Trustworthy Conferencing via Domain-specific Modeling and Low Latency Reliable Protocols

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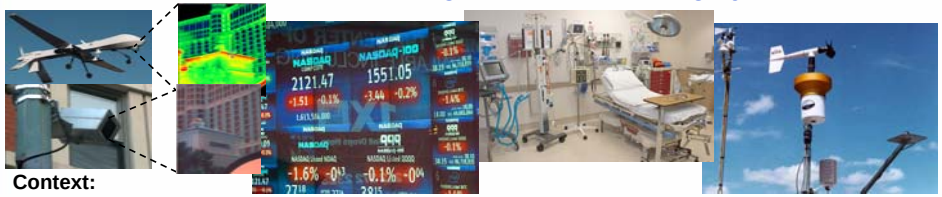
Trustworthiness Challenges for Conferencing Systems



Context:

a) Continuous data streams have timeliness requirements
b) Conferencing requires synchronization of multiple continuous data streams
c) Conferencing implies multiple senders & receivers

Example Applications:

a) Video/infrared coordination (e.g., search and rescue)
b) Stock update correlation
c) Medical telemetry (e.g., wireless ER)
d) Science monitoring (e.g., weather tracking)

Challenges:

a) Provide the right amount of reliability and timeliness
   - Enough data is reliably delivered to be useful
   - Latency is low enough to meet timeliness requirements
b) Abstract away error-prone low-level implementation details

Summary of Solution Approach: Use Model Driven Engineering (MDE) with Low Latency Reliable Protocols to

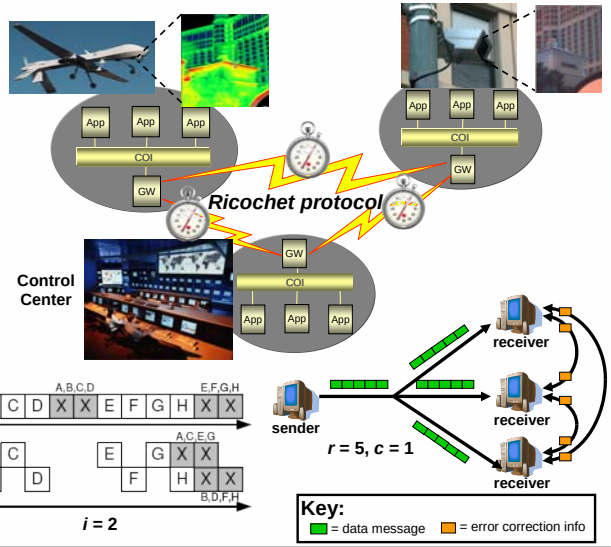
1. Modularize trustworthiness concerns,
2. Reason about the system, and
3. Synthesize "correct-by-construction" transport protocol configurations

Addressing Conferencing Timeliness via the Ricochet Transport Protocol

Ricochet uses a bi-modal multicast protocol & lateral error-correction (LEC) to provide QoS & scalability guarantees

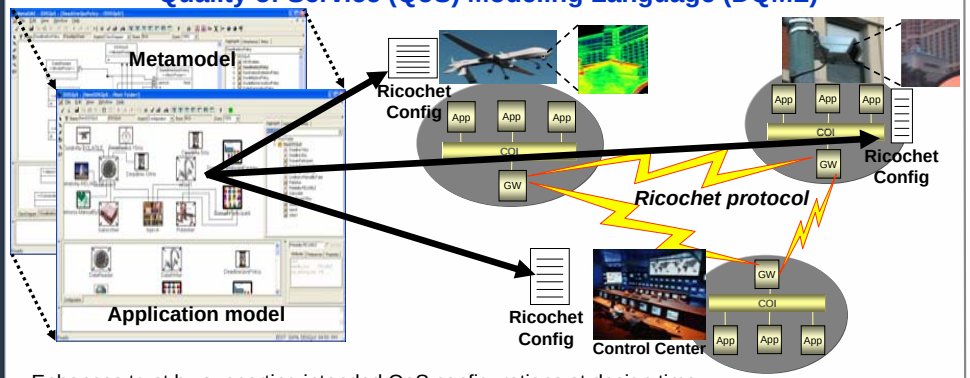
Ricochet supports time-critical multicast for high data rates with strong probabilistic delivery guarantees
- low latency error detection
- low latency error recovery

Ricochet provides tunable settings
- # of packets sent for error correction (*r*)
- # of correction packets (c)
- Amount of interleaving (i)
- NAK inclusion/timeout
- sender's sliding window size



Ricochet provides low-latency high-reliability transport of data

Addressing Trustworthiness via the Data Distribution Service (DDS) Quality of Service (QoS) Modeling Language (DQML)



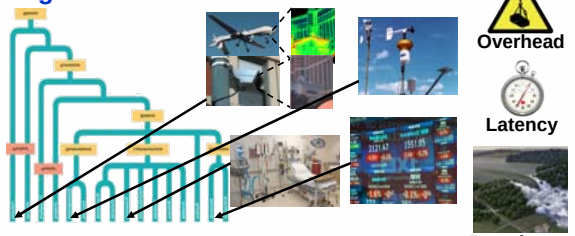
Enhances trust by supporting intended QoS configurations at design time
- Automates complex, tedious, and error-prone QoS compatibility and consistency checking
- Provides separation of concerns to facilitate configuration analysis better
- Generates application artifacts (e.g., OpenDDS source code, Ricochet configuration code)

Supports pub/sub middleware research by providing a base for higher level DDS abstractions
- DDS Configuration Patterns
- Basis for DDS application-specific profiles

DQML uses constraint-checking for analysis, generates intended QoS metadata, and configures the Ricochet transport protocol appropriately

Ongoing Research

Develop conferencing application taxonomy
- Categorize conferencing application types based on timeliness and reliability needs
- Develop DDS QoS patterns and Ricochet settings profiles
- Enhance DQML to include the developed patterns and profiles



Ricochet taxonomy/profiles for security threats
- e.g., DDOS, reliable senders/corrupt FECs
- contain/limit propagation of security threat (gossip susceptibility)
- authentication (acceptable overhead?)

Researching:

1. QoS conferencing profiles for pub-sub middleware
2. Ricochet settings to enhance security against various threats
3. Inclusion of authentication in Ricochet to determine overhead