Abstract

- The US DoD has invested significant funding to date in the development of standards-based Software Defined Radios. While this investment has proven the feasibility of building such radios, the development approach taken by the defense industry has resulted in handcrafted SDR solutions that are costly to develop and maintain, difficult to optimize across a family of radios with varying form factors and intolerant of changes to the underlying standards. As a result, a COTS SDR industry is emerging to address these issues by delivering small, reusable SDR operating environments suitable for deployment across a wide range of form factors and radio device technologies and by delivering SDR tools that boost developer productivity, readily incorporate modifications to the underlying standards, and increase quality of delivered systems. A COTS SDR approach is the key to ultimately lowering the cost of fielding robust SDRs. This presentation will illustrate how PrismTech's COTS SDR solution is delivering on this promise today.

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Transitioning to COTS-Based SDR Solutions

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PrismTech Snapshot

- **Productivity tools and middleware enabling mission-critical and operations support systems**
  - CORBA, RT CORBA, RTE CORBA
  - SDR/SCA
  - DDS
  - Security/Domain Boundary Control
- **Support of open standards, hardware and OS independent**
  - **OMG**
  - **SDR Forum**
  - **IEEE**

SPECTRA TOOLS

OpenFusion®

Xtradyne

OpenSplice™

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Productivity Tools & Middleware Products

Spectra SDR

Tools & middleware for military & commercial Software Defined Radio

- Spectra SE Modelling Tool
- Spectra Code Generators
- Spectra Unit Test Framework
- Spectra Operating Environment

OpenFusion CORBA

The most complete CORBA products solution available for real-time embedded & enterprise applications

- Enterprise ORBs
- Realtime & Embedded ORBs
- CORBA Services
- Safety Critical CORBA
- CORBA Tools

Xtradyne Security

Out-of-the-box security infrastructure solutions for web services / SOAP / CORBA / Java / IIOP

- Xtradyne IIOP DBC
- Xtradyne Web Services DBC
- Xtradyne Node Protect
- Xtradyne Security Policy Server

OpenSplice

Data distribution service, delivering the right information to the right place at the right time.

- OpenSpliceDDS Core Modules
- OpenSpliceDDS Persistence & Content Subscription Profiles
- OpenSpliceDDS Data Local Reconstruction Layer
- OpenSpliceDDS Tools

Fortune ‘Global 500’ Customer Base

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Agenda

- Introduction
- Characteristics of First Generation SDRs
- The Need for COTS SDR Solutions
- PrismTech's Spectra SDR Solution
- Summary

In the beginning…

- Domain expertise was acquired by SDR developers in the complex middleware software technologies required to implement SCA-compliant waveforms and platforms
  - SCA, CORBA, XML, C++, RTOS
- SCA applications were handcrafted by SDR developers
- Core Frameworks were implemented by many of the SDR manufacturers
- SDR operating environments were cobbled together by integrating middleware and RTOS's from multiple vendors
- SDR standards were applied only to GPPs, custom proprietary solutions used for DSPs and FPGAs
- Initial target platforms were not significantly SWaP-constrained

The results…

- Radio and waveform manufacturers have been immersed in complex middleware software technology although their competitive advantage and value-add is their radio domain expertise
- Feasibility of building standards-based (SCA) SDRs was proven, but there is little consistency in delivered software artifacts
- Radio manufacturers are burdened with the maintenance of the SDR operating environment in addition to the waveforms and applications running on the radio
- Portability is improving for GPP-based waveform components, but remains limited for DSP and FPGA-based components
- First generation OEs are finding it difficult to meet SWaP requirements of small form factor radios

What's needed…

- Standards that provide common SDR architectures
  - SCA
  - OMG SW Radio Spec
- 2nd Generation Operating Environments that are:
  - Compliant with the required standards (SCA, SW Radio Spec, etc.)
  - Commercially developed, maintained and supported (COTS)
  - Architected to support all SDR processor technologies (GPP, DSP, FPGA)
  - Scalable across a broad range of platform types and sizes
- SDR Development Tools that:
  - Enable radio developers to design in the radio domain in a platform-independent fashion (PIM)
  - Enforce the required standards
  - Leverage the knowledge of industry experts and best practices
  - Generate the required artifacts to implement, build, deploy and test waveforms and applications on target platforms (PSM)

Which will result in…

- Lower SDR development and maintenance cost
- Faster time to market
- Improved quality of delivered systems
- Increased ability to keep pace with and take advantage of evolving standards
- Renewed focus on radio functionality

PrismTech's Spectra SDR Solution

- SDR Expertise
  - Recognized industry experts in standards-based SDR
- SDR Development Tools
  - Domain-specific model driven development tools for development and test of waveforms and platforms
- SDR Operating Environment
  - Small footprint, integrated, optimized, high-performance operating environment deployable across GPP, DSP and FPGA processors

SDR Expertise, Tools & Platform from a single vendor:

PrismTech Spectra

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PrismTech's SDR/SCA & Middleware Domain Expertise

- Original S/W architects and authors of SCA
  - Dominick Paniscotti, Jerry Bickle
- Leaders in commercial standardization
  - Founders of OMG's SBC Domain Task Force, SDR Forum members
- Middleware visionaries and experts
  - Doug Schmidt, Bruce Trask
- Designers and implementers of several Core Frameworks currently in use in DoD JTRS systems
- Designers and implementers of several SCA-based waveforms
- Involved in the development of many JTRS/SCA-Based Programs
  - Step 1, Step2a, Step2c, Cluster 1, Cluster2, AMF, Cluster 5, MIDSJTRS, AJCN, JSF, WIN-T, FCS
- Prototyped and field tested JTRS radios

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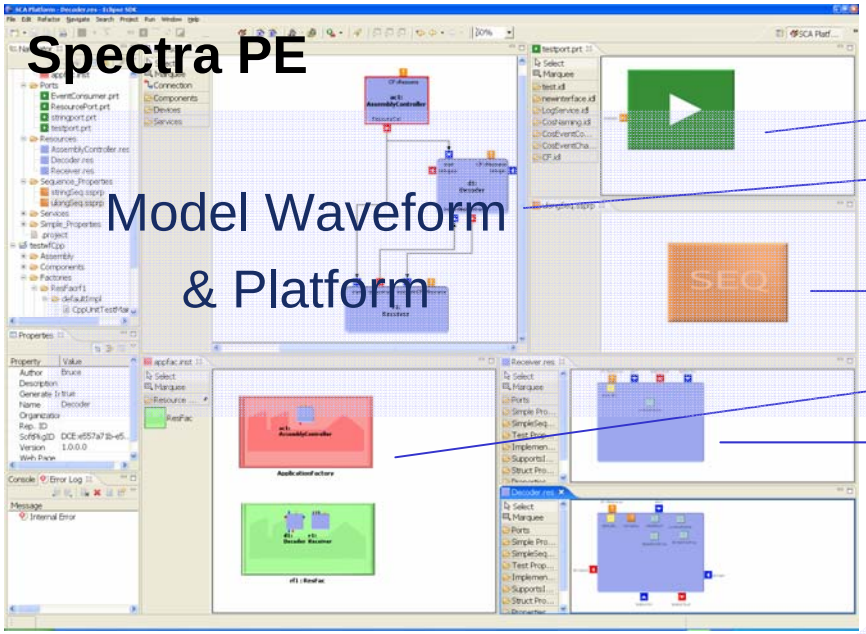
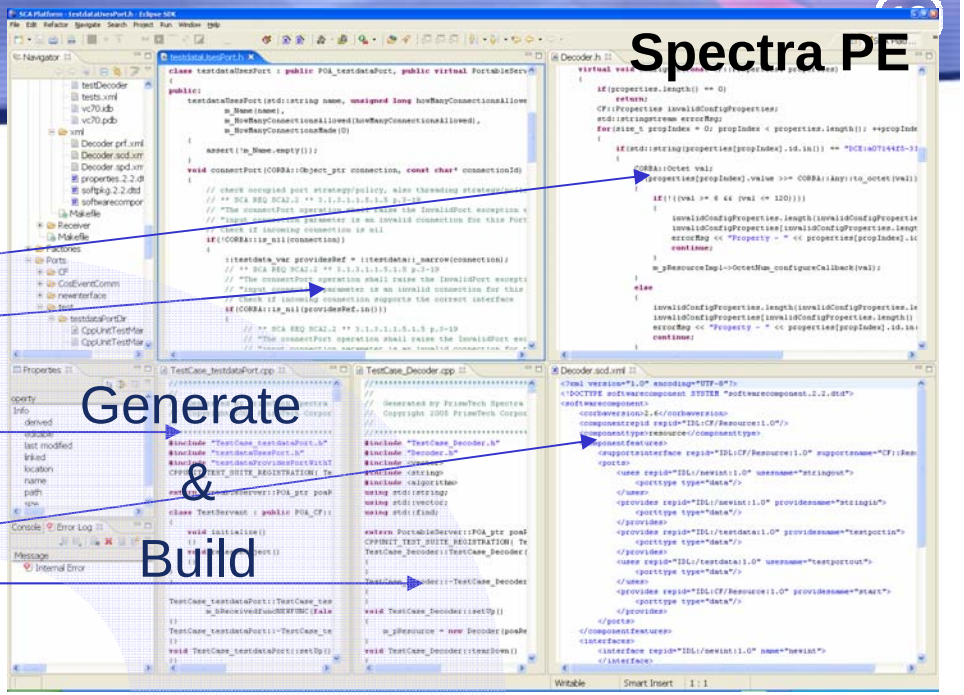
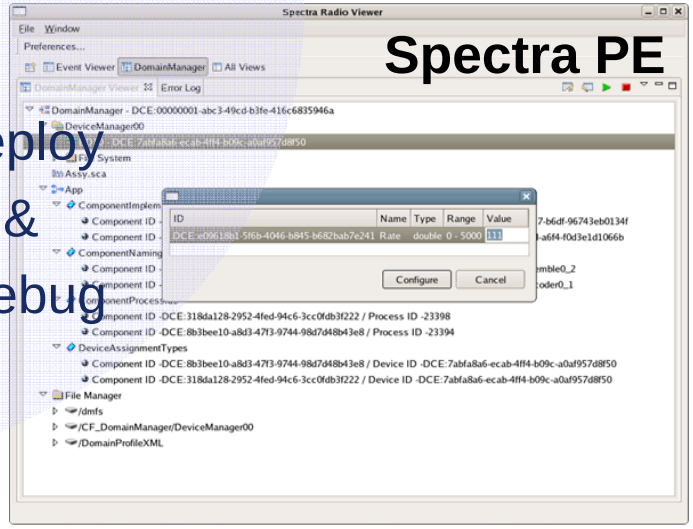
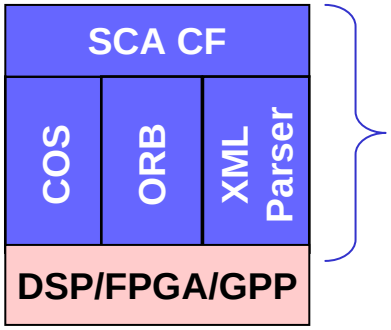
Spectra SDR COTS SDR Development Environment







Spectra OE



Total OE Footprint < 1MB!

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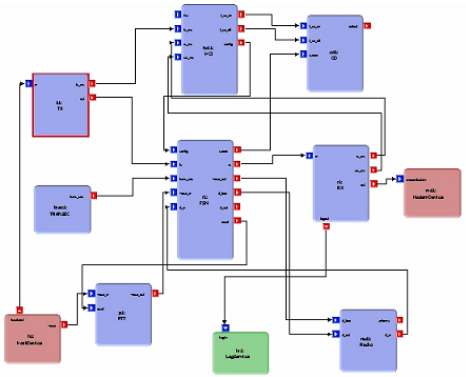
Spectra: Model Transformation

Standards
(SCA, SW Radio Spec, etc.)

Expertise
& Best Practices

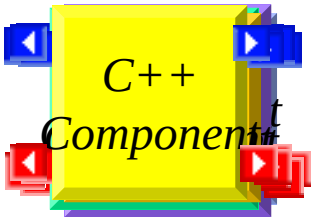


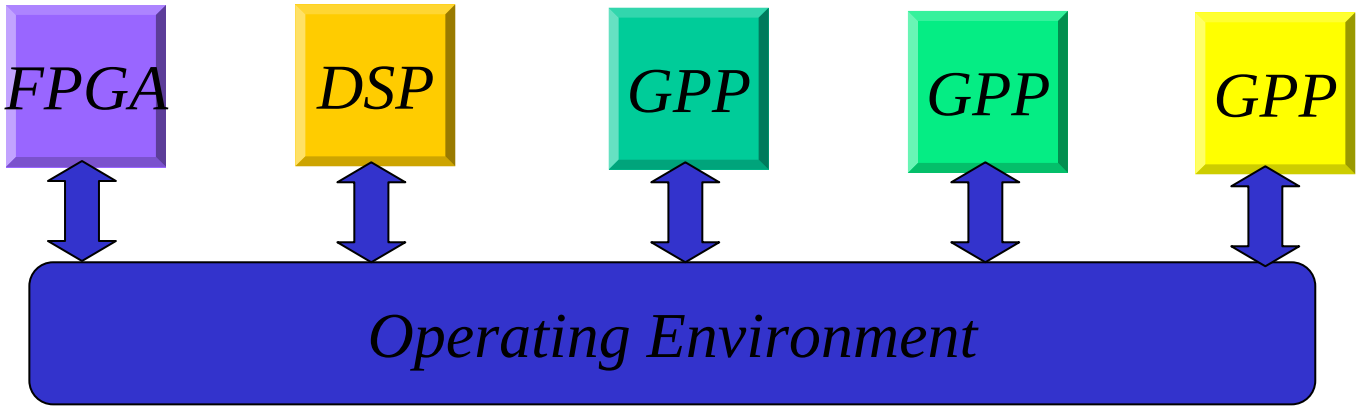

Design Patterns



Model Transformation

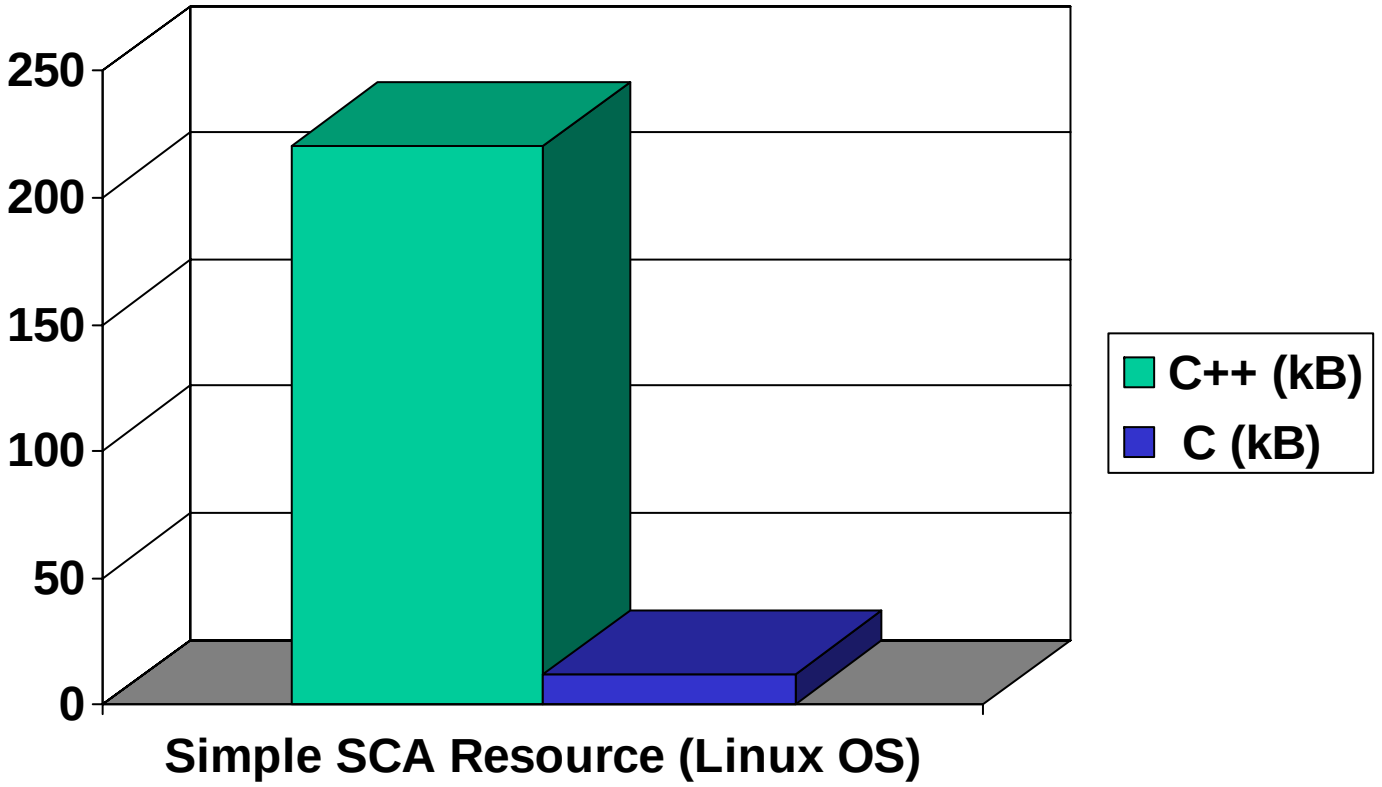
Spectra: Component Code Generation





SCA Component Size Comparison: C vs C++

- Comparison of SCA components using C and C++ code generators



Approx 20x reduction in memory size!

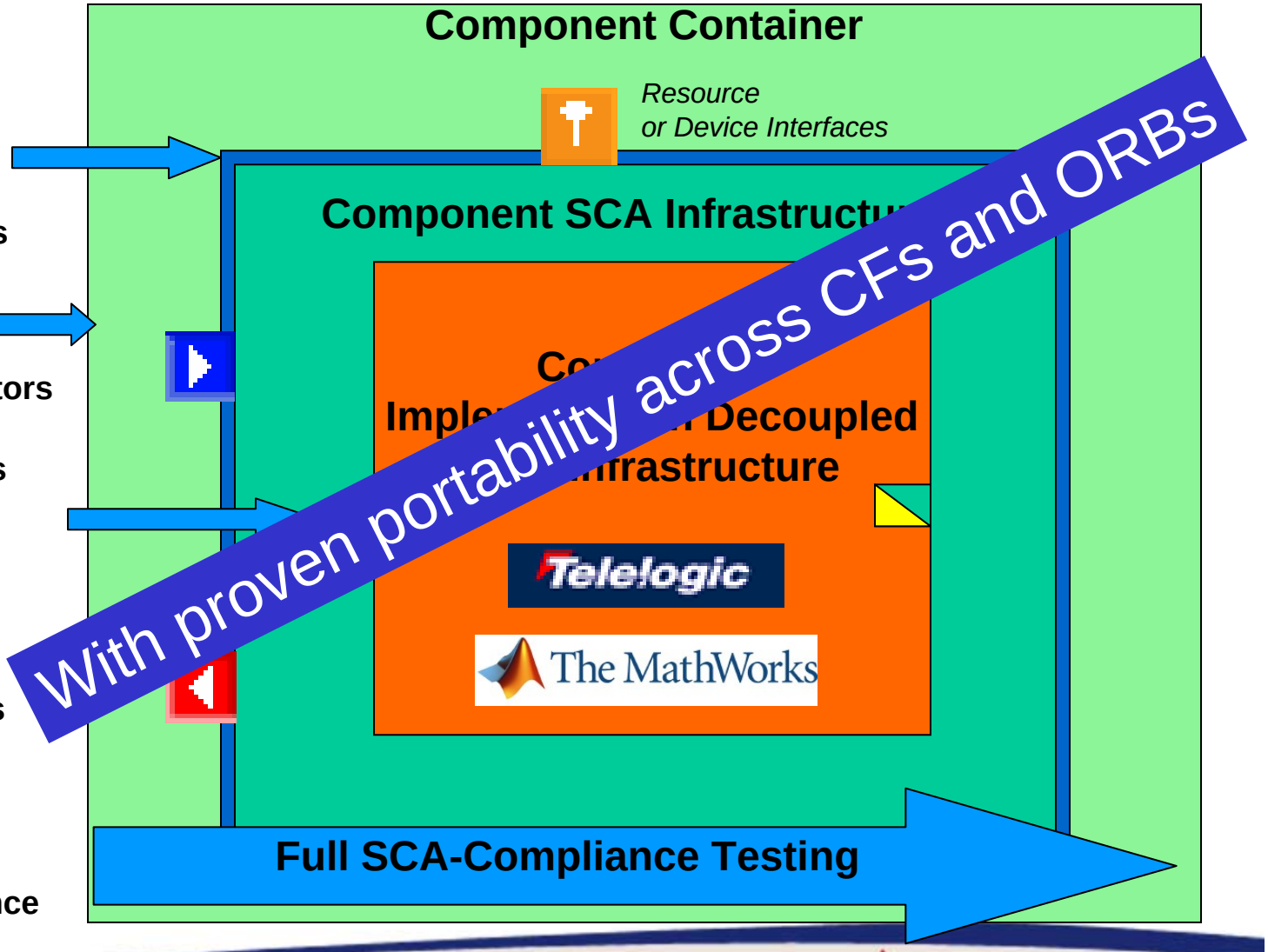
Spectra: Code and Test Generation

Spectra Resource, Assembly and Device SCA PIM Components

Spectra Auto Generates 100% Resource and Device SCA Component Container Code and XML Descriptors

Spectra Auto Generates 100% Resource and Device Component SCA Infrastructure Code (C, C++, VHDL)

Spectra Auto Generates 100% Resource and Device Component SCA Infrastructure Test Code to test Infrastructure Compliance



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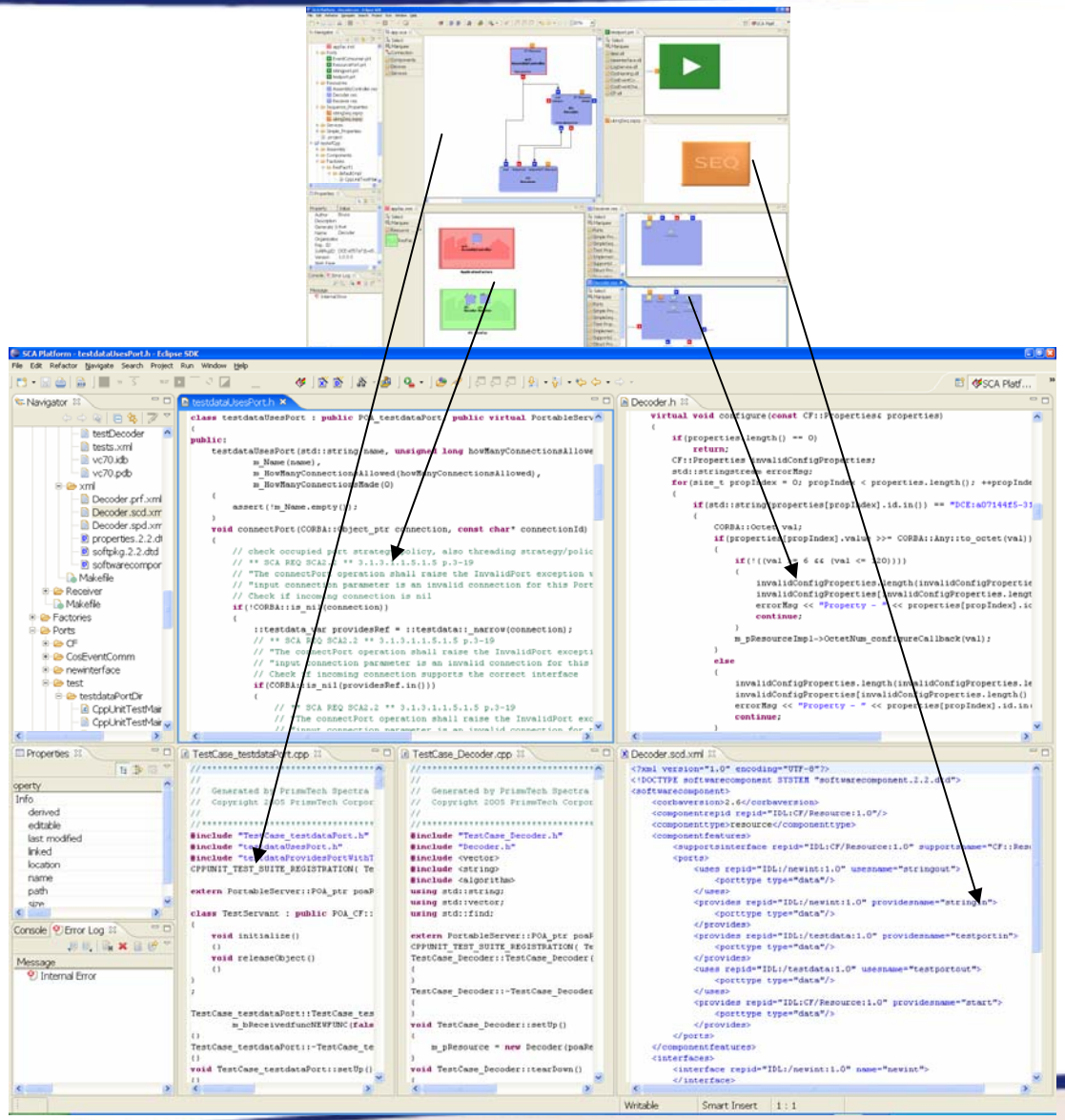
Spectra: Productivity Example



30 Model Elements

Spectra automatically generates ***6000 lines of fully functional SCA compliant infrastructure code****, tests, XML, and build artifacts…all* ***in a few hours*** *of work.*

How long would this take you to write by hand?

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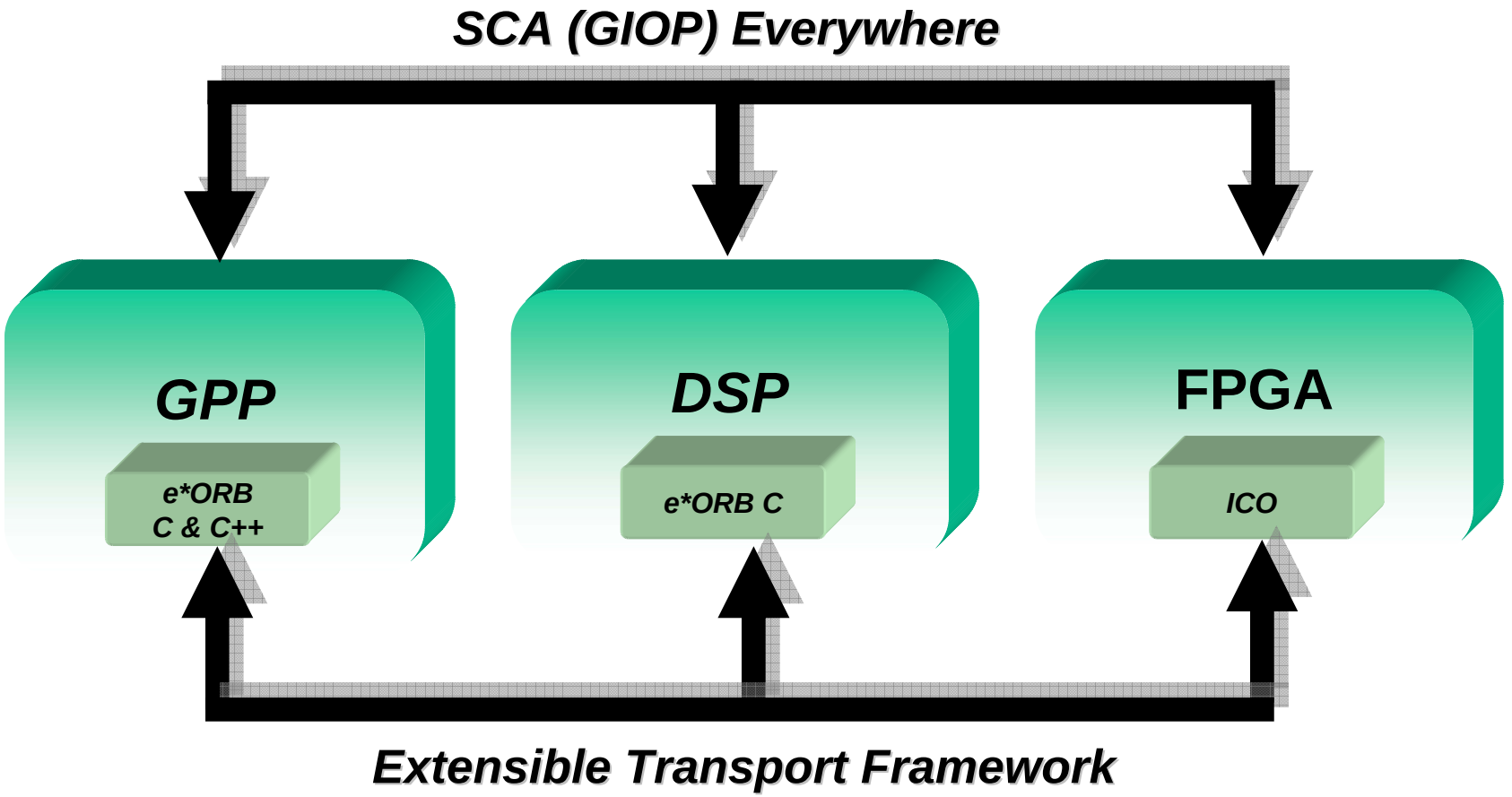
Spectra OE: SDR Operating Environment

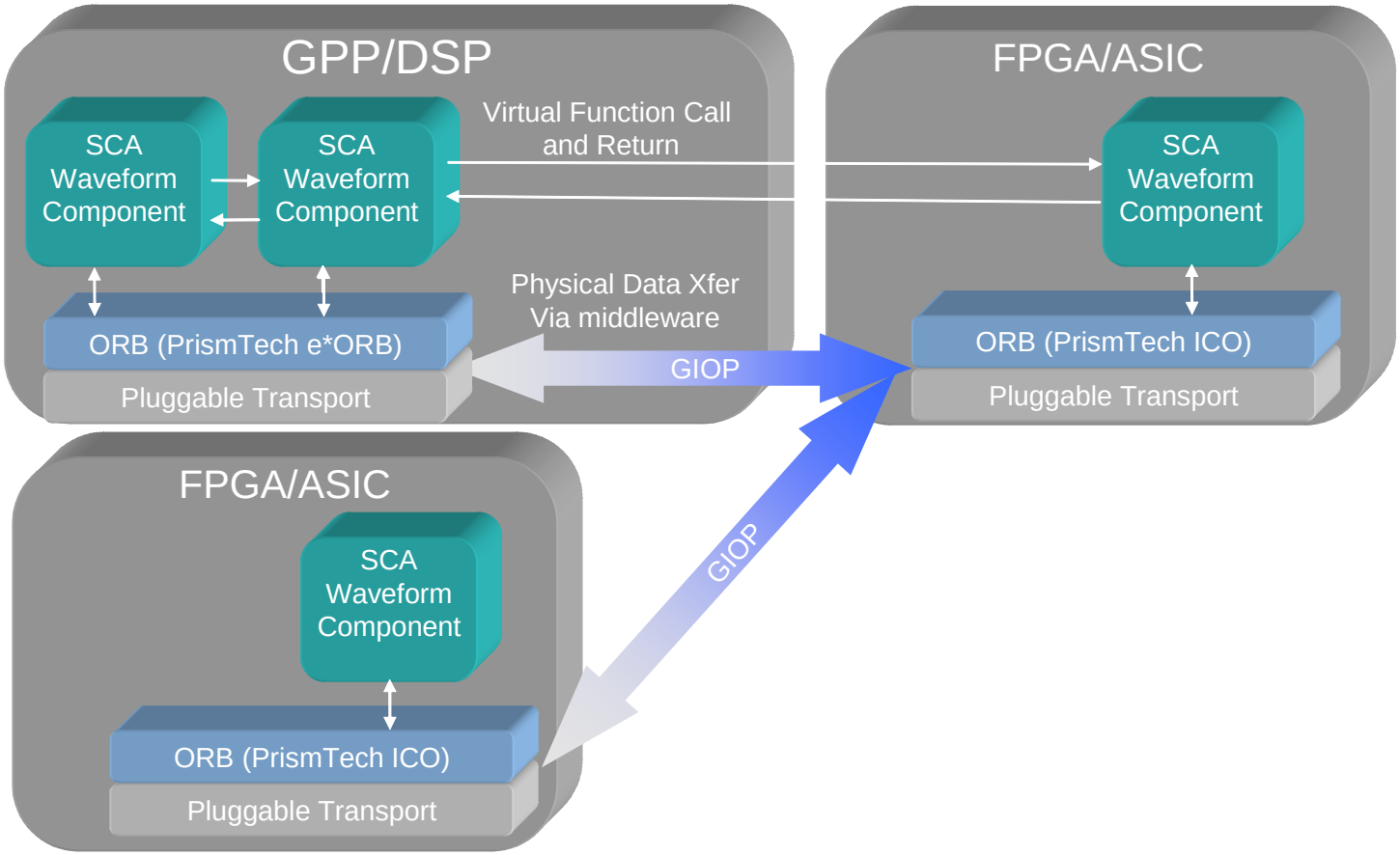
- Turnkey OE solution for radio developers
  - Pre-integrated, optimized CF, ORB and OS solutions “Out Of The Box”
    - Single vendor solution eliminates ORB/OS/CF integration headaches
  - Runs on any mix of GPP, DSP and FPGA – “SCA Everywhere”
    - Optimized ORB for GPP’s and DSP’s
    - Integrated Circuit ORB (ICO) for FPGA’s
- Lightweight, high-performance solution
  - Deploys waveforms quickly
    - Components deploy concurrently
    - Fast, lightweight XML parsing
  - Small footprint
    - **< 1 MB** memory for fully SCA-compliant OE on embedded GPP
    - < 90KB of memory for software ORB on DSP
    - < 3K logic cells/elements for hardware ORB on FPGA

Bringing Architectural Consistency to SDRs

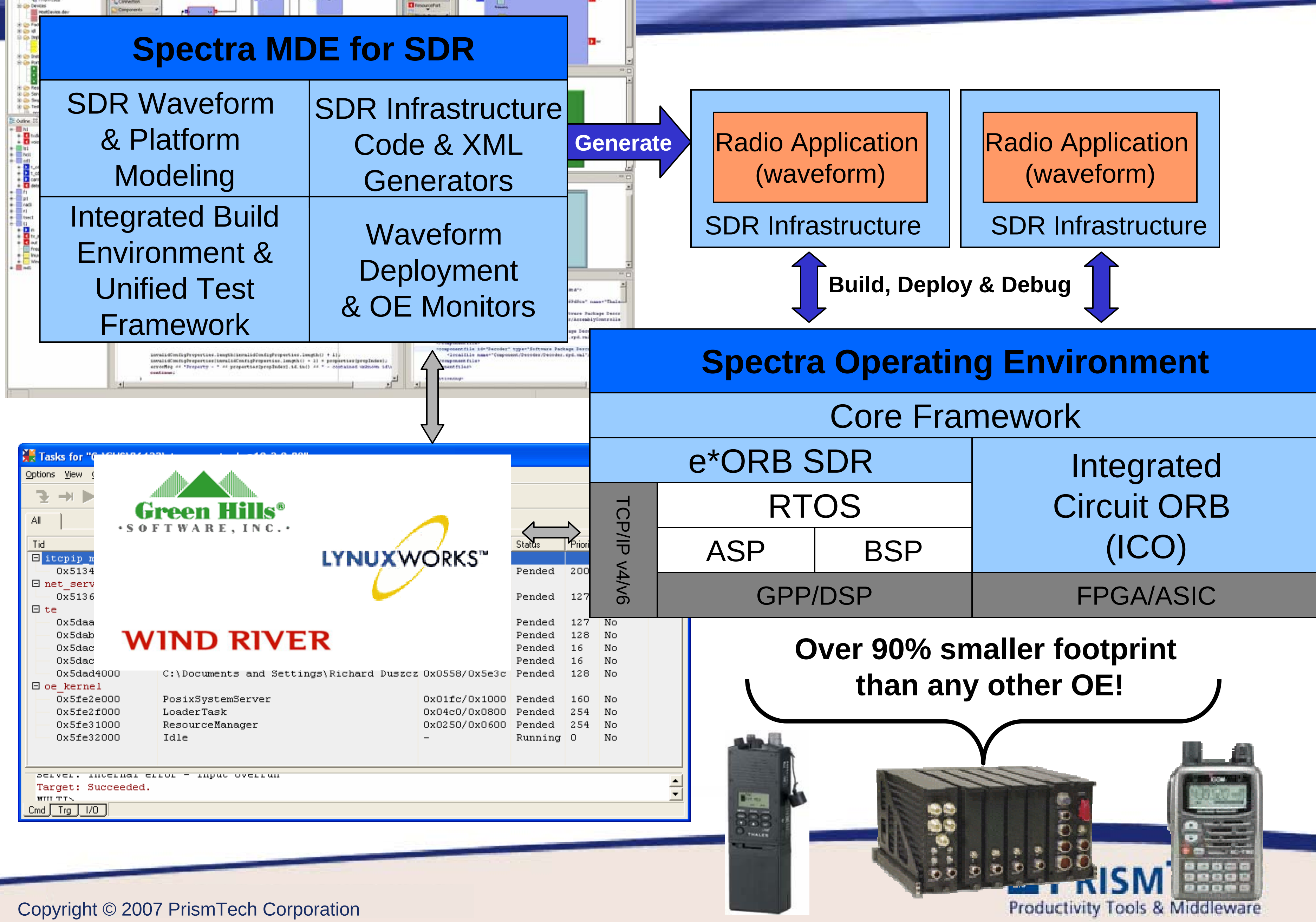


The first standards based, high performance, low footprint, fully interoperable COTS middleware solution that can be deployed across multiple processor types, including GPP, DSP and FPGA environments

SDR Configuration Example



Complete, Integrated SDR Solution



Summary

- Standards-based COTS SDR industry is emerging which will:
  - Lower SDR development and maintenance cost
  - Speed time to market
  - Improve quality of delivered systems
  - Increase ability to keep pace with and take advantage of evolving standards
  - Renew focus on radio functionality
- PrismTech's Spectra SDR Solution is:
  - Delivering on the vision of MDD for SDR today
  - Addressing the use of resource-constrained devices with an architecturally-consistent approach that preserves the intent and benefits of the standards
  - Providing a small footprint Operating Environment that supports stringent SWaP requirements

COTS SDR Solutions are Ready Today

Are You?

Thank You!

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Thank You!