The Design of a CORBA Real-time Event Service

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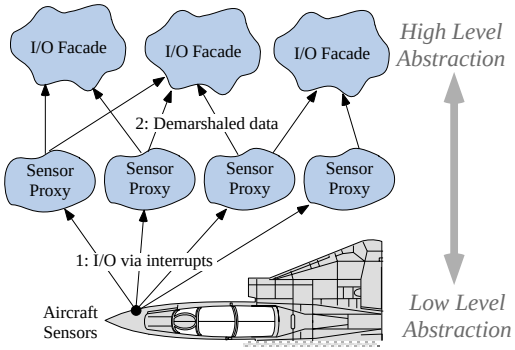
Motivation: Applying TAO to Real-time Avionics

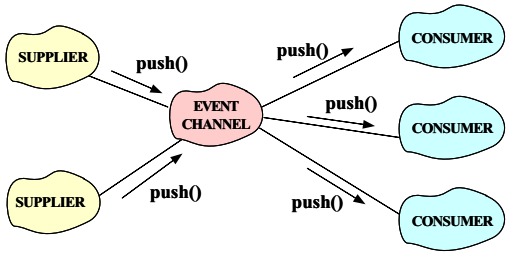


- **Synopsis**
  - *Typical Interactions*
    - I/O arrives
    - Proxies demarshal data
    - Facades process data
  - *Advantages:*
    - Efficient control flow
    - Clean layered architecture
  - *Disadvantages:*
    - Coupled layers
    - Inflexible scheduling

Forces/Domain Characteristics

- I/O driven
  - Periodic processing requirements
- Complex dependencies
  - *e.g.*, I/O Facades depend on multiple sensor proxies
- Real-time constraints
  - Deterministic and statistical deadlines
  - Static scheduling (*e.g.*, rate monotonic)

Candidate Solution: COS Event Service



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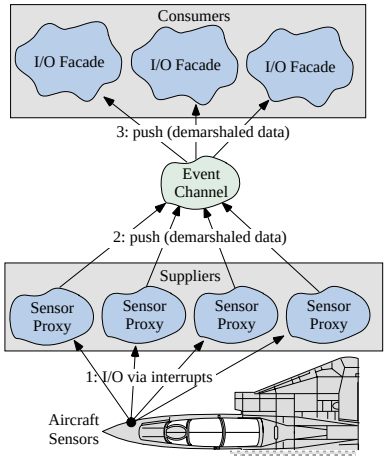
- **Features**
  - Decoupled consumers and suppliers
  - Transparent group communication
  - Asynchronous communication
  - Abstraction for distribution
  - Abstraction for concurrency

Applying the COS Event Service to Real-time Avionics

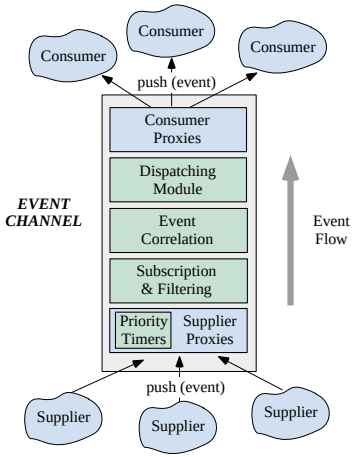


- **Typical Interactions**
  - I/O arrives
  - Proxies demarshal data
  - Proxies push to channel
  - EC pushes to facades
  - Facades process data
- **Advantages:**
  - Anonymous consumers/suppliers
  - Group communication
  - Asynchronous pushes

Issues Not Addressed by COS Event Service

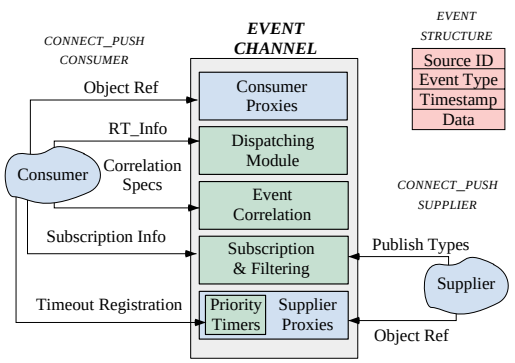
- No support for complex event dependencies
  - Consumer-specified event filtering
  - Event correlations (*e.g.*, waiting for events A *and* B before pushing)
- No support for real-time scheduling policies
  - Priority-based dispatching (*e.g.*, which consumer is dispatched first)
  - Priority-based preemption policies and mechanisms
  - Interval timeouts for periodic processing
  - Deadline timeouts for "failed" event dependencies

TAO's Event Service Architecture



- **Features**
  - Stream-based architecture
    - Enhance pluggability
  - Subscription/filtering
    - Source and type-based filtering
  - Event correlations
    - Conjunctions (A+B+C)
    - Disjunctions (A|B|C)

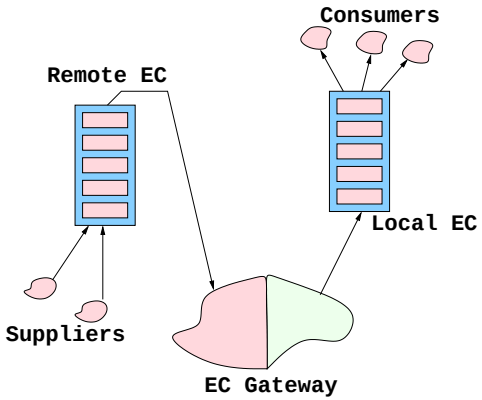
Collaborations in the RT Event Channel



- Well-defined event structure
  - CORBA Anys are inefficient
- Augmented COS interfaces:
  - Extra QoS structure to connect suppliers and consumers

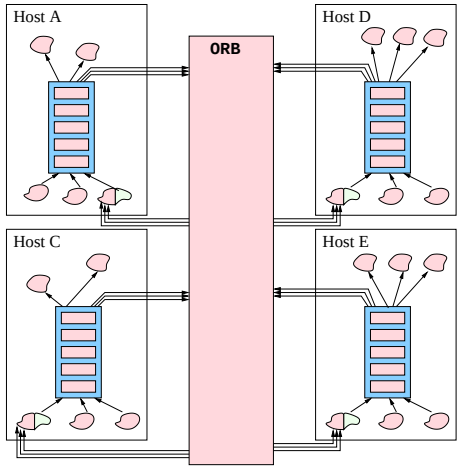
www.cs.wustl.edu/~schmidt/events_tutorial.html

Connecting Several Event Channels



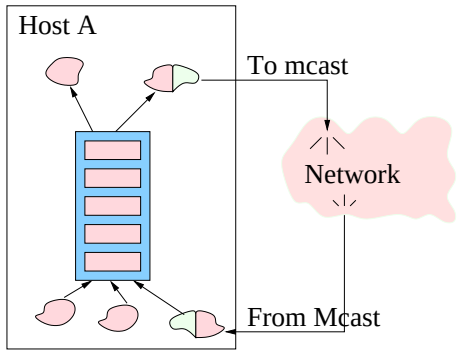
- Events often have locality of reference
- Therefore, use a gateway
  - Connects as consumer to remote EC and forwards events to local EC
  - Events carry time-to-live field to avoid loops
  - Local EC updates subscription and publication list

The IIOP Gateways



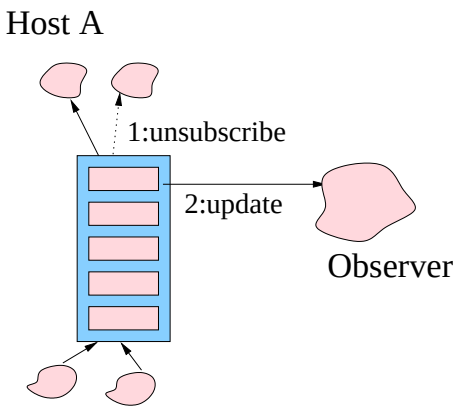
- Problem: without hierarchies the solution does not scale.
  - Not a problem for avionics
- Routing is complicated
- How to handle dynamic changes in the subscriptions?

The Multicast Implementation



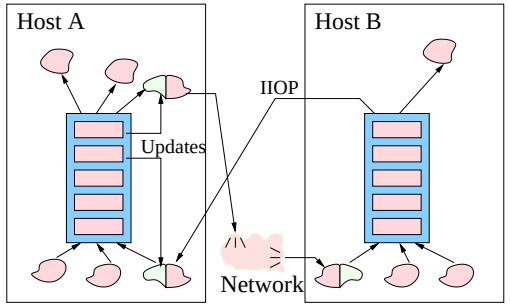
- Efficient use of network resources
- Scales better
- We need to manage multicast groups
  - A simple service maps event types to mcast groups
  - When do we join or leave a group?

Automatic Subscription Management



- How do Gateways find out about subscription changes?
  - Use the Observer pattern
  - Receive both supplier and consumer changes
  - Can be remote: Observer is a CORBA object

Current Status



- The Event Channel is implemented as a TAO service.
  - Fully distributed
  - Highly portable
- Several ECs can be connected using IIOP or UDP gateways
  - No hierarchies or routing

Future Work

- Implement CORBA COS-compliant EC
- Enhance Event Channel to use reliable multicast
- Strategize concurrency mechanisms
- Strategize correlation
- Give users control on servant collocation
  - Using ACE Service Configurator
- Precomputed schedules without need for relinks
  - Downloads from the central scheduling service
  - Save the schedule in persistent storage