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The Software Communications Architecture

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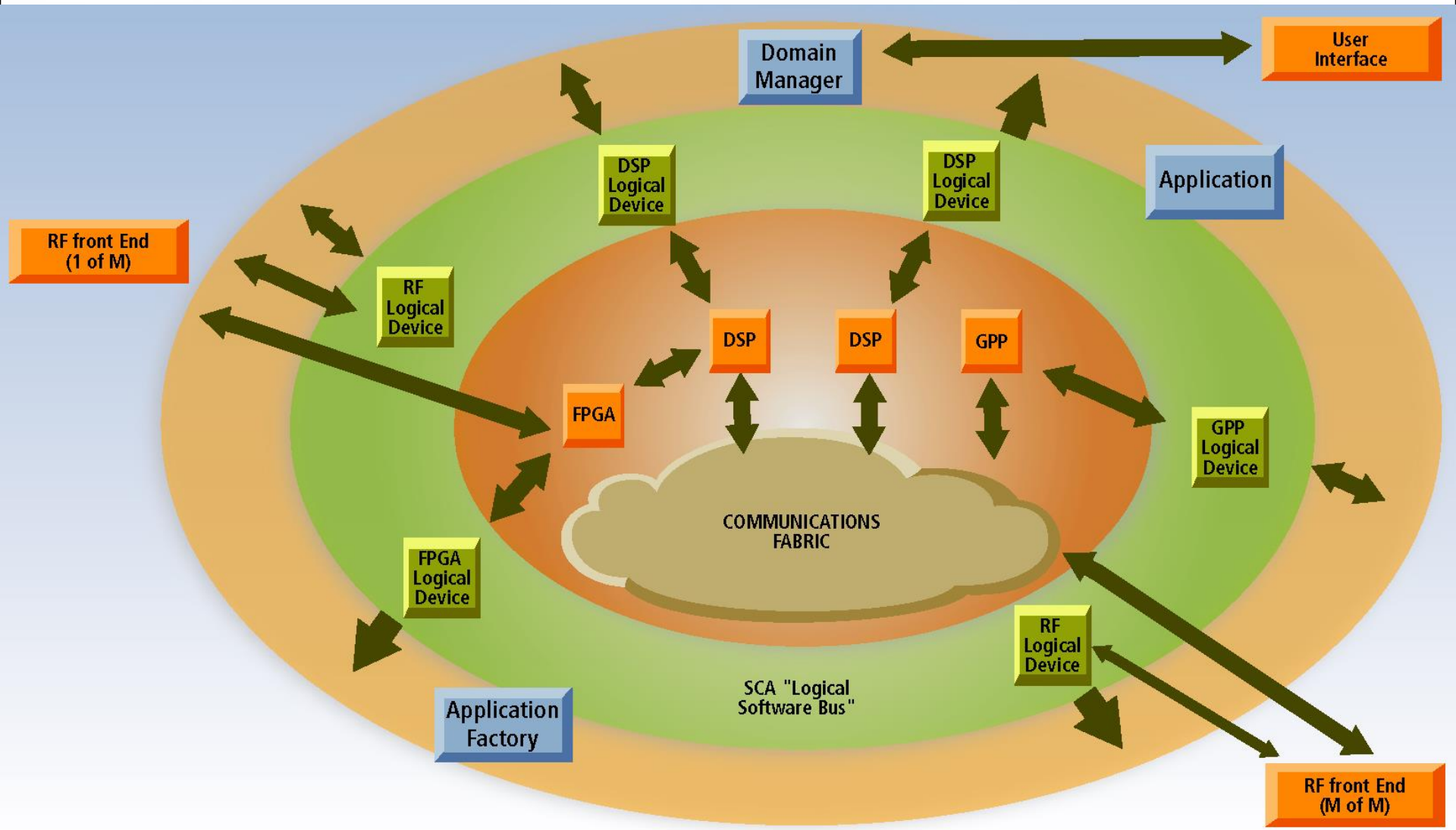
SCA - A Paradigm shift

- **Decouples hardware, software and system integration functions**
  - Facilitates acquisition process by eliminating stovepipe systems
- **Promotes re-use of signal processing software modules**
  - Modulator, demodulator, encoder, interleaver, FFT…
  - Reduces application development cost
- **Open framework architecture**
  - "Glues" the software and hardware
  - Facilitates application and module portability

SCA Core Framework

- **Central radio software piece, the “operating system”**
- **Provides an abstraction between software and hardware**
  - Defines interfaces, behavioural specifications and general rules to support devices and application portability
- **Based on commercial standards**
  - X.731 ITU/CCITT OSI System State Management
  - CORBA
  - Posix (Portable Operating System Interfaces)
  - CCM (Corba Component Model)
- **Designed to meet commercial as well as military application requirements**

SCA Design Concept



SCA Core Framework

- **The Core Framework consists of:**
  - Base Application Interfaces
  - Framework Control Interfaces
  - Framework Service Interfaces
  - Domain Profile

- **It specifies a life cycle for the signal processing modules to be downloaded on the hardware:**
  - Load
  - Initialize
  - Connect
  - Configure
  - Execute
  - Terminate
  - Unload
  - Release

Building a Reference Implementation

- **What is a Reference Implementation ?**
  - Open-source software
  - Defines the behavior of the specifications
  - Codifies *all* of its relevant technical aspects

- **Benefits of RI**
  - Reduces the level of ambiguity of the SCA specifications
  - Increases the potential for interoperability
  - Increases understanding of the architecture through an example
  - Reduces the cost and time-to-market of SDRs

CRC and SCA-RI

- **Active member of SDR Forum**
  - Participated in the development of the SRA
  - Involved in SCA technical discussions
    - Introduced the concept of *Ports* to enable true modularity of software components

- **Developed a PoC Software Defined Radio**
  - FM Line-of-Sight
  - SCAv0.3
  - In C++ on Digital Signal Processors (DSP)

- **Realized the need for an Open Source Reference Implementation**
  - Proposal to SDR Forum to promote commercial adoption
  - October 2001

SCARI (1)

- **Implementation**
  - SCA version 2.1
  - Mandatory features
  - Written in Java for portability and ease of comprehension
  - Includes a simple waveform example

- **Partners**
  - Implemented in collaboration with DRDC – Ottawa
  - Sponsored by the SDR Forum

SCARI (2)

- **Product**
  - 60,000 lines of code, 300 pages of documentation
  - Peer reviewed
  - Available at www.crc.ca/rmsc or www.crc.ca/scari
  - More than 7000 downloads from worldwide organizations
  - 37 000 hits since June 2002

- **By-product**
  - CRC submitted 21 technical change proposals to JTRS / JPO in reference to SCA version 2.2

Impact of SCARI

- **Opened the door to new players**
  - No longer limited to the majors
  - Decoupled Hardware / Software / Waveform development
- **Facilitated the emergence of new markets for SDR concepts**
  - Radar processing
  - Medical imagery
  - Other signal processing intensive applications
- **Transformed the waveform development approach**
  - Modularity at component level rather than applications

Waveform Development Vision

- **Current Approach**
  - Extension of conventional techniques
  - Single monolithic block defining the application
  - In this case, the waveform is the application

Taken from JTRS API Supplement

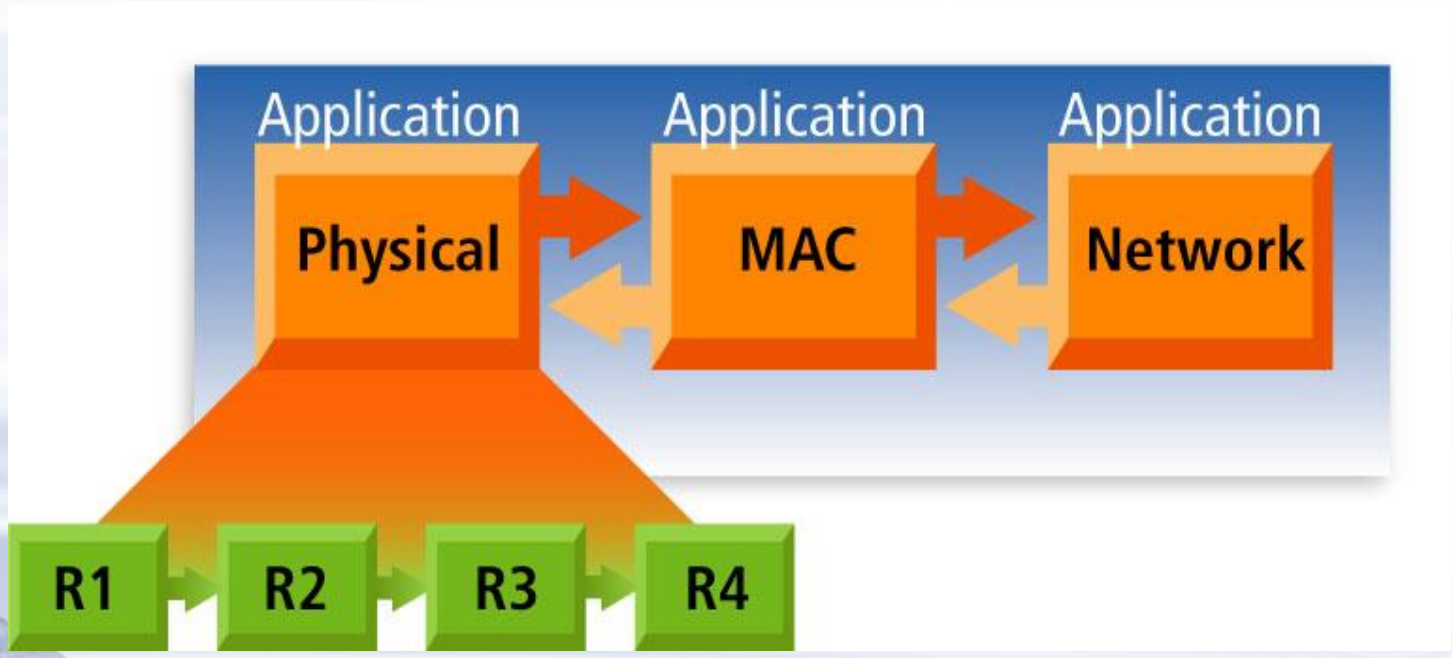
Waveform Development Vision

- **Considering that software cost is:**
  - 20% development
  - 80% maintenance

- **Development approach strongly promoted by CRC**
  - Reduce the granularity of the software components
    - Similar to specialized chip sets in board design
    - Simplifies debug and maintainability
    - Facilitates reuse of components between applications

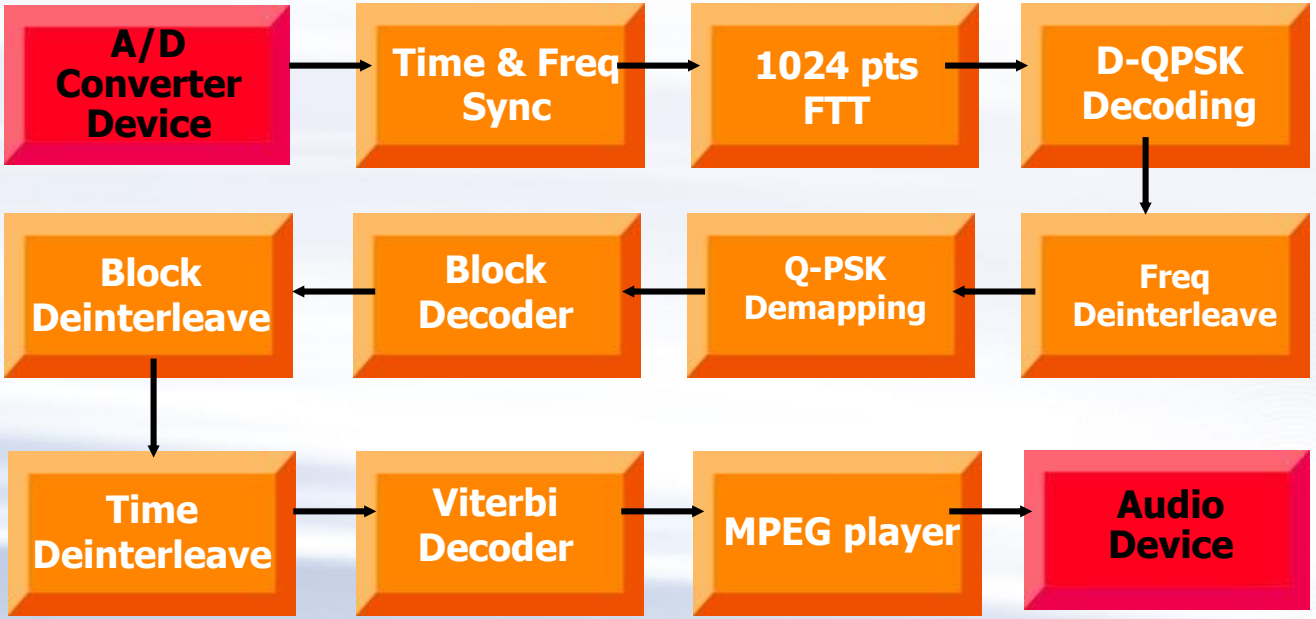
Waveform Development Vision

- **A waveform is composed of many applications**
- **Each application is composed of many signal processing modules (resources)**



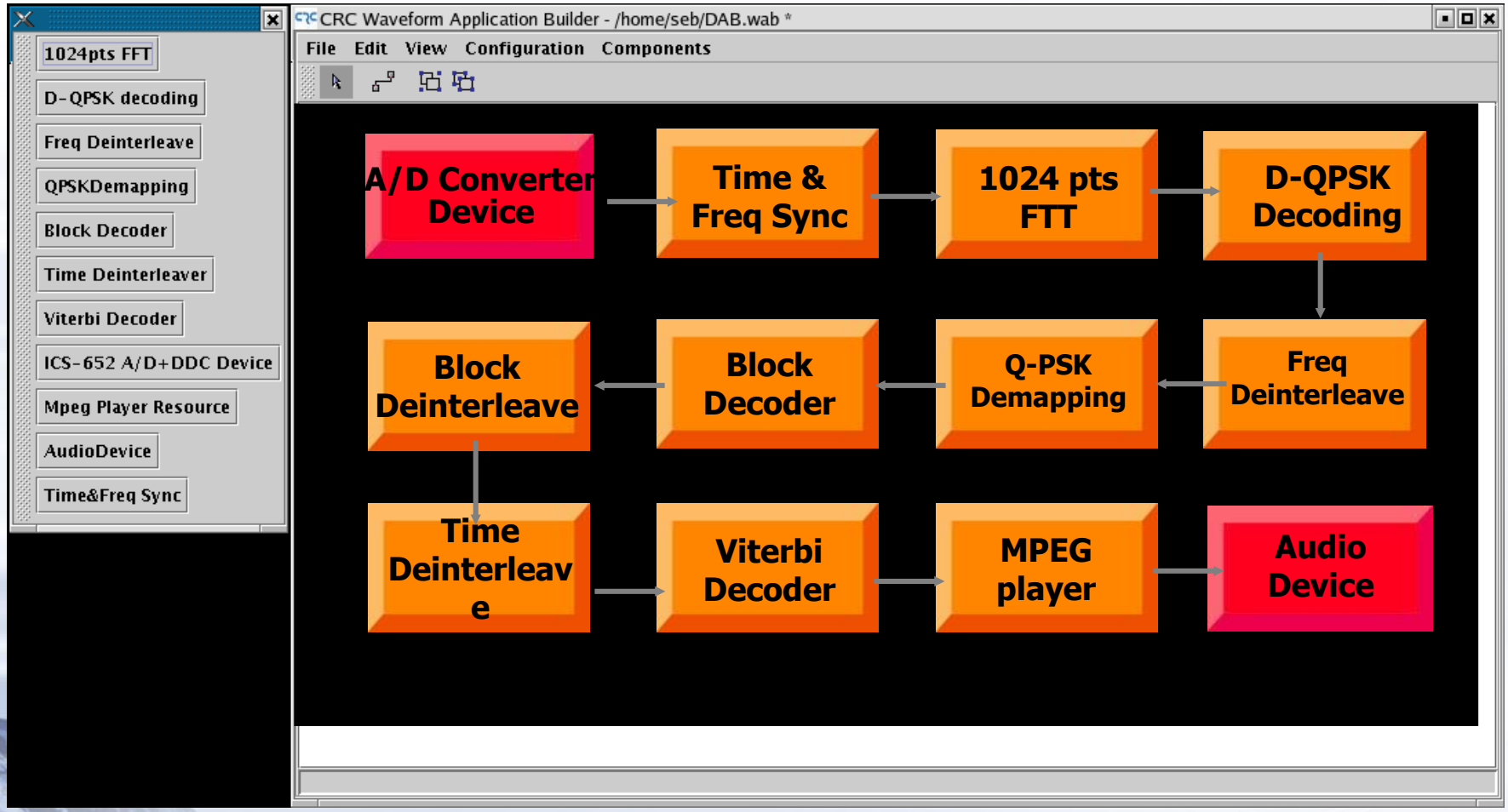
Application Example
Digital Audio Broadcast

- **Physical Layer of the DAB receiver application containing 12 resources**



CRC Waveform Application Builder

DAB Example



Connecting Applications

- **Connections between applications is however required**
  - This is supported by the SCA but mechanism not flexible enough, requires hardcoding
- **There is a need to transpose the resource connection mechanism to the application level**
  - CRC will submit a change proposal to JTRS/JPO
  - Paper to SDRF conference to be published

Following the RI

- **CRC continues to develop software to promote the expansion of the Software Define Radio**
  - SDR Development Tools
    - Waveform Application Builder (WAB)
    - Radio Manager
    - Node Boot Builder
  - SCA Core Framework v2.2
    - Java
    - Hybrid
    - C++

CRC SCA Core Framework v2.2

- **Java**
  - Extension of SCARI
  - Low cost
  - Most valuable for training
  - JTEL certification would be important for public release

- **Hybrid**
  - Java for management functions, C++ for signal processing
  - Easy to maintain Domain Manager
  - Allows development of devices and resources in C++
  - Mid-range cost
  - Applicable to embedded platforms with single board computer running Java virtual machine

CRC SCA Core Framework v2.2

- **C++**
  - Full feature implementation of SCA CF v2.2
  - All C++ implementation
  - Applicable to embedded platforms
  - High cost

Thank You

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