Performance Evaluation of Operations in RedSIB with Substitution Mechanism

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Dataflow Network Model

- IoT is large set of interconnected elements
- The base are data coming from smart devices and sensors

Dataflow network
- Multi-step information refinement
- Well-suited for sensor data processing
Agent Substitution Mechanism

- Many units of IoT are mobile devices
  - have a limited power supply
  - use unreliable wireless channels
- Processing unit may unexpectedly disconnect
  - break existing data flows
  - loose accumulated context information

Agent substitution idea

![Diagram showing the substitution mechanism with input, primary agent, substitution manager, and output connections.]

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Agent Substitution Mechanism Operations

- Keeping primary and substitute agents registry
  - Agent registration
  - Agent unregistration
- Agent substitution procedure
  - TCP/IP connection failure
  - Explicit substitution request
- Primary agent return
- Store subscription notifications during the substitution
Agent Substitution Implementation Aspects

Substitution mechanism is implemented as a SIB module
- Must detect disconnection as fast as possible
- Must efficiently manage agent context

Mechanism uses special configuration ontology
- Any KPI can be used to create dataflow agent
- Uses fixed number of internal subscriptions to track data modifications

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**Experiment goal:** estimate the mean time of insert and remove operations substitution

Perform 1000 following test cycles, where N is the current cycle number

- Setup N subscriptions to the smart space
- Insert and remove random 50 times (triples do not trigger subscriptions)
Core SIB Operations Testing Results

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**Experiment goal:** estimate the mean time of substitution operation execution

Perform 35 following test cycles, where \( N \) is the current cycle number

- Register \( N \) primary agents and \( N \) substitute agents
- Perform voluntary substitution request for primary agents
Substitution Performance Testing Results

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Impact of Substitution on SIB Operations

**Experiment goal:** estimate the mean time of core operations execution during the substitution operation execution

Perform 900 following test cycles, where $N$ is the current cycle number

- Register 10 primary agents and 10 substitute agents
- Initiate $N$ subscription to the smart space
- Simultaneously:
  - Insert and remove 50 random triples
  - Begin substitution for primary agents
Impact of Substitution on SIB Operations

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Conclusion and Future Work

- Substitution mechanism
  - Implemented as a SIB module
  - Uses special configuration ontology
  - Uses fixed number of subscriptions

- Performance considerations
  - Modifications did not impact on core operations
  - Substitution time is small, but should be improved

- Future Work
  - Migration to RedSIB 0.9
- Dataflow agents are stereotypical entities
- Dataflow agents are KPs conforming to certain rules
- Input channels are subscriptions
- Output channels are modified triples
- Internal state is a set of "private" triples
Dataflow Network Agent Implementation

- Dataflow nodes are KPs
- Context is stored inside SIB
- Inputs are subscriptions
- Outputs are triple modifications

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SIB Modules Modification

Communication module

Data modification request

Data modification module

Data retrieval request

Data query module

Subscription notification

Subscription manager

Subscription request

Database

Connection failure notification or substitution request

Internal triple operations module

Request

Notification

Notification storage module

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