An Open, Reconfigurable Computing Approach to Space Data Communications Processing

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Remote Sensing Ground Stations
Multi-mission Requirements

- **Satellite Access Service Providers**
  - Provide access to customer satellites as a standard service
  - Customer buys access time, bandwidth, or data “by-the-bit”
  - Store-and-forward and real-time WAN data routing
- **Customer-owned Multi-mission Ground Stations**
  - Access to remote sensing telemetry for multiple satellites
- **These systems must support:**
  - Varying data rates, to 300 Mbps+
  - Various telemetry protocols, including CCSDS and a variety of TDM protocols
  - Mission-specific data products
- **Mission requirements are not fixed a priori, and may in fact be unknown, as the mission set will grow over time**

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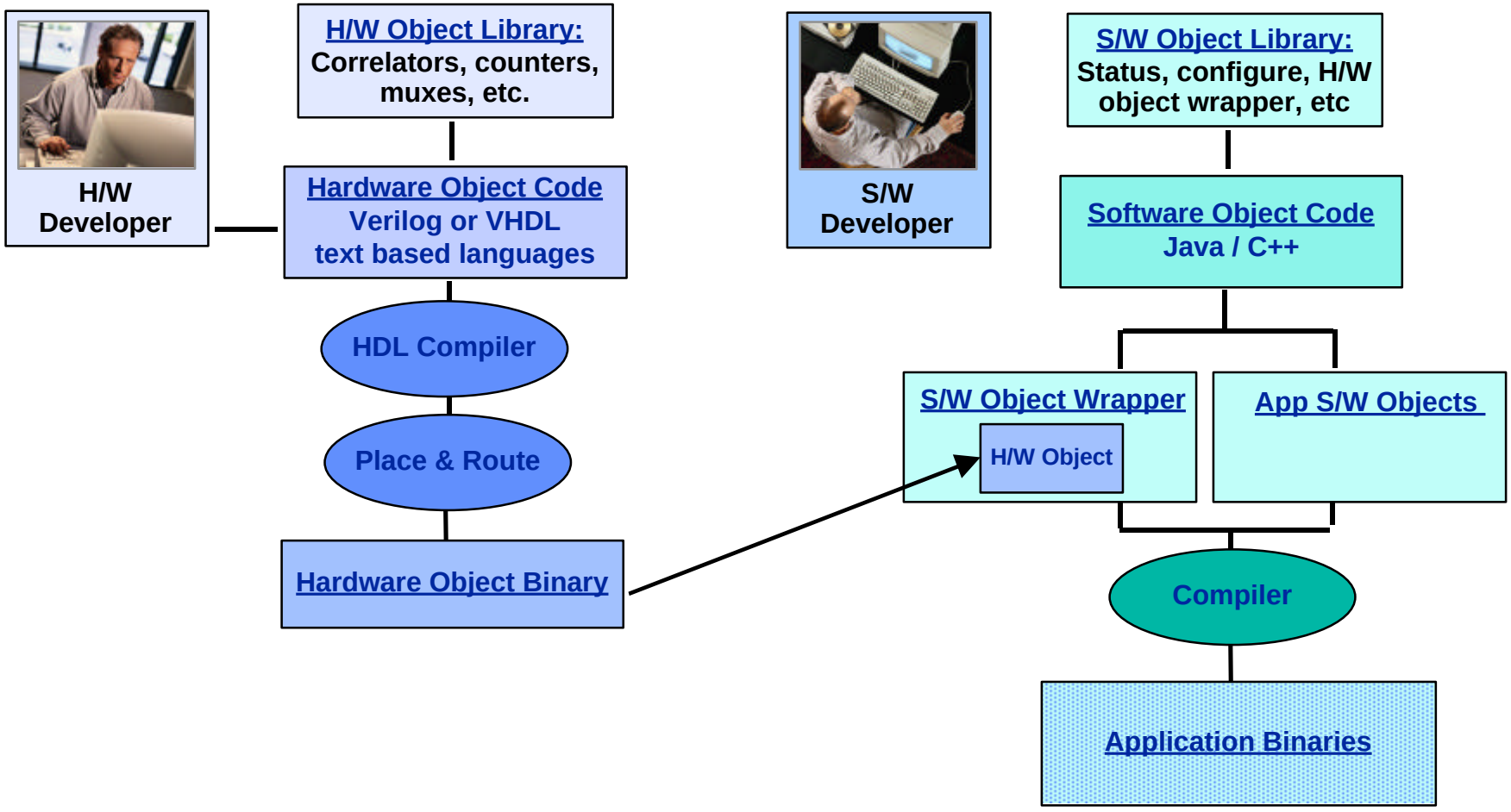
Telemetry Protocol Processing
Multi-mission Requirements

- **Programmable data acquisition**
  - Bit Synchronization, Frame synchronization
  - De-randomization
  - Forward error detection/correction - CRC, Reed-Solomon
  - Time stamping and Frame annotation
  - CCSDS “service processing”
- **Network data delivery**
  - Decommutation/Demultiplexing
  - Programmable routing
  - LAN/WAN data delivery
- **Programmable forward link and command link**
  - Command verification and closed-loop control (e.g. COP-1)
  - Secure throughput commanding service
- **Multi-protocol Simulation**

TSI TelSys' Approach
Reprogrammability + Reconfigurability

- **All TSI systems are reprogrammable**
  - Parameterized to allow broad support for multiple protocols
  - System operation is controlled by setup parameter values
- **All subsystems use a standard, run-time reconfigurable card product, the VIPcard™**
  - Subsystem functions are configured in run-time downloaded hardware logic
  - The VIPcard can be reconfigured an unlimited number of times
- **Reconfigurability yields hardware speeds with software flexibility**
  - Subsystems are high-performance, application-specific gate-level logic, but software programmed
  - Subsystems are seamlessly integrated as software elements
- **The same hardware performs many different functions**
  - Data acquisition, simulation, forward link, command link
  - Reduced sparing costs
  - Supports future growth in capabilities and changing requirements

Reconfigurable System Development



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Reconfigurable Run-Time Environment

- **Extends conventional operating systems for dynamic reconfigurable subsystems**
  - SUN Solaris™,SGI IRIX™
  - Windows NT™
  - VxWorks™
- **Allows reconfigurable subsystems to be integrated into an application as software components (e.g. Java objects)**
- **Binds reconfigurable subsystems to VIPcard processors and software on host microprocessor**
  - Reconfigurable object configuration & management
  - Reconfigurable & software inter-object communications
  - Application Programming Interface (API)

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Summary

- **Multi-mission support makes ground station requirements a moving target**
  - Mission requirements are not fixed a priori, and may in fact be unknown, as the mission set will grow over time
- **High performance requirements necessitate hardware solutions**
- **Reconfigurable technology provides a malleable, high-performance solution**
  - Application-specific hardware logic
  - Run-time programmable, under software control
  - Seamless integration into software environment