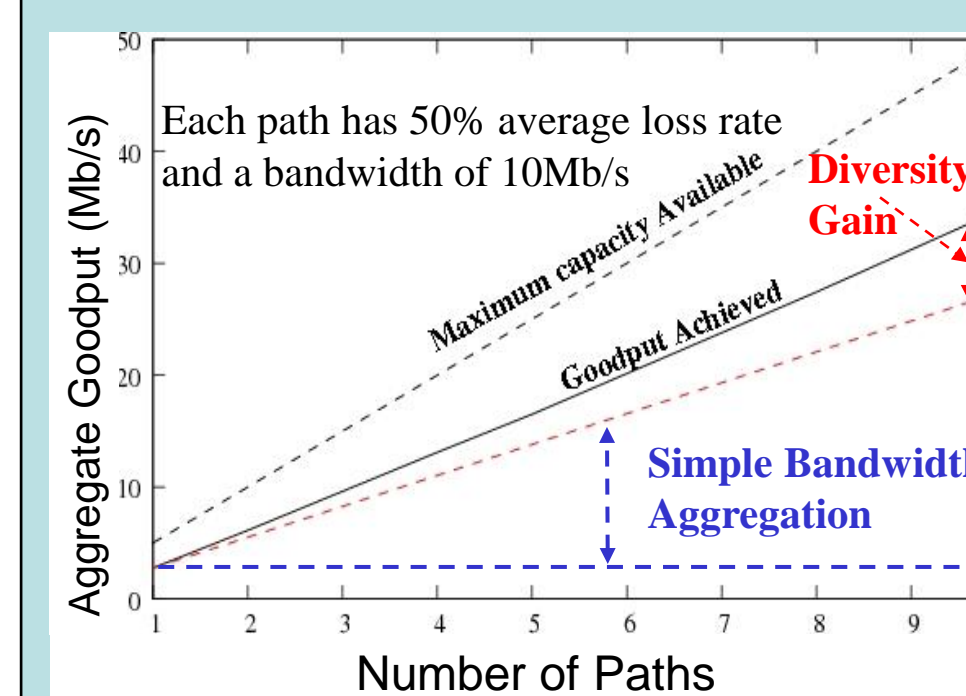


- MPLOT codes data packets to form a block of coded packets.
 - Code-rate adapts in accordance with the network losses.
- FEC coding allows receiver to recover data packets without additional re-transmissions even when a few packets are lost in transmission.
 - Reduces delay in data-delivery.

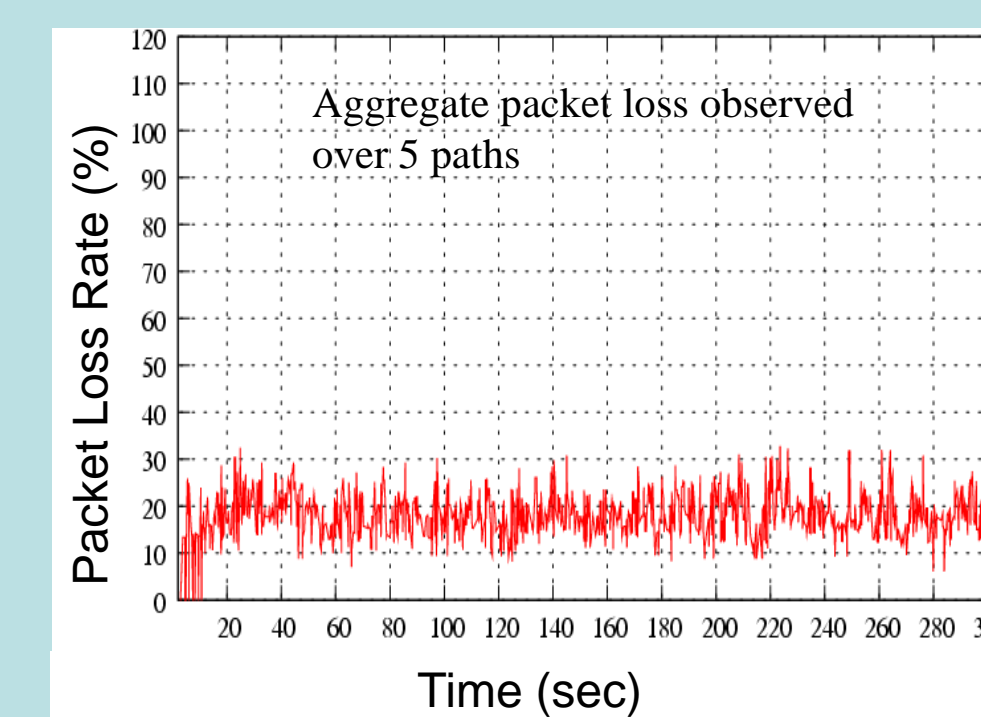
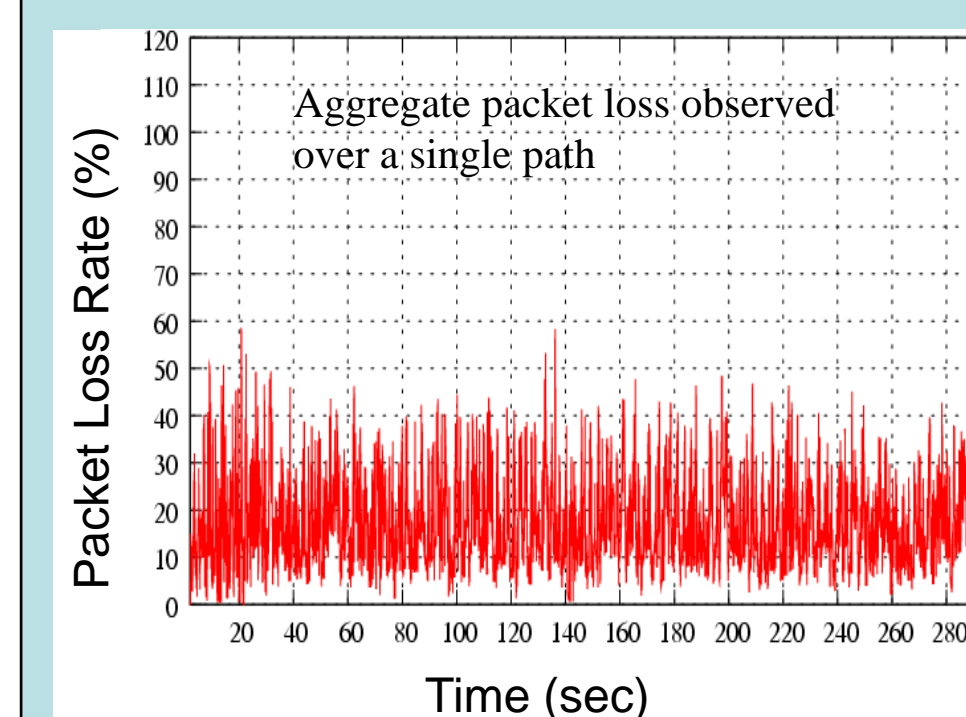
MPLOT- Diversity Gain

- The combination of multiple paths, FEC coding, intelligent packet mapping with aggregate reliability allows MPLOT to adapt quickly to changing conditions.
 - Shortest reverse path can be used to acknowledge packets sent on longer paths-reducing effective delay.
 - Intelligent packet mapping takes advantage of better conditions on paths.

Simulation Results



MPLOT achieves a higher gain in bandwidth than is suggested by simple bandwidth aggregation. Differences in path losses and delays are exploited to gain significant gains in goodput.



The aggregate losses seen across all paths reduce significantly as number of paths increases. This provides room for transferring more data from the same bandwidth.