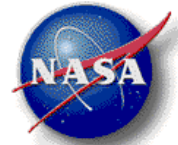




# CCT PROJECT SPOTLIGHT



## INTEROPERABILITY TECHNOLOGY

### Auto-Generated Semantic Processing Services

#### Semantic Processing

*“Deriving information from or encoding information into communication constructs (messages, packets, frames, streams, etc.) using a formal description (a common semantic) based on domain knowledge (the domain ontology)”*

#### Auto-Generated Semantic Processing (AGSP)

*“Using generative programming techniques to automatically generate custom/dedicated communications software solutions directly from high-level semantic models (XML metadata).”*

#### Key Concepts

Emphasize specification, minimize implementation

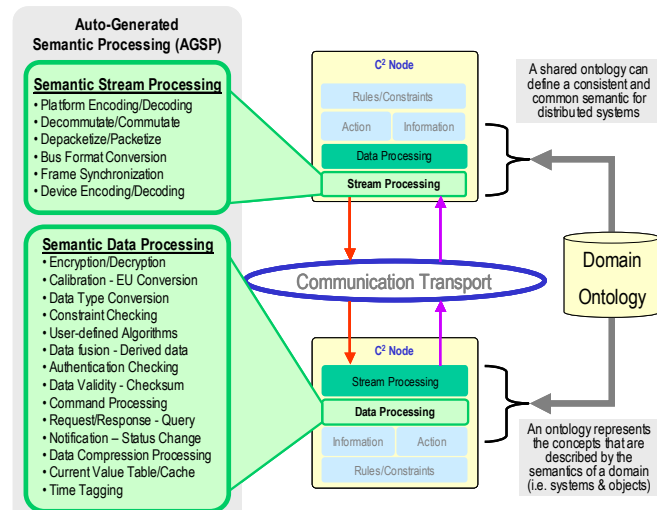
- Replace the design, implementation and debug of complex protocols, custom device mappings, and unique data manipulation algorithms with an XML metadata specification that maps to an abstract communications model
- Interpret XML metadata specifications that describe complex communication constructs

Ensure system interoperability and exchange of normalized information

- Provide device, platform, and protocol transparency to configure, generate and deploy multiple software communications services across multiple heterogeneous runtime environments
- Enable semantic integrity gateways that bridge legacy and future architectures

Widely distributed defense operations, a sustained space exploration effort, and emerging global business intelligence management require simultaneous operation of a network of systems that must be interoperable with a high degree of information integrity. Creation of these integrated networks demands new and innovative strategies for achieving interoperability that enhances mission effectiveness of future as well as legacy systems.

Interoperability depends on a transparent understanding of protocols, semantics, and knowledge across disparate systems. Under NASA sponsored research, Command and Control Technologies has developed methods for using formal enterprise ontologies to auto-generate cross-platform information processing software suitable for modular integration into any weapon, spacecraft, ground processing, or embedded C<sup>2</sup> system. The resulting technology significantly reduces development and recurring costs for legacy and future C<sup>2</sup> systems that encode, decode, and process information; and will enhance interoperability by assuring data integrity and consistent interpretation of meaning between collaborating systems.



Common Ontology for Stream and Data Semantic Processing

#### Approach

The AGSP technology is a crosscutting domain software capability for mapping C<sup>2</sup> knowledge (protocols, messages, algorithms, sensors, stimuli, behaviors, etc) into software technologies (requirements, models, classes, objects, processes, etc.) using a formal metadata specification and auto-generation methods. The auto-generation method is implemented in con-

junction with a Product Line strategy to enable large-scale software reuse.

Because interoperating systems share a common ontology that can be defined using a rigorous metadata specification based on XML Schema (such as the CCSDS XTCE standard), it is feasible to auto-generate stream and data semantic processing services directly from XML descriptions. The auto-generator produces modular code that can be statically or dynamically integrated into C<sup>2</sup> mission application software (i.e. as software libraries).

The necessary information processing services (application specific products and/or components) are built from a base of common assets created through domain engineering. Domain engineering and application engineering serve as complementary, interacting, parallel development processes that comprise a model-based, reuse-oriented software production system that produces stream, protocol, and semantic services.

**Example Applications**

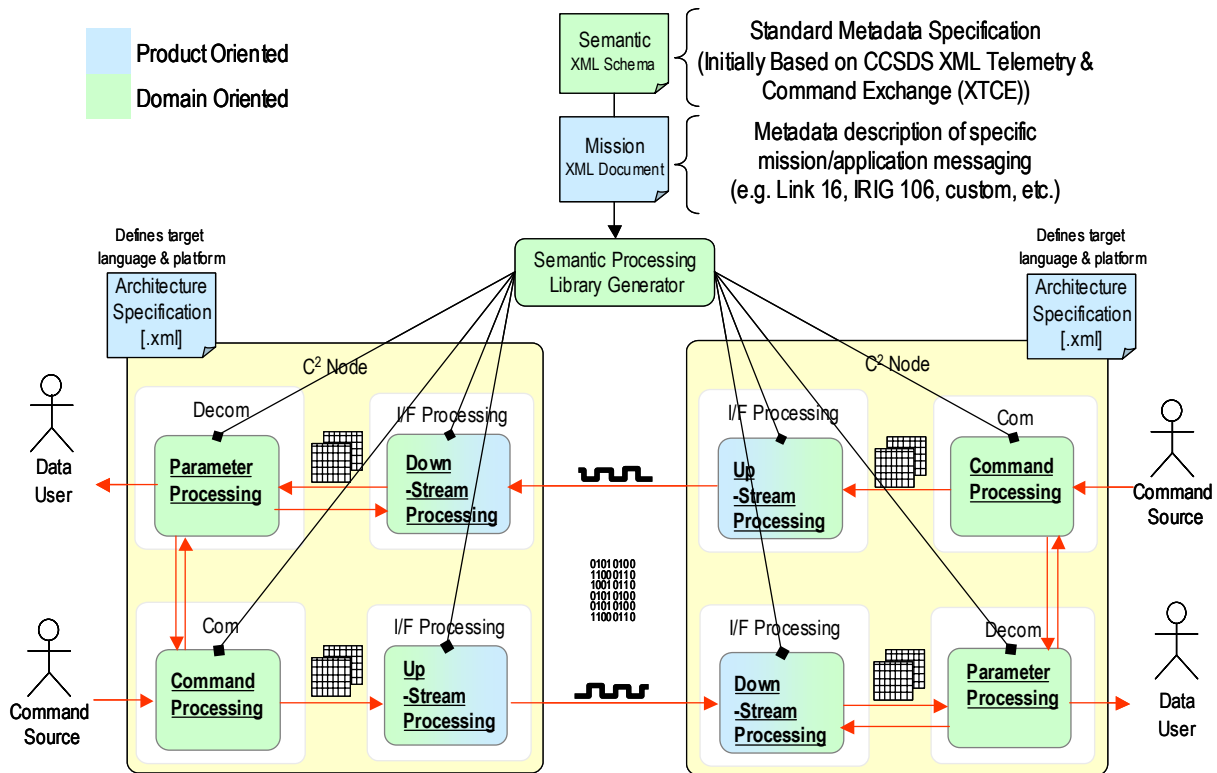
- Parse and build messages sent between heterogeneous systems
  - Perform device and platform specific data translations

- Commutate and decommutate data values located anywhere in a stream of bits
- Operate on a synchronous bit stream or asynchronous packets
- Perform linearization on raw measurements
- Build commands or messages and check them against prerequisites
- Synthesize and fuse data with equations or algorithms
- Validate conditions and report alarms and events
  - Constraint violations
  - Change notification

Some of the major benefits of the AGSP technology:

- Enables interoperability and enforces a common semantic between systems
- Reduces or eliminates custom software required to create new or adapt legacy systems
- Produces very compact and efficient software for real-time and embedded systems
- Modular library-based design integrates well with any system architecture
- Generation improves software quality by ensuring consistency and large-scale reuse

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AGSP Deployment Concept – System Architecture Agnostic