

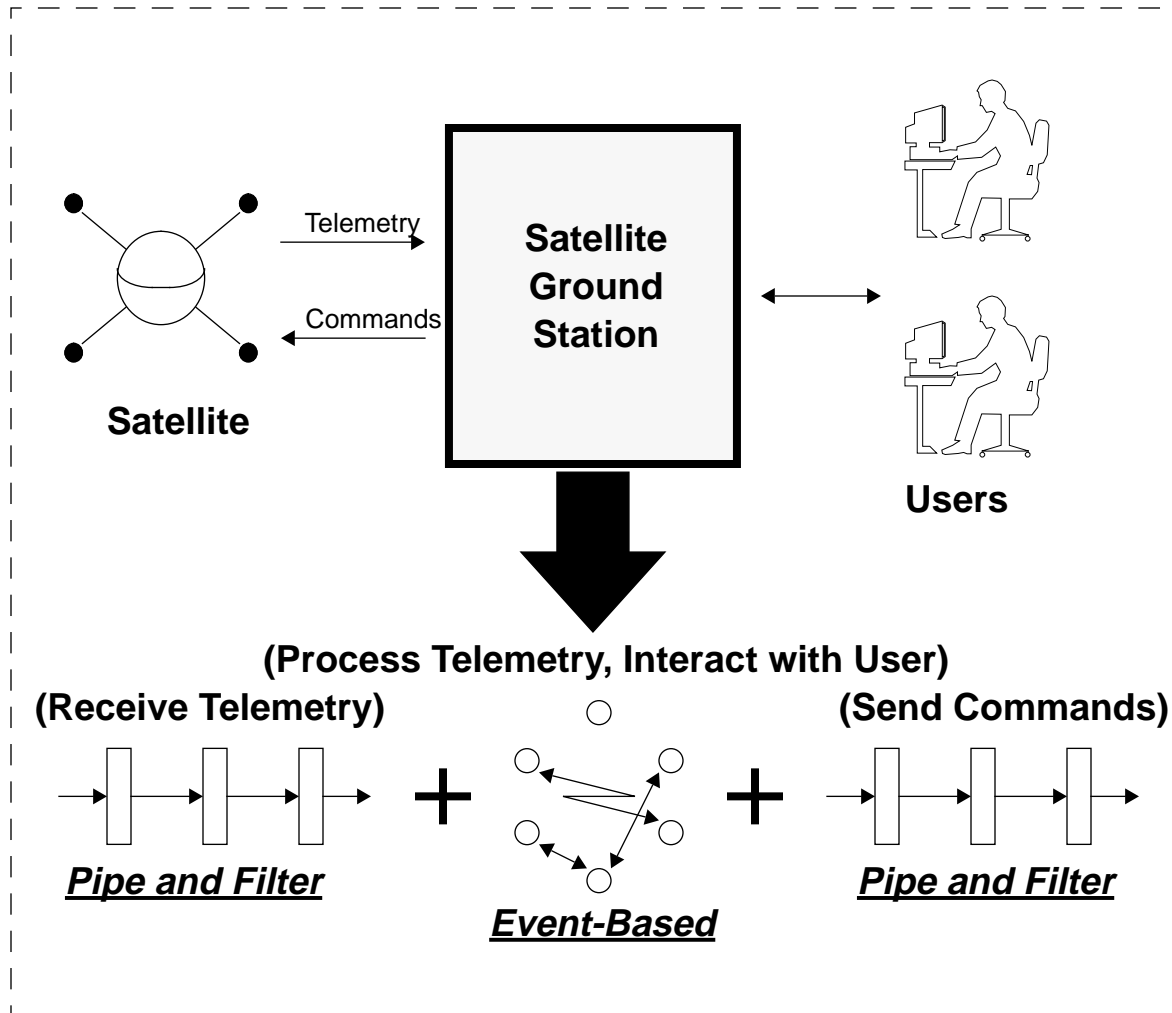
# Identifying Architectural Mismatches in Heterogeneous Architectures

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# A Heterogeneous Architecture

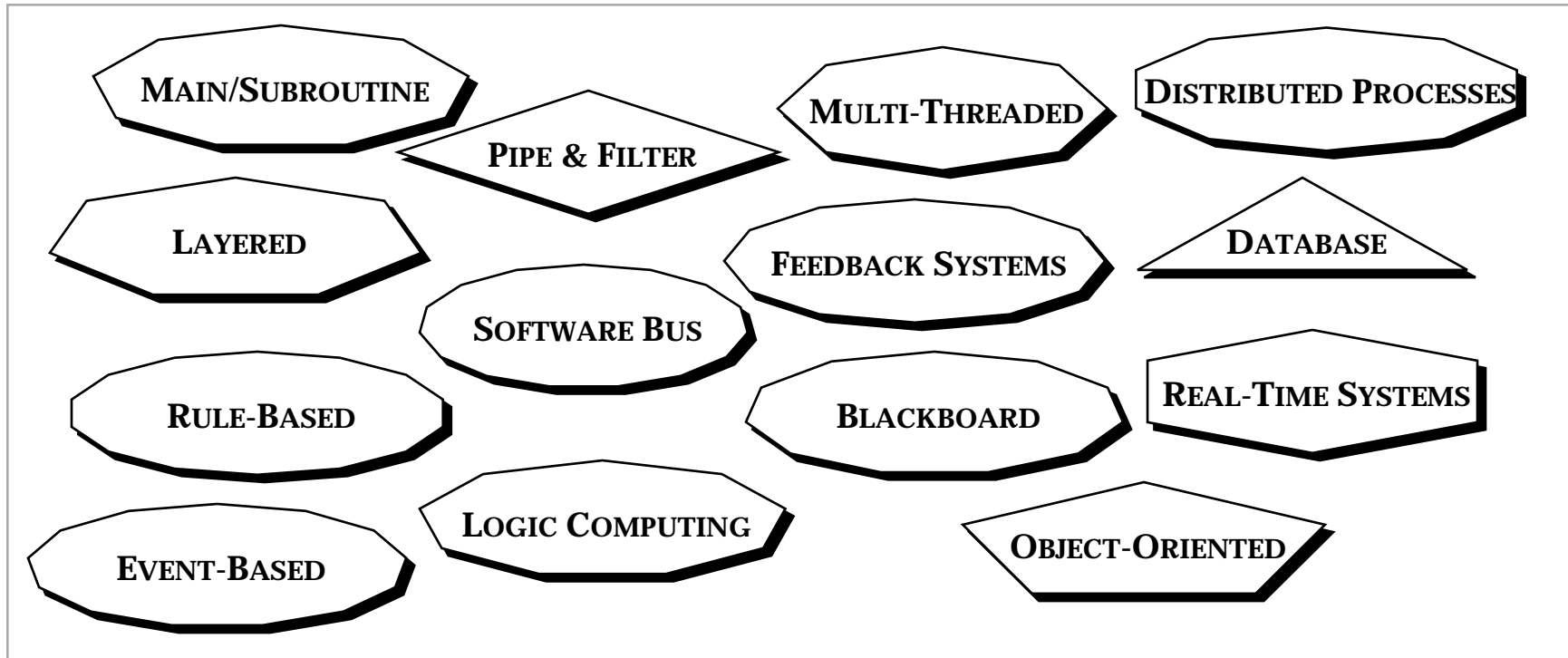


## **Architectural Mismatches:**

- 1. Processing subsystem expects events not streams of data**
- 2. Processing subsystem too slow for other subsystems**
- 3. Three subsystems expect different cpus**

## Example: Simplified Satellite Ground Station

# Heterogeneous = Uses Different Architectural Styles



Vendor	COTS* Package	Styles found in resulting COTS-based products
TRW	UNAS	event-based, distributed processes
Quintus	Prolog	rule-based, logic computing
HP	SoftBench	event-based
FI	OBST	object-oriented, database
AT&T	BaseWorX	software bus, event-based
Borland	Delphi	object-oriented, database, distributed processes

\* COTS = Commercial Off The Shelf

## Common Foundation of Styles

- **Base entities underly style-specific entities: port, data component, control component, object, data connector, control connector, trigger, system**
- **Recurring conceptual features form a space of styles**

Conceptual Feature	Choices
dynamicism of computations (supported control transfers)	static, dynamic (calls, spawns)
supported data transfers	implicit global data distributor, explicit data channels, shared variables
triggering capability	yes/no
concurrency of computations	single-threaded, multi-threaded
distribution	single node, multiple nodes
layering	layered (connector-specific), none
encapsulation	yes/no

## Instantiating a few styles, COTS in the space

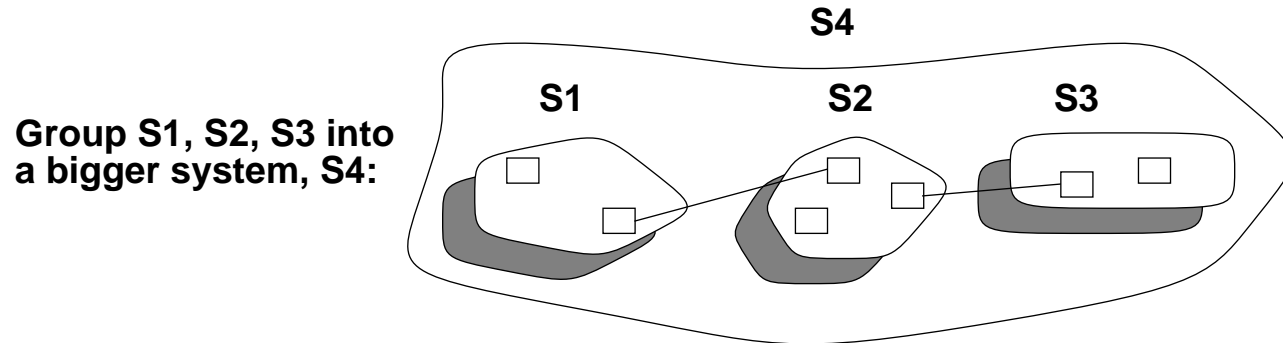
- **Pipes & Filters, Main/Subroutine, Distributed Processes, Event-Based, TRW's UNAS**

Conceptual Feature	Pipe/Filter	Main/Sub.	Dist. Proc.	Event-Based	UNAS
Dynamism	static	static	dynamic	static	static
Supported data transfers	explicit data connectors	shared data variables	explicit data connectors	implicit network, shared data variables	explicit data connectors
Triggering capability	no	no	no	yes	yes
Concurrency	multi-threaded	single-threaded	multi-threaded	unconstrained	multi-threaded
Distribution	unconstrained	single node	multiple nodes	unconstrained	multiple nodes
Layering	unconstrained	unconstrained	unconstrained	unconstrained	unconstrained
Encapsulation	no	no	no	yes	yes

- **Main benefits of conceptual features**
  - facilitate characterization of new styles
  - provide starting point for composition mismatches

## Identifying Architectural Mismatches

- **Use the common foundation to specify different subsystems in an application, and their composition**



- **Potential mismatches can be identified based on the specification. Examples:**
  - **two concurrent threads sharing data**
  - **a layering constraint is violated**
  - **a spawn is made into a system which is not dynamic**
- **Architect's Automated Assistant (AAA) automates this analysis**

## Using AAA in the Satellite Ground System Domain

- **Aerospace has drafted: “Reference Architecture for the Standard Satellite Control Segment of the Satellite Control Network”**
  - **Specifies a Common Core Telemetry, Tracking & Control (TT&C) System**
  - **Specification: dataflow, controlflow, interfaces, performance benchmarks, hardware mapping**
  - **Characterization in AAA’s conceptual features:**

<b>Dynamicism of computations</b>	<b>Telemetry front end: static; client back end: dynamic</b>
<b>Supported data transfers</b>	<b>Explicit data connectors, shared data repository</b>
<b>Triggering capability</b>	<b>None</b>
<b>Concurrency of computations</b>	<b>Multithreaded</b>
<b>Distribution</b>	<b>Distributed over more than one machine</b>
<b>Layering</b>	<b>None enforced</b>
<b>Encapsulation</b>	<b>Yes</b>

## Searching for Mismatches with the Core TT&C System

- **AAA can be used to search for architectural mismatches between**
  - **Aerospace reference architecture**
  - **Different satellite ground systems (SGS's) for different programs**
    - **GPS, SBIRS, MILSTAR, ...**
- **Process for using AAA:**
  - **specify the reference architecture core**
  - **specify the specific SGS**
  - **specify their composition**
- **Based on the specification, AAA produces a set of potential mismatches**
- **AAA available for SunOS 4.1.3, Motif**