END-TO-END SERVICE GROUP

Justin P. Rohrer, Dennis Schwerdel, Abbas Siddiqui, Martin Becke, Divya Giri

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RESEARCH PROBLEM

- Current and future internetwork heterogeneous entities
  - Currently best-effort, without selectable properties
- Applications need end-to-end "homogeneous" functionality
  - With some quality of service constraints
- Little/no information exchanged currently
- How do we map, aggregate, and tune network capabilities to service requirements?

WHY IS IT IMPORTANT

- More bandwidth won't fix everything, forever
- Diverse requirements from future applications
  - e.g. guaranteed service for telepresence
- "best effort" priorities are not equal for all application
  - e.g. latency vs bandwidth

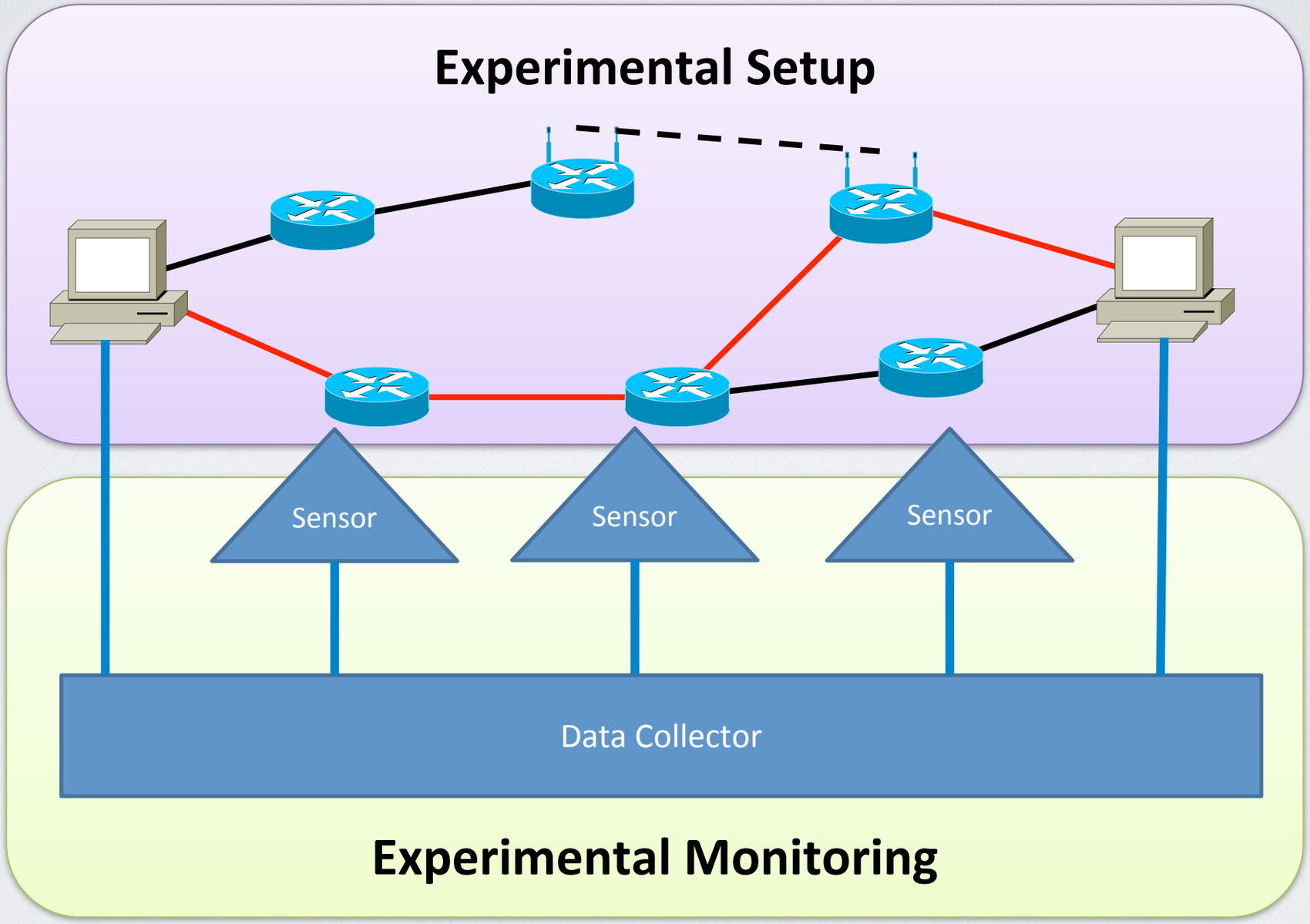
EXPERIMENT DESIGN

- Multiple application/traffic types
  - Measure end-to-end performance
- Multiple decision algorithms/locations
  - Compare making decisions at network edge vs core
- Centralized data collection
- Scope: ~100 application nodes, 10-20 routing nodes

EXPERIMENT MEASUREMENTS

- Optimize end-to-end performance for multiple applications
  - e.g. latency, jitter, error-rate, throughput
- Need to instrument intermediate links and nodes
  - Provide "best possible" optimal solution as reference
  - To debug anomalies

EXPERIMENT DESIGN



GENI/G-LAB FACILITIES

- Wireless and/or wireless-emulation facilities (ProtoGENI)
- Wired facilities (ToMaTo + ProtoGENI)
- Controlled environment: guaranteed minimum bandwidth links
- Sub-millisecond time synchronization
  - (GPS time sources?, IEEE 1588v2)

EXPECTED RESULTS

- Minimum complete set of network element properties
- Immutable attributes
  - e.g. latency, medium, geographic location, topology
- Tunable parameters
  - e.g. encryption, error correction, topology?

EXPECTED RESULTS

- Minimum complete set of application (user) requirements
  - e.g. max. delay, min. bandwidth, reliability, asymmetry
  - need a comprehensive but tractable set of metrics
- Best location for decision functionality (core or edge)

BENEFIT OF COLLABORATION

- Exchange of ideas and experience
- High-latency trans-atlantic connection
- Larger scale through combined resources
- Combined feature set
  - ToMaTo: packet tracking, dynamic topology
  - ProtoGENI: many nodes, wireless nodes, "real" hardware

END OF SLIDES

- Any Questions?

SCOPE

- Target new applications
- Utilize currently unavailable metadata
- Green-field, clean-slate

EXPERIMENT IDEAS

- Need heterogeneous topology, with metadata description
  - Implies control-plane API
- Outcome: Find ideal set of information to expose in network
  - Find ideal set of constraints required by application
  - Future-proofing?
  - Determine placement of functionality

DECISION METRICS

- Per link/node
  - BER/PER, MTU, available bandwidth, latency, jitter
  - Cost, "extra features"

PROPOSED EXPERIMENTS

- There is only one world-wide computer
  - No networking needed, only inter-process communication
- Problem solved*
- *Dependent on creation of world-wide computer**
  - **Design and production to be outsourced