Experiences with Middleware for a Networked Embedded Software Technology Open Experimental Platform

Venkita Subramonian and Chris Gill
Department of Computer Science
Washington University, St.Louis, MO
{venkita,cdgill}@cs.wustl.edu

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What is NEST?

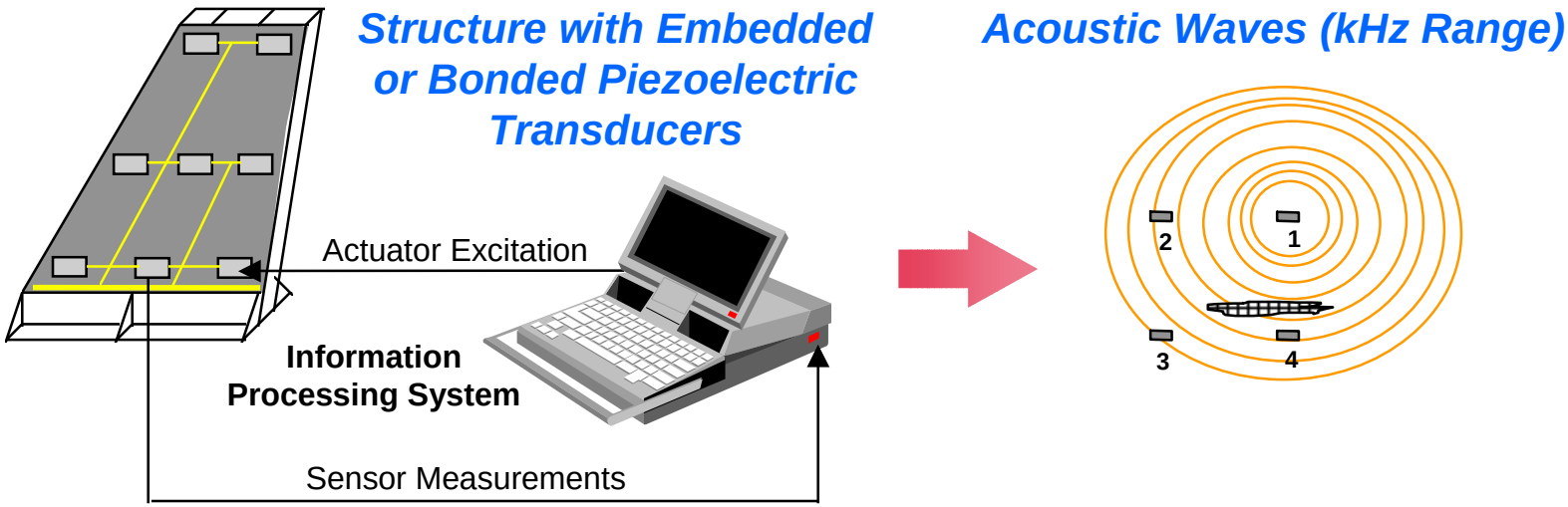
- Networked Embedded Software Technology
- Distributed Real-Time system with 100 to 100,000 networked nodes
- Resource constrained hardware components
- Requires fine-grain fusion of hardware and software components
- Applications in advanced avionics and space systems, weapon systems, wireless devices

NEST Services

- Predictable and dependable behavior despite local failures
- Real-time Coordination Services
  - Data exchange
  - Synchronization
  - Self-stabilizing protocols
  - Replication
  - Fault tolerance
- Automated synthesis of services

An Open Experimental Platform for NEST

Active Damage Interrogation



Why Middleware for NEST?

- Service reuse across NEST applications
- Flexible framework
  - Can be customized to a particular NEST application/execution context
  - Can exist across various levels of scale
- Address NEST design forces through
  - Distribution of control
  - Resource management
  - Time synchronization protocols
  - Heterogeneous processing
  - Dynamic reconfiguration
  - Fault detection and recovery

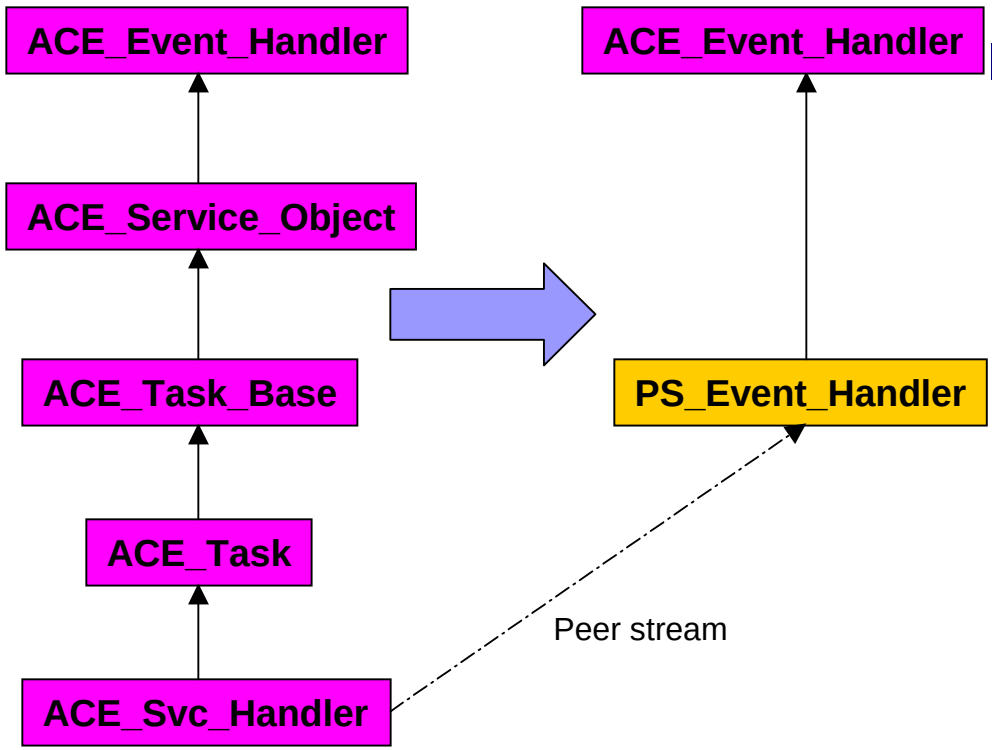
Yet Another Middleware?

- NO!!!
  - No single solution will work across use-cases
  - Need an open framework within which we can ***compose*** only the NEST services needed
  - Requires fine-grained ACE-level primitives
- CORBA based middleware is well proven
- Leverage ideas from small footprint ORBs
  - e-ORB, UBI-core, etc.
- Use design patterns
  - Capture solutions to design forces *in a context*
  - Guide generative composition of primitives

NEST middleware composition

- ACE/TAO
  - Pattern rich middleware frameworks
  - Capture some inherent structure of the NEST domain
- Bottom-up approach
  - Re-factor ACE classes for finer granularity
  - Composition of features across multiple use cases
- Top-down approach
  - Subset TAO to meet NEST requirements
  - Coarser-grained and larger-scale, may be automated
- Hybrid approach

Towards a Fine-Grained Substrate



- Decoupling concerns
  - Reactor
  - Acceptor
  - Connector
  - Event Handler
  - Svc Handler

Conclusions and Future work

- Minimal footprint IIOP ORB framework
  - Full CORBA compliance both *attainable* and *optional*
- Development underway using and extending
  - NEST design forces (guide what is needed)
  - TAO strategies (capture key solutions)
  - ACE primitives (provide a flexible substrate)
- Will leverage advanced techniques for subsetting and extension
  - Generic/Aspect-Oriented/Generative Programming
  - Automated custom generation that leverages the evolution of the baseline