



Open Plug-N-Play Modular Architecture for Signal Processing, Tracking, and Exploitation Research (MASTER)

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Focus of MASTER Case Study on Developing a Framework for a Sensor Exploitation Testbed



- Open and extensible architecture
- The relationship of an architecture and the Agile development methodology
- How an architecture enables multi-mission data processing
- Leveraging existing sensor exploitation
- Evolution through re-factored code
- Move towards community standards

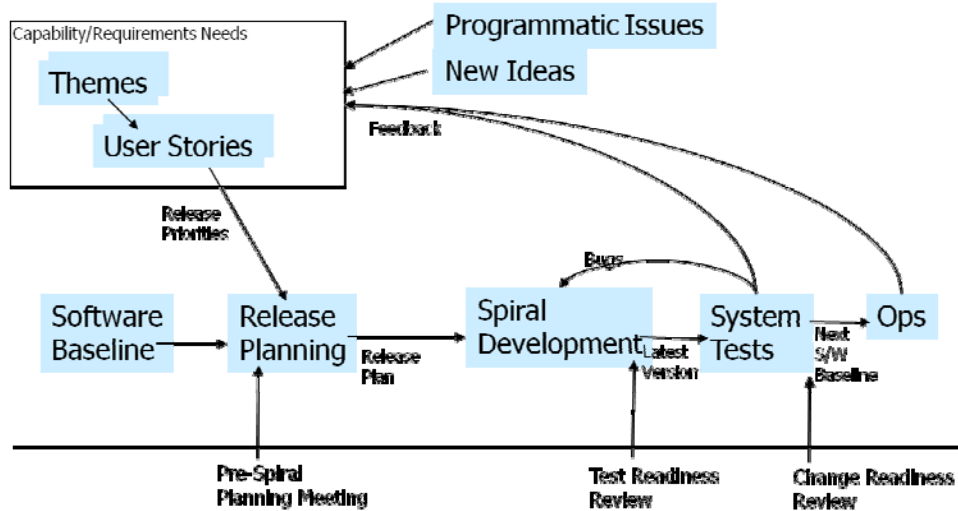
SMC/XRF built a Joint Architecture for More Unified Operations Through Community Interaction



- Managing Multiple Stakeholders with proven Agile process
 - Capability driven specifically designed to be responsive within fixed budgets
 - Emphasizes the need for ongoing iterative development with completed, demonstrable functionality
 - Periodic and frequent stakeholder interaction/involvement
- Utilizing Cross-program synergy “Enterprise Approach”
 - Cross-project opportunities, leveraging across multiple DOD programs
 - Look for the best of the best (BoB) algorithm-software-hardware
- Experiencing broad OPIR Community Involvement
 - Aerospace Corporation, Space Dynamics Laboratory, AF Research Labs, MITRE, Sandia National Labs, and Aerospace Fusion Center
 - Multiple Industry Non-disclosure agreements used throughout development

Proven Agile business process provides responsive solutions to War-fighter needs within cost and schedule constraints

Agile Development Process and Modular Architecture Evolves System in a User Environment

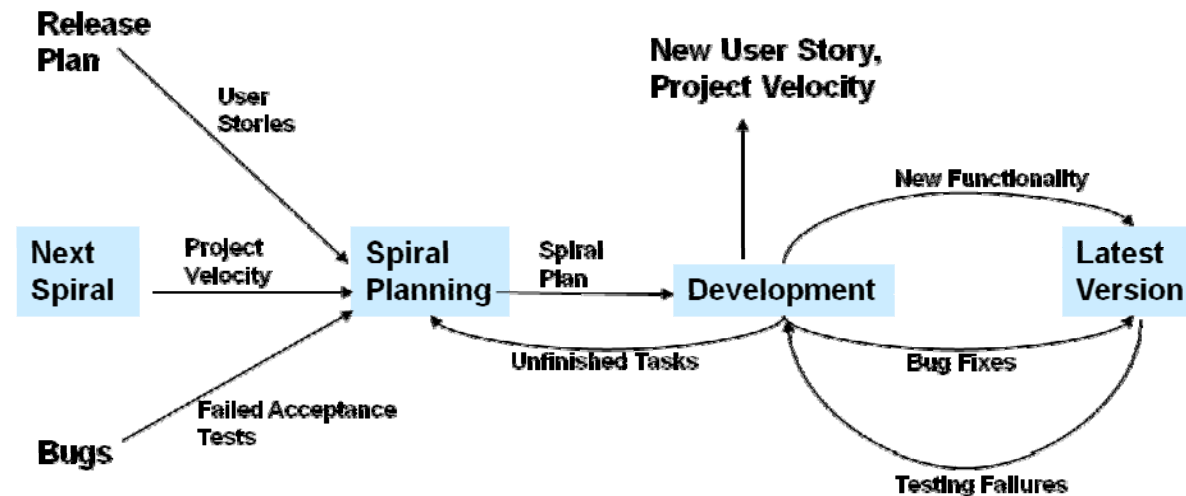


Agile Process



Government Coordination

Spiral Development



A Key is to Have a Real User Involved in Development

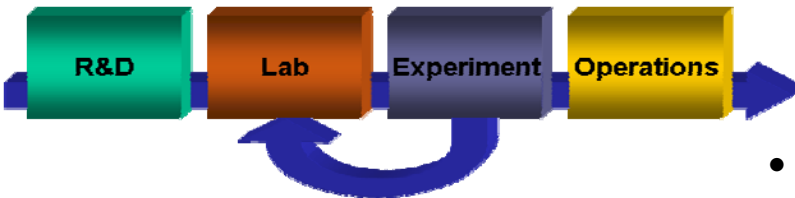
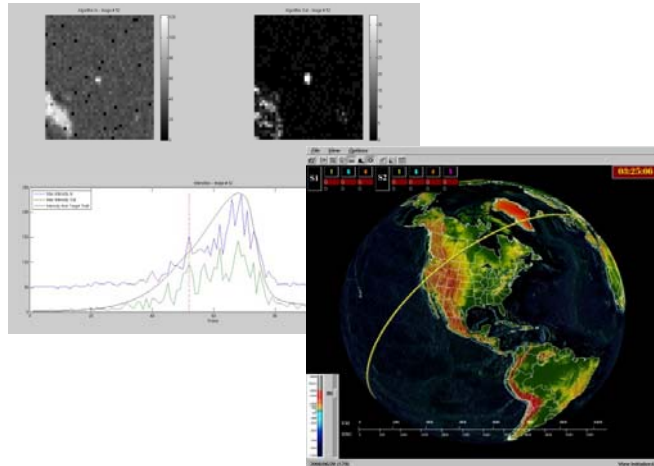
System Development Overview



- Coding for the Algorithm Development Lab (ADL) Started January 2008
 - Algorithm development, refinement and characterization
 - Delivered ADL Oct 2008 within 4 software spirals
 - Start to major milestone in 7 months
 - ADL Ribbon Cutting on 29 May 2009
- Initial Engineer Ops Baseline delivered January 2010
 - Performing ground signal and mission data processing to support R&D sensor demonstration
 - Leveraged existing mission processing and client visualization suite tools

**Initial Mission Processing for R&D sensor delivered
To Engineering Ops within 24 Months of Design Start**

Modular Architecture for Signal/Mission-Processing Tracking and Exploitation Research (MASTER)

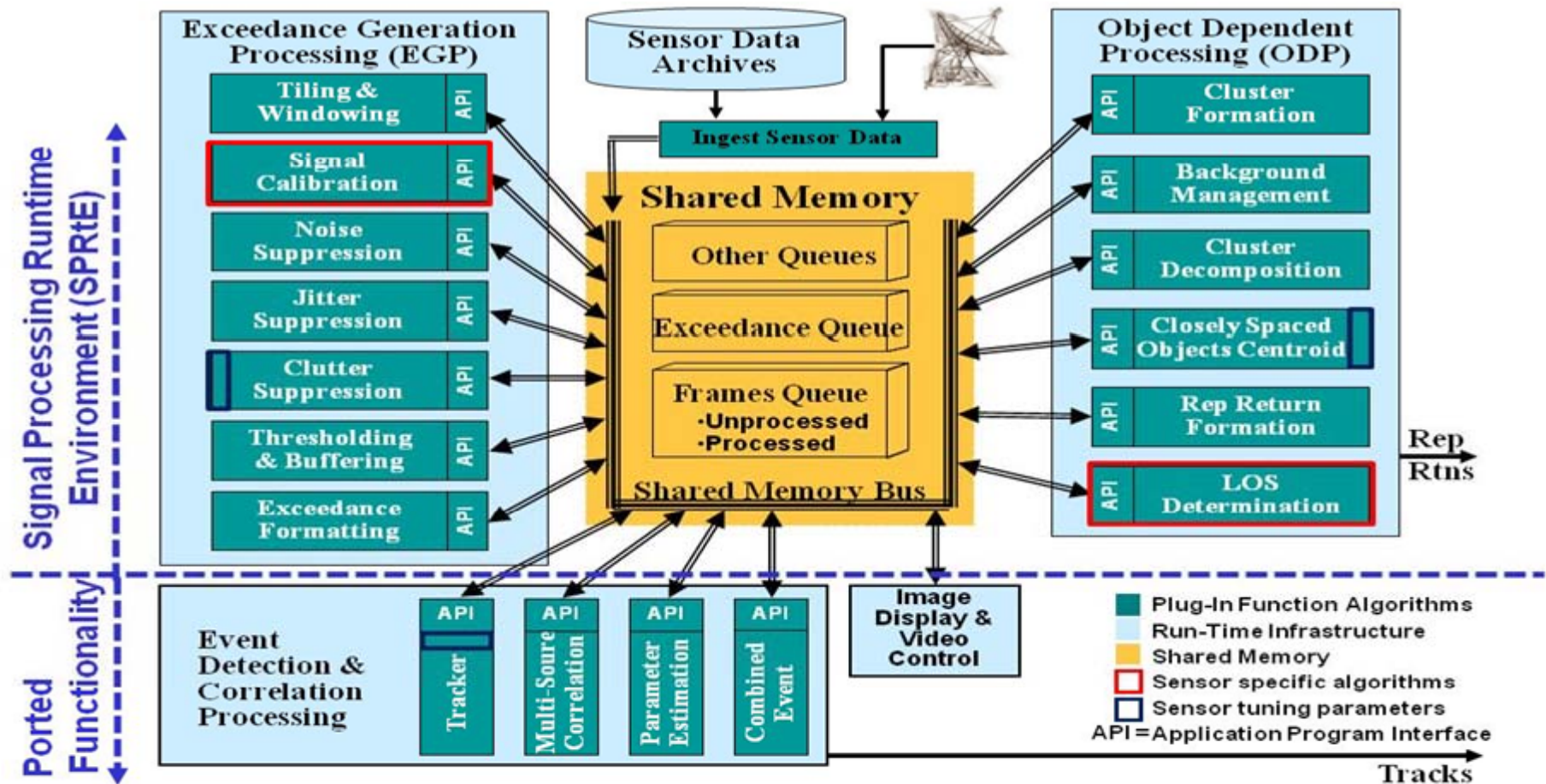


From R&D to operations – continual support of risk reduction & enhanced capabilities

- **Advanced Open System Architecture**
 - Flexible 64 bit Linux OS, Platform Independent
 - Parallel Algorithm processing
 - API-driven plug & play facilitates 3rd Party
 - Unified Design Standards (UML & MOSA)
- **Mature Algorithmic Processing Suite**
 - ~50+ algorithmic plug-ins
 - Extensive Set of Analysis Tools
 - Leveraged existing active DOD program assets
 - OPIR Community Involvement
- **Sensor Agnostic Processing**
 - Multiple data sources – Chamber, Sims & Live
 - Sensors currently in Ops & other R&D sensors
 - XML/HDF5 data format for Web Services
 - SOA Services as Needed, Enterprise Ready

**MASTER Provides a Collaborative OPIR Enterprise
With Advanced Multi-Source Exploitation**

MASTER Architecture has Mature Algorithm Processing Suite



Developed an Open Architecture that provides users Sensor Agnostic Ground Processing

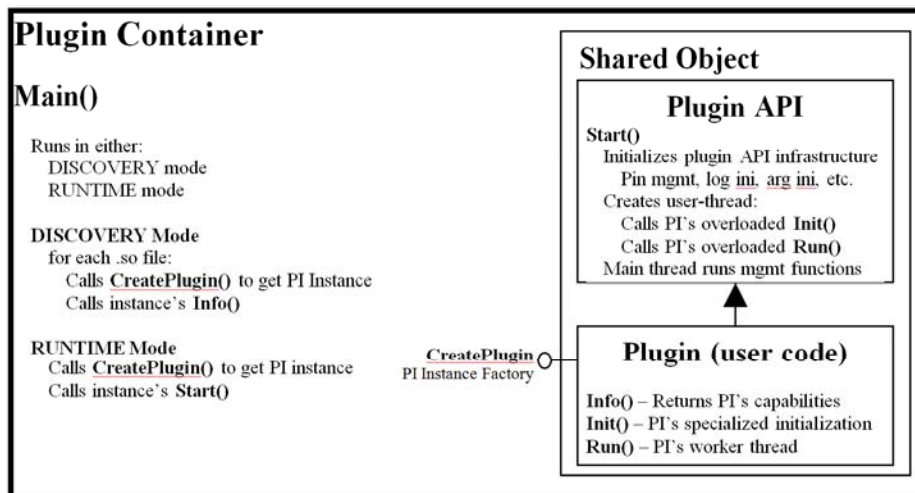
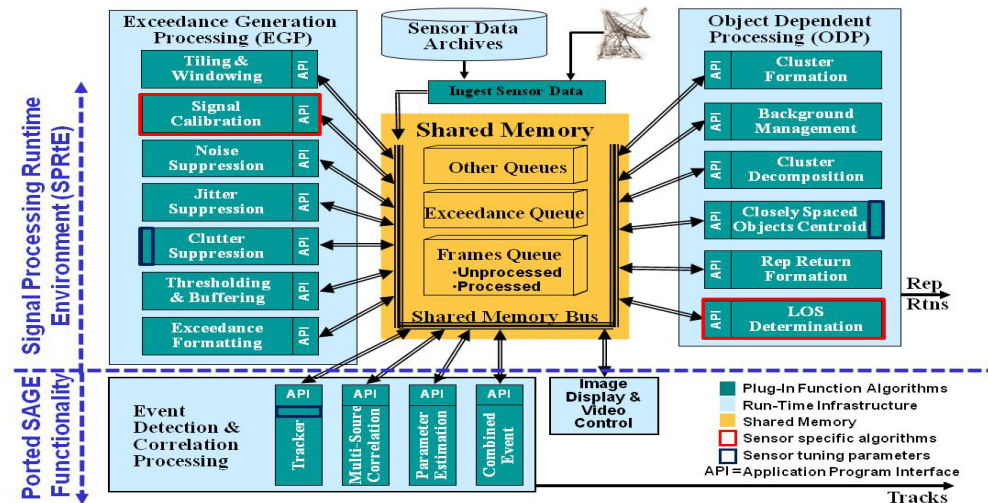
- Quickly adaptable to new sensors, missions and alternative algorithms
- ~150+ plug-ins exist today

What Is MASTER/SPRTE Architecture?

✓ Frontend/Signal Processing Plug-ins:

- ✓ Comply with “SPRiTE” API
- ✓ Common Startup & Shutdown
- ✓ Common Argument & Logging Servers
- ✓ Common Queue configuration and access methods
- ✓ Allows for algorithm alternatives
- ✓ Each configuration recorded in XML
- ✓ Plug-in’s auto restart capability at runtime

✓ Implemented in 64 bit Red Hat Linux

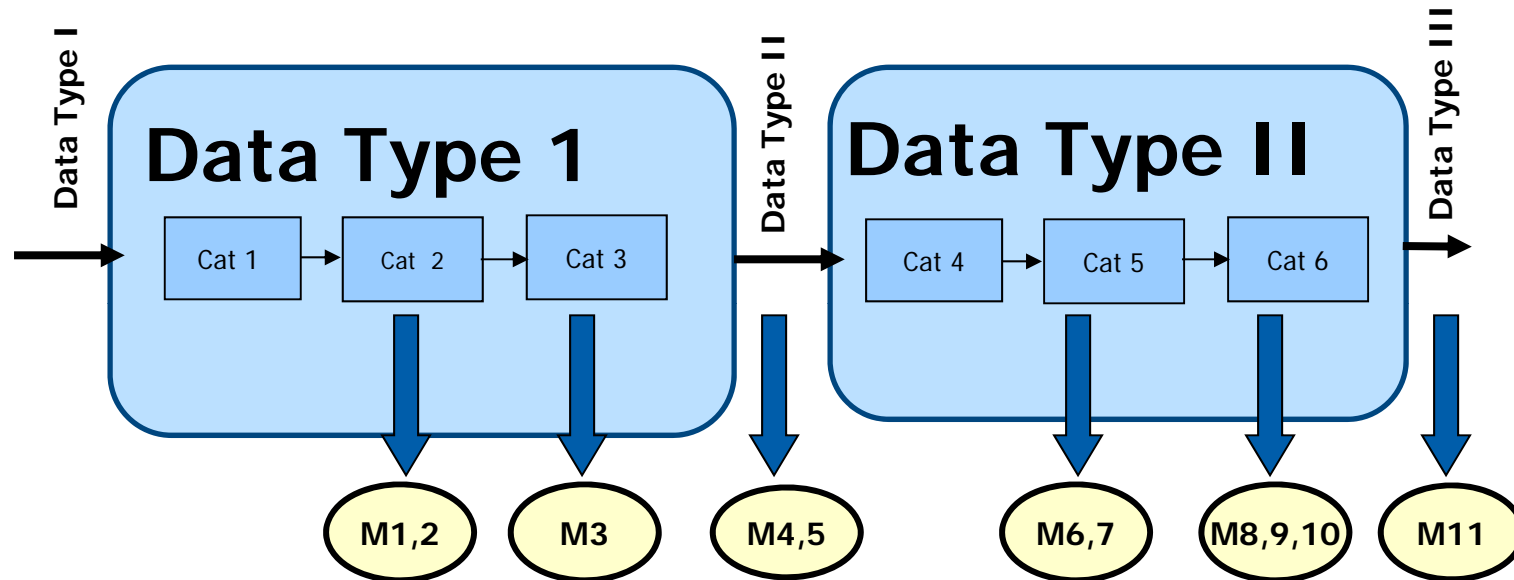


✓ Leveraged Existing Components

- ✓ Missile Tracker Suite Plug-inized
- ✓ Multi Source Correlator (MSC) plug-inized
- ✓ Tactical Parameter Estimator (TPE) plug-inized
- ✓ Plug-ins comparable with Executable versions

Delivered SDK, including API and test-harness, enables 3rd-party development of algorithms

Analysis Portal Tools Automate Quick Algorithm Evaluation and Provide for Auto-Regression

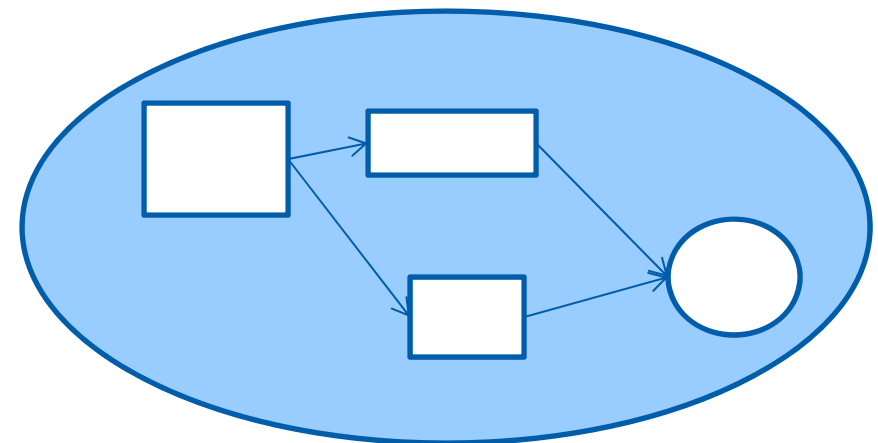


- Inspired by statistical process control
- Provides standardized performance metrics

Multiple Parallel Algorithm Architecture Using Split and Merge Functionality



- Can create parallel processing chains, each customized
- Methodology to spatially partition moveable windows
- Supports subsequent plug-ins
- Merger plug-ins, with rule-sets

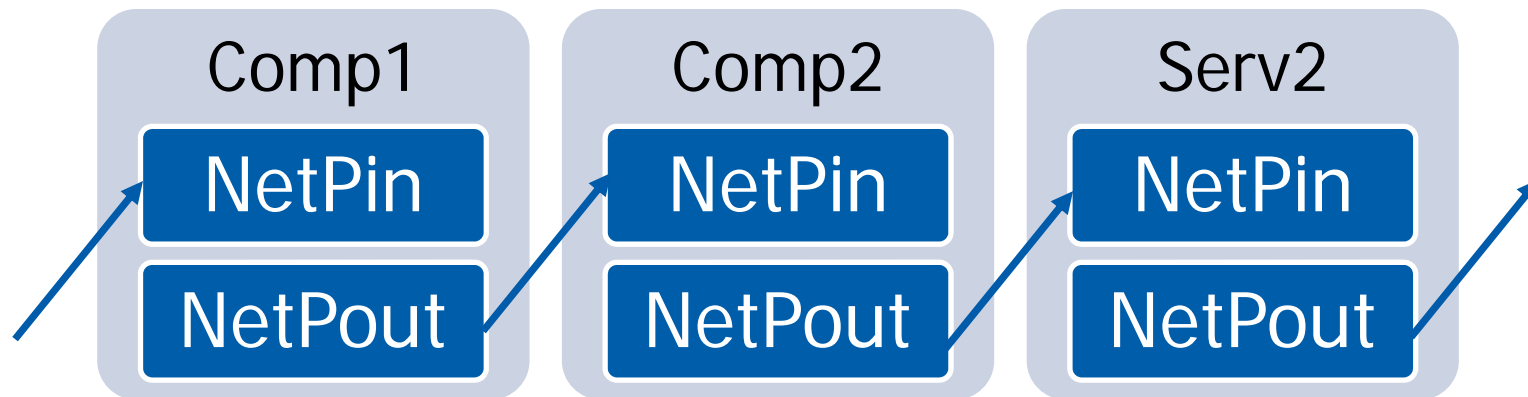


Architecture Supports Parallel Processing Data
to Exploit Optimum Target Extraction

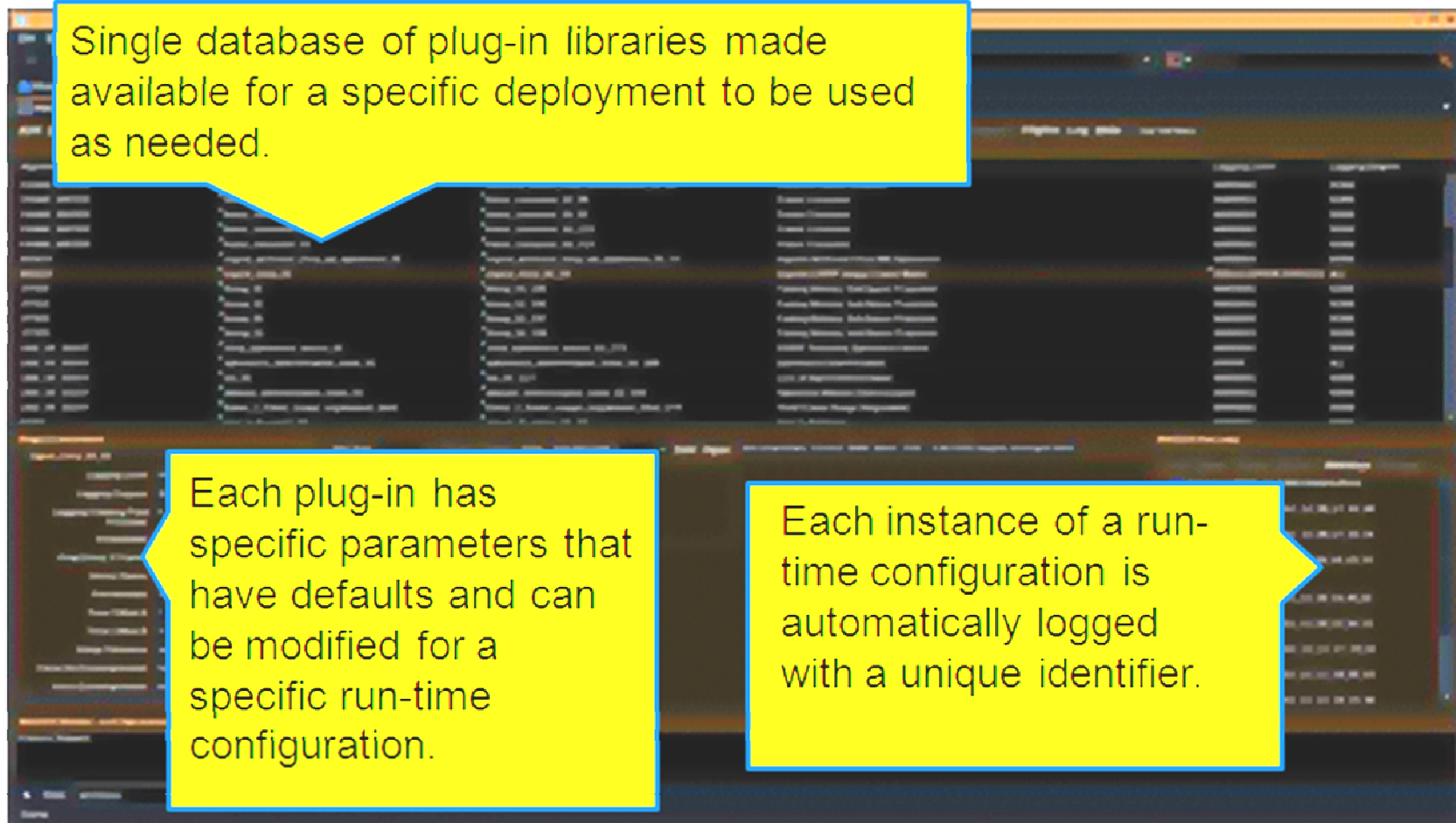
MASTER/SPRTE Provides Flexibility to Span Processing Across Distributed Machines



- Network plug-in type provides input and output interface to other machines
- Flexibility allows scaling same processing chain onto different hardware environments
 - Maximize utility of legacy hardware
 - Flexibility to optimize processing across servers



Architecture Provides for Easy Configuration Management



Having Completely Specified Configuration is Key to Rapid Integration and Test

An Open Architecture Delivers Multiple Benefits



Collaboration and efficient responsiveness to changing mission and geopolitical needs

- **Low Risk Evolutionary path, Tech Readiness Assessment**
 - Development → Engineering Ops → Real-time Data Services → Military OPS
- **High TRL, Flexible and Scalable Enterprise Solutions**
 - Processing Multiple data sources (on-orbit, chamber or simulated)
- **API-driven plug & play architecture facilitates:**
 - Sensor Agnostic data processing and exploitation
 - 3rd party development and Fly-off of alternative algorithms
 - Ability to effectively react to sensor/mission changes
- **Open COTS H/W and S/W**
 - Helps contain long-term O&M cost
 - Modern COTS software with 64-bit architecture removes key growth constraints



Government Investment has produced a non-proprietary, flexible architecture to process Multi-Source, Multi-Int data

Plans desired for MASTER

- Add system entry points for existing and emerging data interface standards
- Add other 3rd party plug-ins
- Standard data sets
- Pluginize legacy systems
- Interface to other existing systems



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