Path Tracing (PT)

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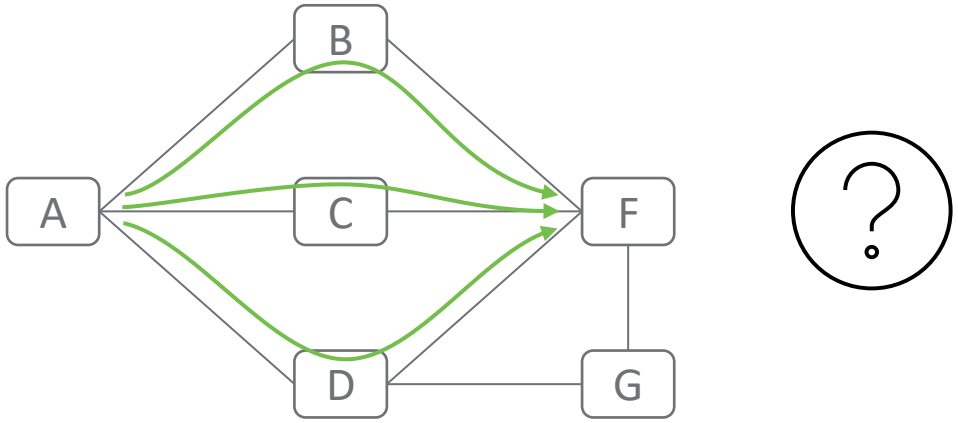
How did the packet arrive from A to F?

- 3 possible “valid” ECMP paths
  - Any drop?
  - End-to-End Latency homogeneity?



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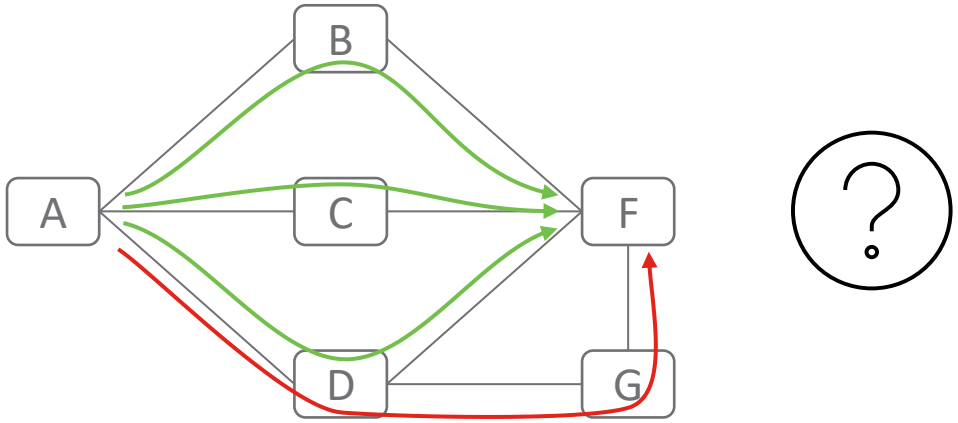

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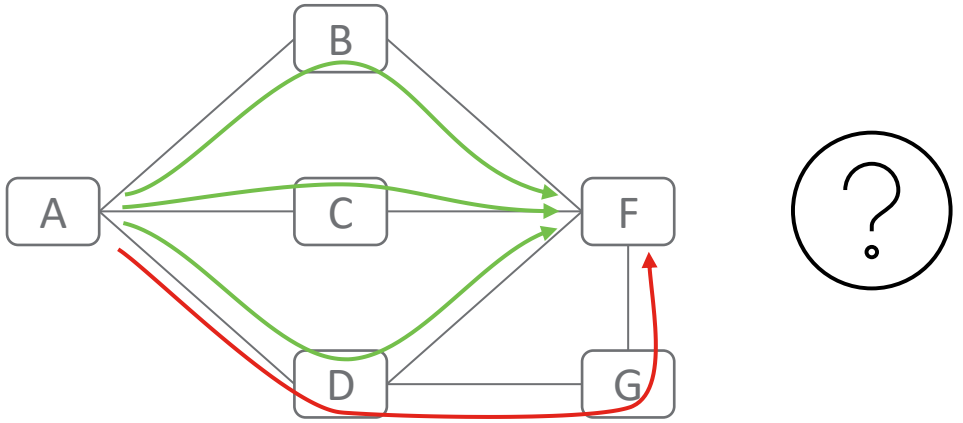
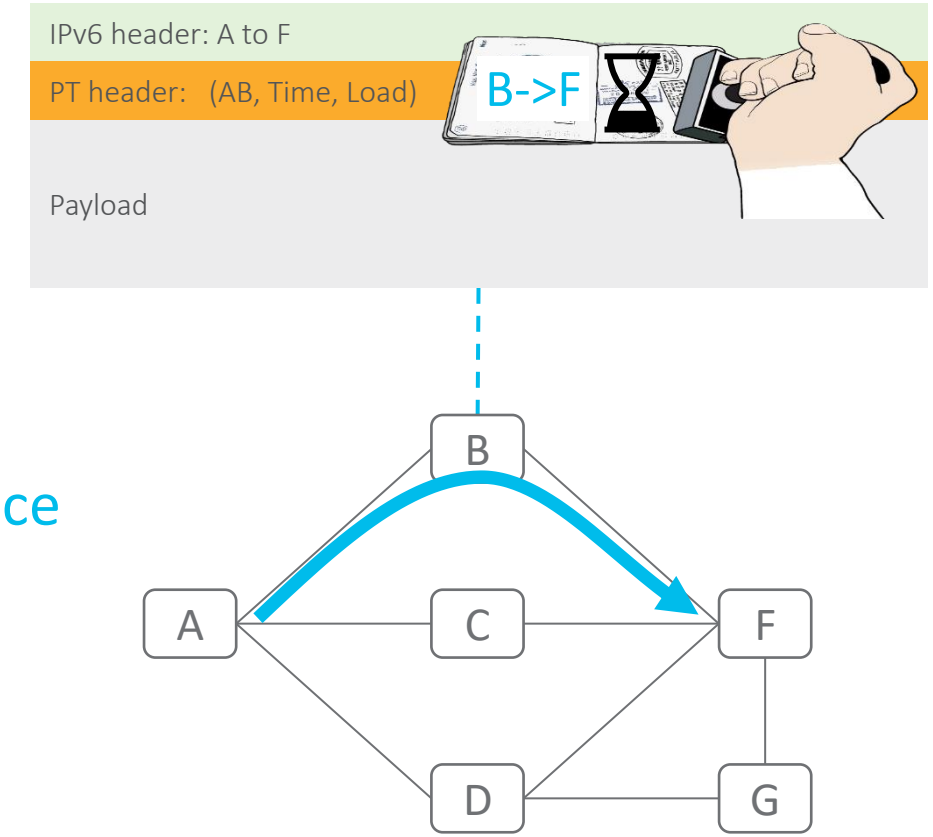
- 40-year-old unsolved IP problem



Stamping Trajectory in PT Header

- Each transit router records in PT header:
  - Outgoing interface ID
  - Timestamp (with 0.06ms accuracy)
  - Load
- Highly compressed for low MTU overhead
  - Only 3 bytes per hop!
- Implemented at linerate: Reports true packet experience
- Native interworking with legacy nodes
  - Seamless deployment
- Hardware/XR feature with analytics app



Mature Eco-System

- Midpoint PT under deployment - IOS XR 7.8.1
  - Cisco 8000 (Silicon One Q200; native SDK)
  - NCS5700 (DNX2 - J2; native SDK)
  - ASR9000 (LS)
- Rich Eco-system
  - Cisco, Broadcom, Marvell, +others
  - Linux, FD.io VPP, P4, Wireshark, TCPDUMP
- Ongoing standardization
  - Path Tracing in SRv6 networks (ietf.org)

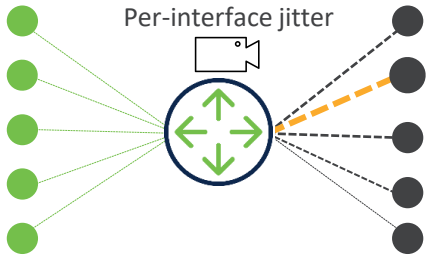
Use-cases

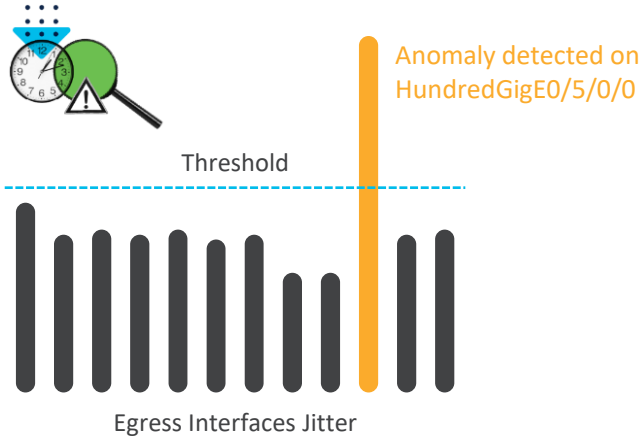
EDM: ECMP Dataplane Monitoring

- EDM detects
  - An expected ECMP path that drops all its traffic (dataplane corruption)
  - An ECMP path that is not expected (routing/dataplane corruption)
  - Incoherent latency between ECMP paths
- EDM measures
  - End-to-end latency of each path (0.06msec in WAN, 0.2usec in DC)
- Current technique of sending probes from anywhere to anywhere without any PT data requires AI processing of huge data sets

Jitter Analytics

- EDM probing creates an extensive dataset
  - Dataplane Timestamps at each hop
  - 0.06ms accuracy in the WAN (0.2usec in DC)
- Jitter Analytics studies this dataset on a per-node/per-intf
  - Jitter introduced by that node and egress interface
  - Min, Avg, Per50, Per80, Per90…
  - Across different queues
  - AI-based Alerts
- Per-Node Jitter at 0.06msec in live network has never been done before





Conclusion

- Path Tracing is another innovation solving a 40-year problem
- Significant applicability: transport assurance
  - Loss, Latency & Jitter
- Shipping and in deployment
- Rich Eco-System
  - Opensource implementations available
- E2E focus: HW and Analytics

The bridge to possible