JTRS SCA: CONNECTING SOFTWARE COMPONENTS

François Lévesque, Charles Auger, Steve Bernier, Hugues Latour

Communications Research Centre (CRC), Canada

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Outline

- **Software Component Portability**
- **SCA Connection Model**
- **Connection Portability Issues**
- **Connection Portability Guidelines**
- **Inter-Application Connections**

Software Component Portability

- **In general, software component portability can be obtained using one of three approaches:**
  - **Interpreter:** source code of a portable component is sent to an interpreter program that behaves appropriately for the host platform
  - **Virtual machine:** source code of a portable component is compiled for a specific platform and is executed by a virtual machine that behaves appropriately for the host platform.
  - **Multiple compiles:** source code of a portable component is compiled for each different host platforms and is executed natively

Software Component Portability (con't)

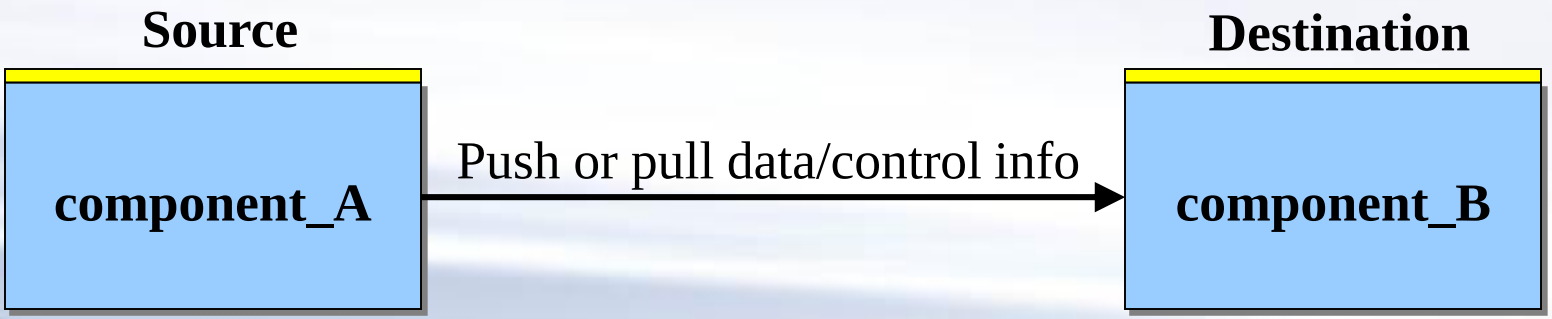
- **The SCA uses the multiple-compiles model to achieve portability:**
  - SCA components (e.g. *Devices* and *Resources*) are compiled for the different platforms in which they are intended to be used
  - Components provide a description of their requirements and capabilities, which are compared during the process of software deployment

Software Component Portability (con't)

- **SCA connection portability**
  - This portability model doesn't deal with connection portability
  - If it is not used properly, the SCA connection model can lead to portability problems
  - Even though SCA components were compiled for their target SCA platforms, connection portability problems may preclude their execution

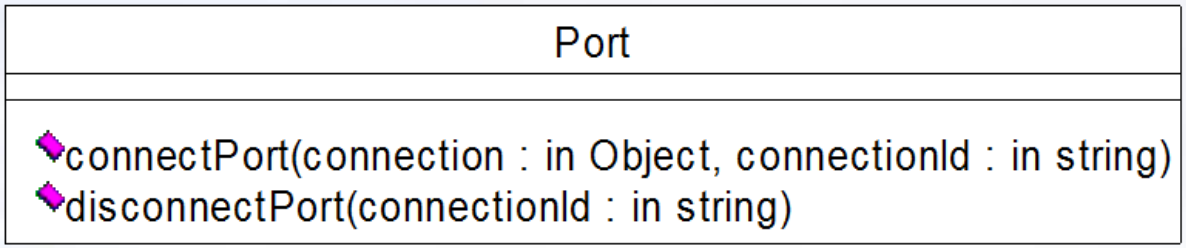
SCA Connection Model

- **SCA connections**
  - Connections are used to provide references to components for communication and control purposes
  - Connections are unidirectional
  - Orientation of a connection doesn't indicate data flow
  - Connections are used in DCD (node) and SAD (application)



SCA Connection Model (con't)

- **Connection source:** to receive a reference to the destination component of a connection, the connection source must provide a special API named *Port*

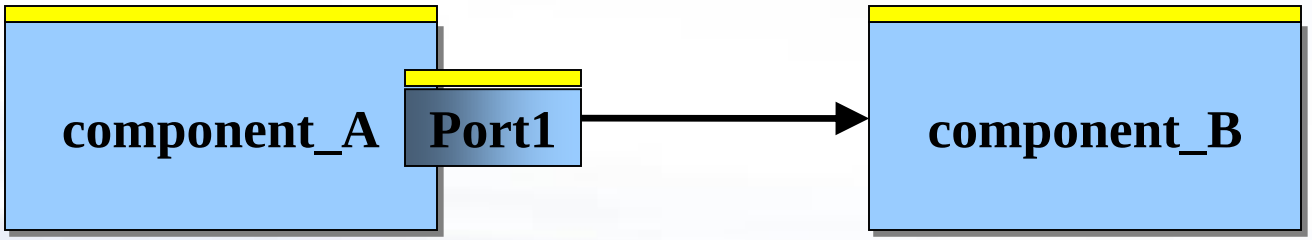


SCA Connection Model (con't)

- **Two types of SCA connection:**
  - **Port-to-component:** Connection destination inherits the interface needed by the source; connection is established directly to the component
  - **Port-to-port:** Connection destination implements the needed interface by aggregation; connection has to be established to the sub-component implementing the interface

SCA Connection Model (con't)

- **Port-to-component connection**



  - **Connection:**

    portA1 = component_A.getPort("Port1")

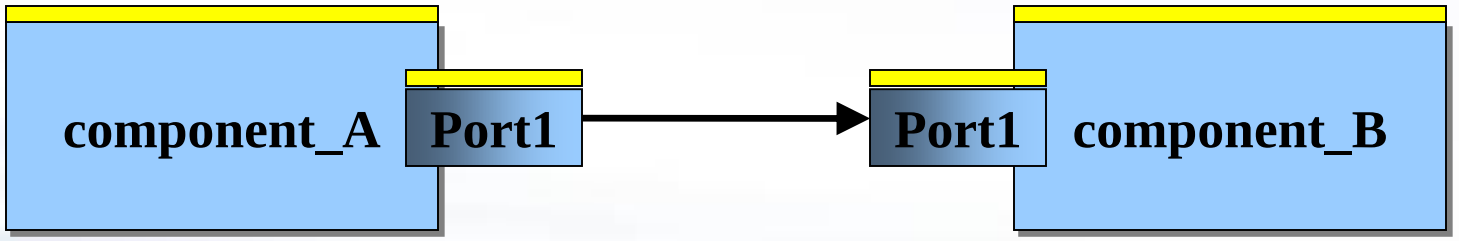
    portA1.connectPort(component_B, "toB")

  - **Disconnection:**

    portA1.disconnectPort("toB")

SCA Connection Model (con't)

- **Port-to-port connection**



  - **Connection:**

    portA1 = component_A.getPort("Port1")

    portB1 = component_B.getPort("Port1")

    portA1.connectPort(portB1, "toB1")

  - **Disconnection:**

    portA1.disconnectPort("toB1")

SCA Connection Model (con't)

- **The SCA offers five mechanisms for obtaining/identifying the source or destination component of a connection**

- **Can be categorized into "direct" and "indirect" identification mechanisms**
  - **Direct identification mechanisms:** source or destination component is identified using pre-defined (static) information
  - **Indirect identification mechanisms:** source or destination component is identified using runtime information

SCA Connection Model (con't)

- **Direct identification mechanisms:**
  - **Naming service name**: CORBA naming service is queried using a name to obtain a reference to a component. Naming service registration is only mandatory for *Resource*s
  - **Component instantiation reference**: in an assembly descriptor (SAD, DCD), each component instance is associated to a unique identifier which can be used to establish connections

SCA Connection Model (con't)

- **Indirect identification mechanisms:**
  - **Domain finder**: used to establish connections to radio services (e.g. log, naming service). Services from all nodes register to the *DomainManager* using a name and a type.
  - **Device that loaded a component**: allows a connection with a *Device* that was used to load a specific component (e.g. FPGA *Device* that was used to load a specific algorithm)
  - **Device used by a component**: allows a connection with a *Device* that is being used by a specific component. Usage relationship are declared using capabilities and capacities requirements

SCA Connection Model (con't)

- **Restrictions for node connections (DCD):**
  - Components of a node are launched by a *DeviceManager* while the connections are established by the *DomainManager*
  - Because of a lack of API between the *DeviceManager* and *DomainManager*, the information gathered by the *DeviceManager* when launching the components cannot be provided to the *DomainManager*
  - Therefore, the following indirect identification mechanisms cannot be used:
    - Device that loaded a component
    - Device used by a component

Connection Portability for Applications

- **Issues that can preclude connection establishment for an application:**
  - Reference to a specific *Device* name
  - Reference to a specific *Port* name
  - Reference to a specific *Service* name
  - Different Radio Frequency (RF) chain implementations
  - Association between a component and a *Device*
  - External connections

Connection Portability for Applications (con't)

- **Reference to a specific *Device* name**
  - The name of a *Device* is chosen by a radio integrator; it may differ in each radio
  - Therefore using a direct identification mechanism is not portable
  - The Device involved in a connection should be identified using its characteristics (capabilities and capacities)
    - The SCA will have to standardize more capabilities/capacities

Connection Portability for Applications (con't)

- **Reference to a specific *Port* name**
  - To connect to *Devices*, applications may use port names which are defined by the *Device* developer
  - Port names for SCA components provided by a platform and used by an application should be standardized

Application Connections Portability (con't)

- **Reference to a specific *Service* name**
  - Services register to the *DomainManager* using a name and a type
  - Components connect to radio services using domain finder connections
  - Since the component that implements a radio service may be different in each radio, connections to services should not be identified using a name
  - Connections to radio services should be identified using a service type (e.g. filemanager, filesystem, logger, namingservice)

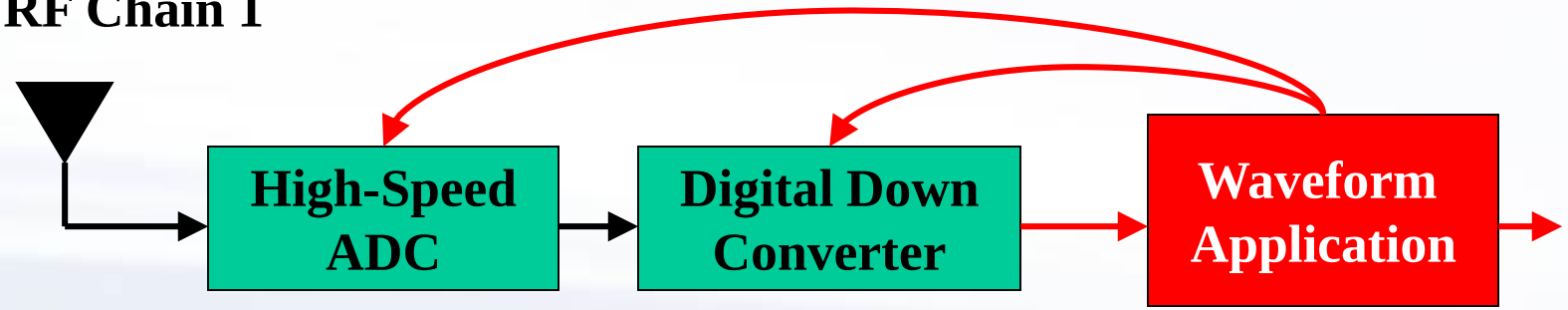
Connection Portability for Applications (con't)

- **Different Radio Frequency (RF) chain implementations**
  - The steps that need to be performed for the conversion of RF signals to baseband data sample can be implemented in various ways
  - Different radios could provide different groups of RF Devices and still offer an equivalent service
  - To configure a *Device*, an application needs to be connected to it
  - Since the number of *Devices* used by an application can vary, it is impossible to define a portable application assembly descriptor because of the varying requirements in terms of connections

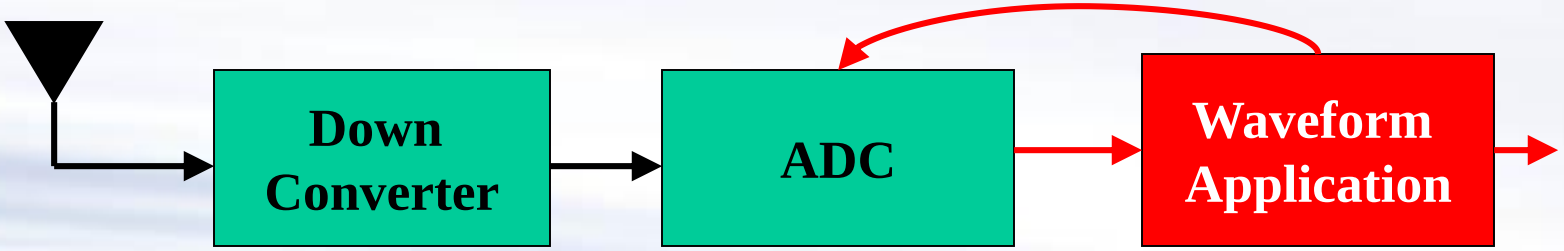
Connection Portability for Applications (con't)

- **Different Radio Frequency (RF) chain implementations**

- RF Chain 1



- RF Chain 2



Connection Portability for Applications (con't)

- **Different Radio Frequency (RF) chain implementations**
  - One way to address this problem is to abstract the RF device chain
  - Application components would not connect to individual RF devices but only to a high-level abstraction artifact
  - The OMG SWRadio group has introduced the concept of an RF_Channel component that could be used as a basis for a solution in the SCA

Connection Portability for Applications (con't)

- **Association between a component and a *Device* (ie: *usesdevice*)**
  - The declaration of an association can be defined:
    - globally for a component (component level) or
    - for a specific implementation of a component (implementation level)
  - Connections referencing an association not defined for all implementations could fail depending on the chosen implementation
  - Associations should be defined at the component level rather than the implementation level
    - For more portability, associations to devices should only be made with the assembly controller component

Application Connections Portability (con't)

- **External connections**
  - For an Application to be controlled (ex: from a console GUI), connections must be established with it. There are two options:
    - Connections to sub-components
    - Connections to external ports
  - Connections to sub-components of an Application break the encapsulation concept and may create portability problems
    - Modifications to sub-components of an application may render external connections unusable
    - Even tough the application is portable and may be executed, it cannot be controlled

Application Connections Portability (con't)

- **External connections (con't)**
  - External entities should connect to the external ports of an application (i.e. defined in the application's SAD)
  - The external ports should be mapped to the ports of the assembly controller to allow connections without breaking the encapsulation

Inter-Application Connections

- **Problem**
  - In many scenarios, multiple applications must communicate with each other in order to provide a single aggregated functionality to the radio user
  - The current version of the SCA (2.2) doesn't specify how applications may be connected with each other
  - An application can potentially be connected to another application since it implements the *PortSupplier* interface

Inter-Application Connections (con't)

- **Problem (con't)**
  - However, there are problems preventing portable connections between applications:
    - The order in which applications are created is usually controlled by the radio operator. It is difficult to automate the launch of two (or more) applications in a specific sequence suitable for connection establishment
    - The name of an application component is always appended to the name of the application (chosen at run time by the radio operator). Pre-defined application names have to be used

Inter-Application Connections (con't)

- **Potential Solution 1**
  - One of the applications involved in a connection registers as a radio service
  - The connection could identify this application using the *domainfinder* identification mechanism
  - Advantage:
    - This solution would preserve application encapsulation which is good for maintenance and portability
  - Disadvantages:
    - Requires a new type of service called "application"
    - The name of the second application (i.e. service) would have to remain unchanged

Inter-Application Connections (con't)

- **Potential Solution 2**
  - Add support for the concept of aggregate applications to the SCA
  - An aggregate application would be composed of two or more applications
  - Advantages:
    - The radio operator does not need to launch many individual applications with a specific name to obtain the aggregate application behavior
    - Connections would be established between applications, thus preserving encapsulation

Inter-Application Connections (con't)

- **Potential Solution 2 (con't)**
  - Disadvantages:
    - Requires modifications to the SCA standard
      - *ApplicationFactory* behavior has to be altered to launch aggregate applications in addition to the standard applications
      - A new assembly descriptor is needed to indicate which applications compose the aggregate application and how they must be inter-connected

Questions ?