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DICOMT Software Defined Radio For Search And Rescue

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- Introduction
- DICOMT Concept
- SCA and multi-application design
 - Shortcomings and Solutions
- DICOMT Implementation
- Test Results

Deployable Interoperable Communications Terminal (DICO MT)

- Emergency management applications
- Integrated communications system
 - Connects terrestrial and satellite systems
 - Provide interoperable communications
 - Scalable and upgradeable
- Waveforms Development
 - Initial: AM, FM, P-25, DVB-S
 - Tetra, DVB-S2/RCS, to follow
- Based on SCA architecture
 - SSPI SDR-4000 platform
 - CRC SCARI Software Suite



DICOMT Concept



- Research and Development project
 - Research into improving the capabilities of a software radio within the SCA framework
 - improve application portability
 - facilitate deployment and interaction of multiple concurrent applications
 - dynamic redeployment (including new connections) of single or multiple applications
 - Development of a prototype public safety radio with satellite backhaul

DICOMT Project Research

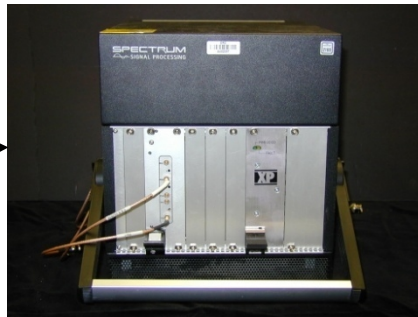
- Identify shortcomings of the SCA when considering setups involving deployment of multiple Applications
- Minimize the number of changes needed to move an Application from one platform to another
- Create a solution to resolve both issues, while remaining SCA compliant

DICOMT Project Development

- Bridge public safety radios with a satellite backhaul link
- Public Safety
 - Protocols: AM, FM, P25
 - Frequencies : 120, 150, 850 MHz
- Satellite
 - Protocol: DVB-S (Future DVB-S2, DVB-RCS)
 - Frequencies: Satcom bands



Public Safety Radios



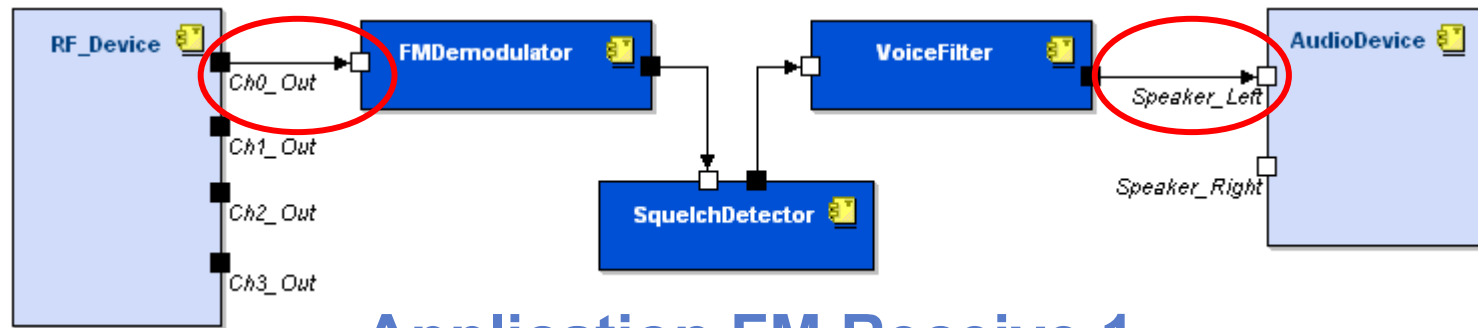
SDR-4000 Communications Bridge



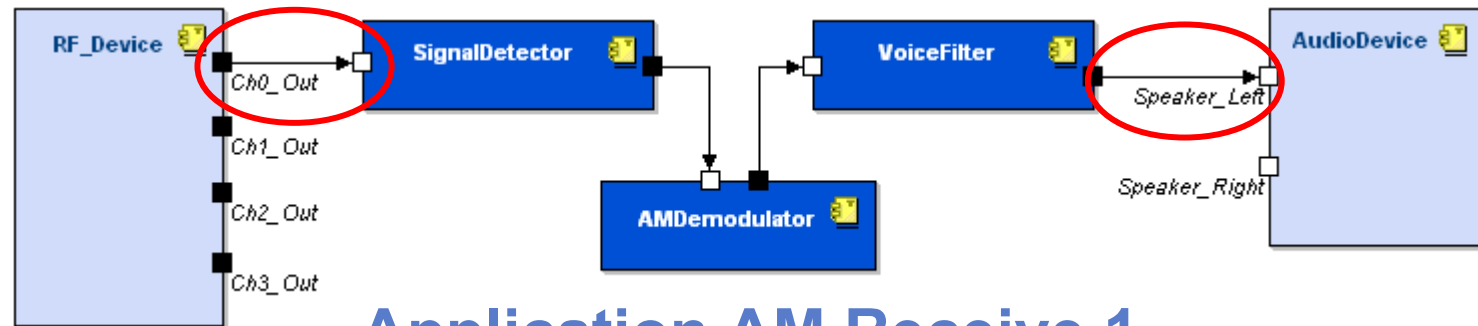
Satcom Modem

SCA Shortcoming 1

Connections to/from Devices are wired to named ports



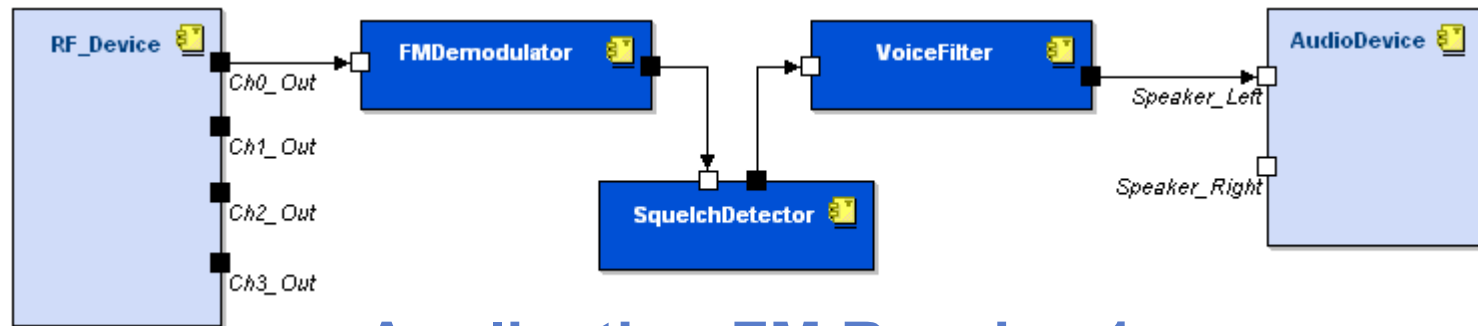
Application FM Receive 1



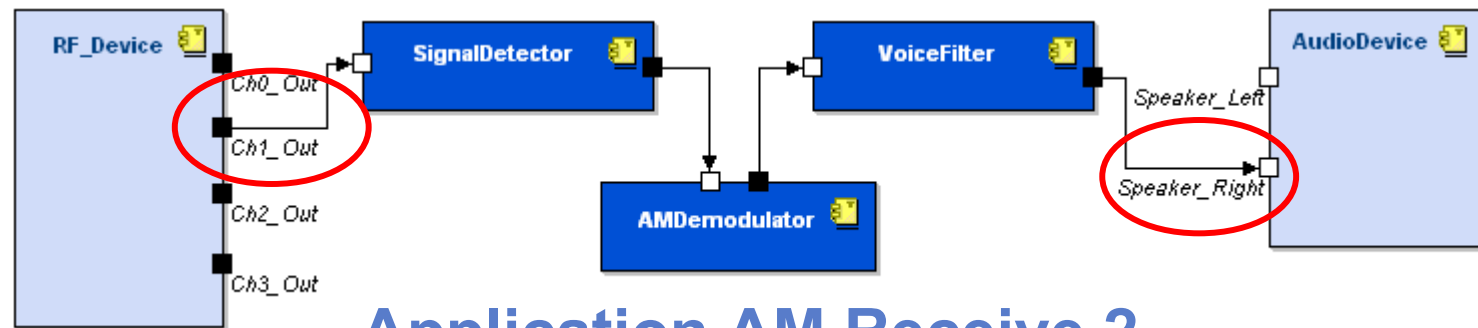
Application AM Receive 1

SCA Shortcoming 1

... causes problems in multi-Application systems
Applications can be modified...



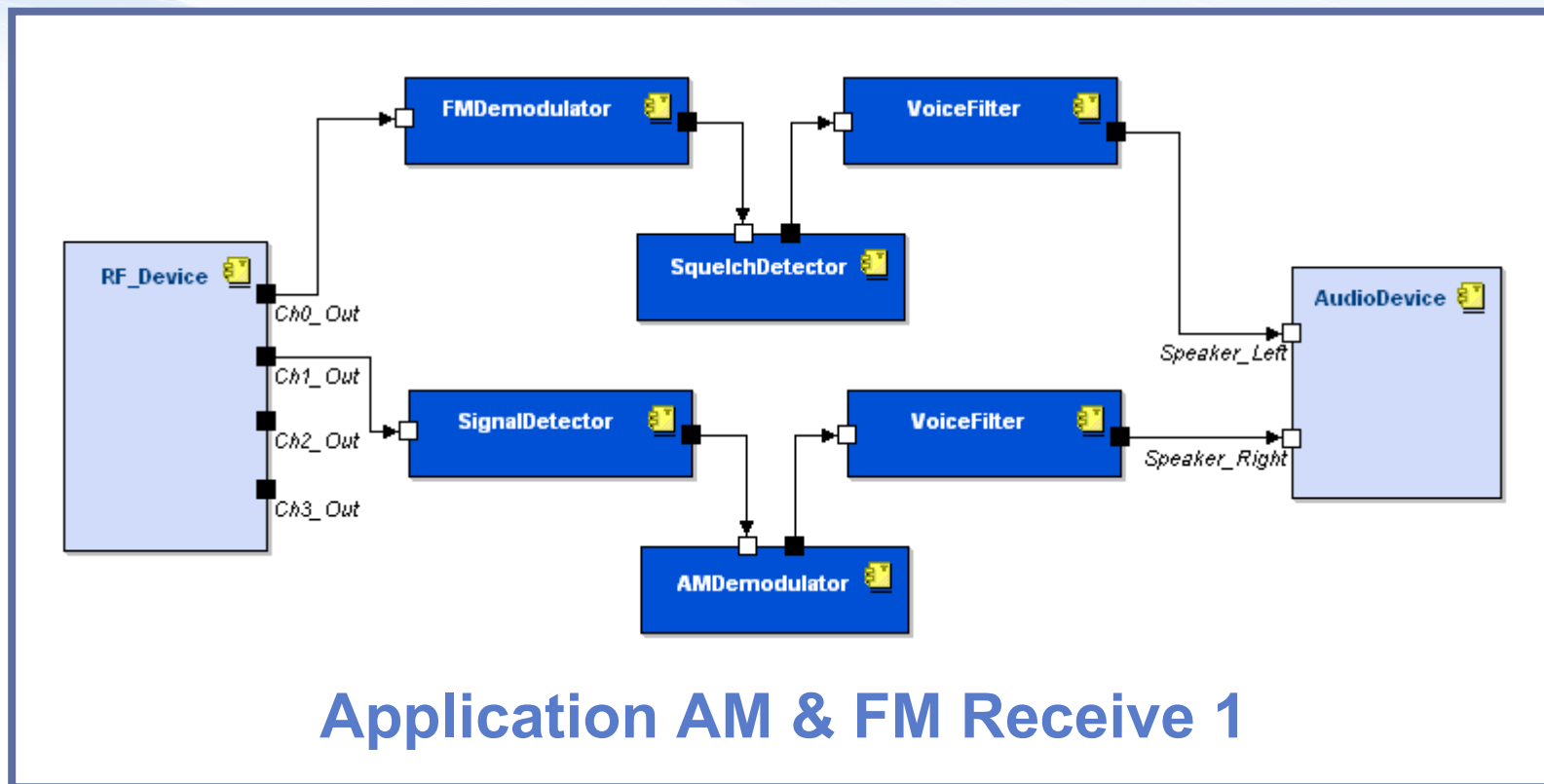
Application FM Receive 1



Application AM Receive 2

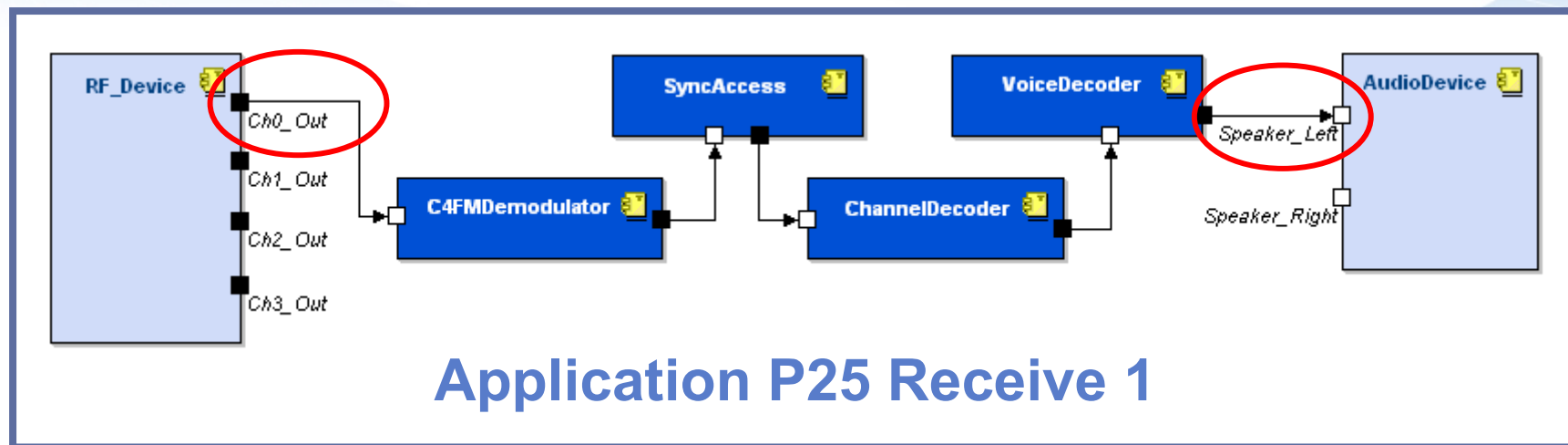
SCA Shortcoming 1

... or combined



SCA Shortcoming 1

... but there will always be more applications...



SCA Shortcoming 1

AM Rx – AM Tx – FM Rx – FM Tx

AM Rx – AM Tx – FM Rx – FM Tx

AM Rx – AM Tx – FM Tx

AM Tx – FM Rx – FM Tx

FM Rx – FM Tx – P25 Tx

FM Tx – P25 Rx – P25 Tx

AM Rx – AM Tx – FM Rx

AM Rx – FM Rx – FM Tx

FM Rx – FM Tx – P25 Rx

FM Rx – P25 Rx – P25 Tx

AM Rx – FM Rx

FM Rx – P25 Rx

AM Rx – AM Tx

AM Rx

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P25 Rx – P25 Tx

AM Tx

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P25 Rx – AM Tx

AM Rx – P25 Rx

FM Rx – FM Tx

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AM Rx – AM Tx – FM Tx – P25 Tx

AM Tx – FM Rx – FM Tx – P25 Tx

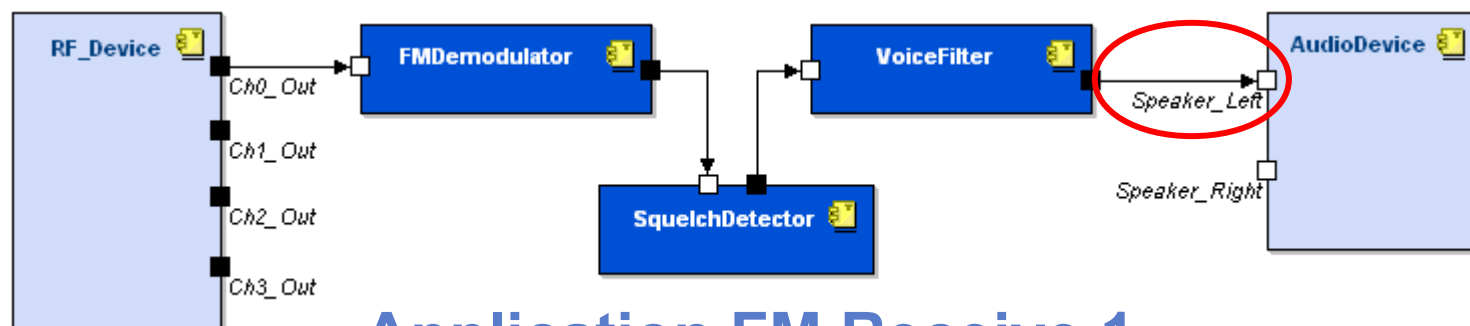
FM Tx P25 Rx – P25 Tx

AM Rx – AM Tx – FM Rx – P25 Tx

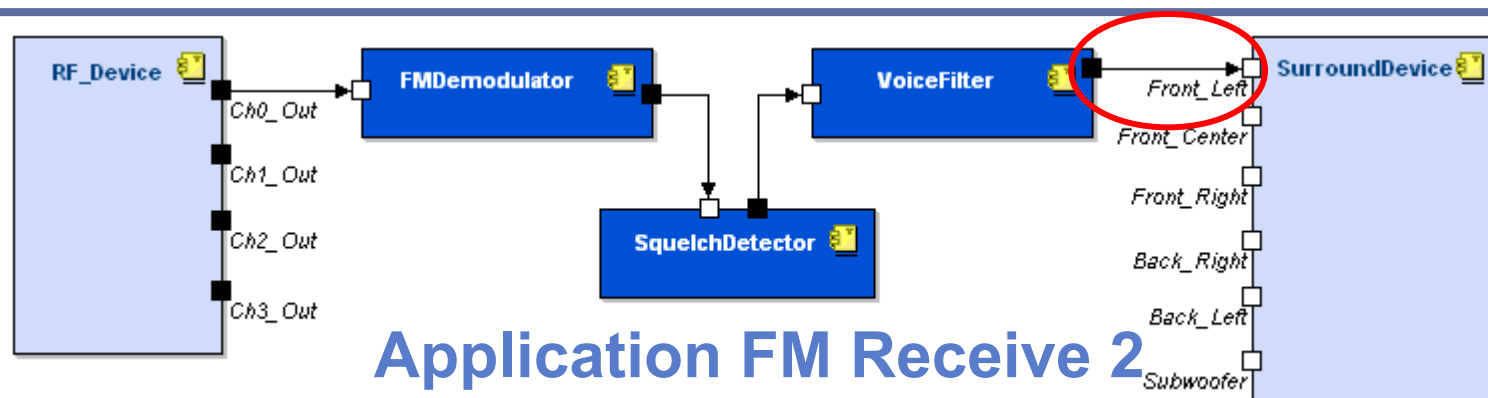
AM Rx – FM Rx – FM Tx – P25 Tx

SCA Shortcoming 2

Changing Devices on a platform requires changing Application connections and possibly configuration...



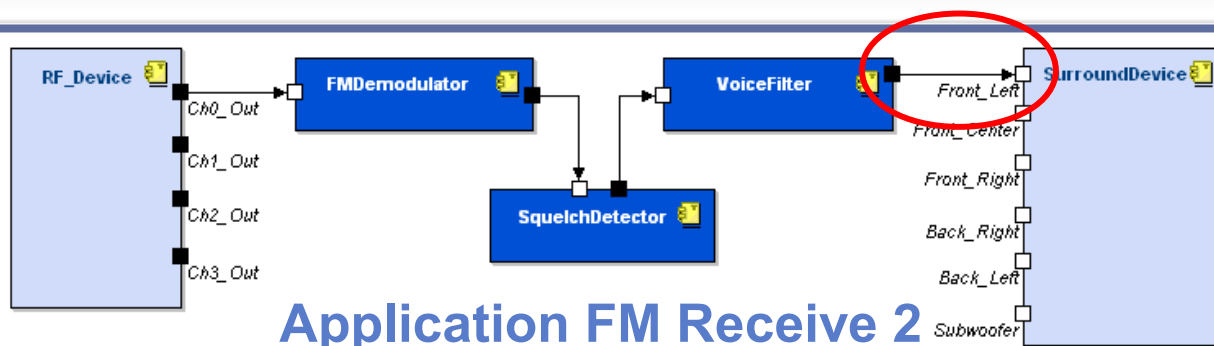
Application FM Receive 1



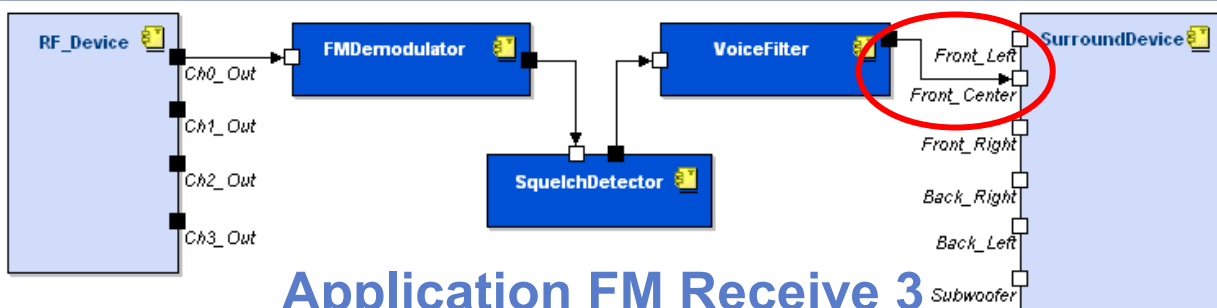
Application FM Receive 2

SCA Shortcoming 2

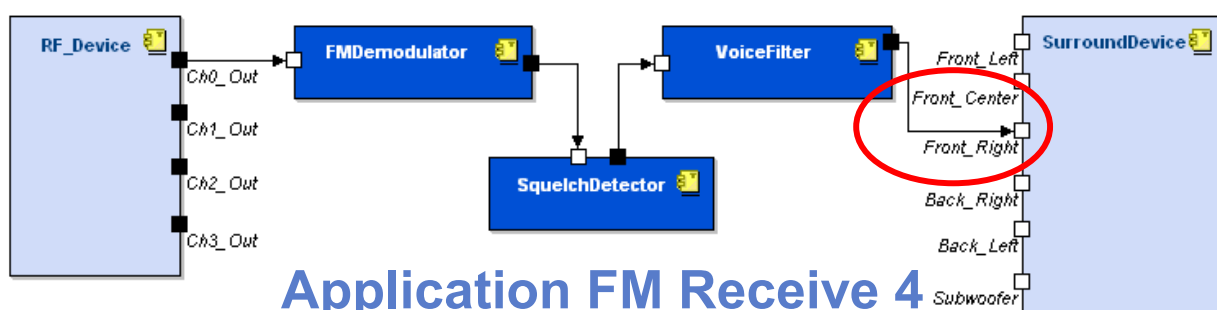
... connecting to different ports requires new Applications.



Application FM Receive 2



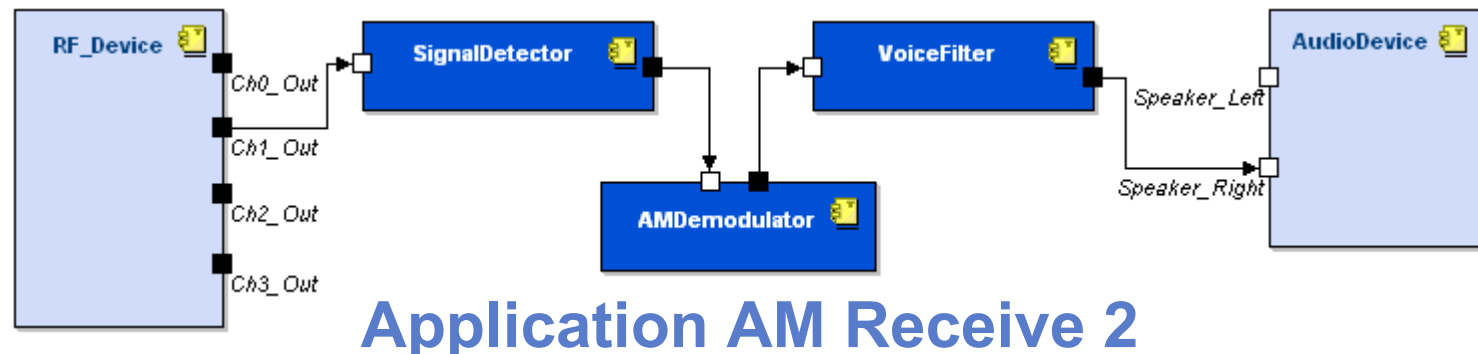
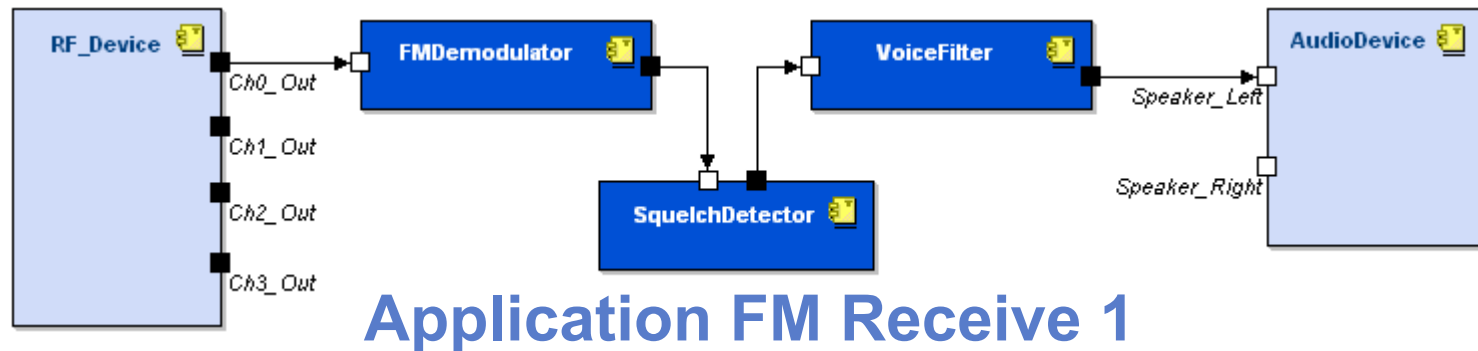
Application FM Receive 3



Application FM Receive 4

SCA Shortcoming 3

Applications with conflicting Device configurations



Even when there are no conflicts in port connections

SCA Shortcoming 3

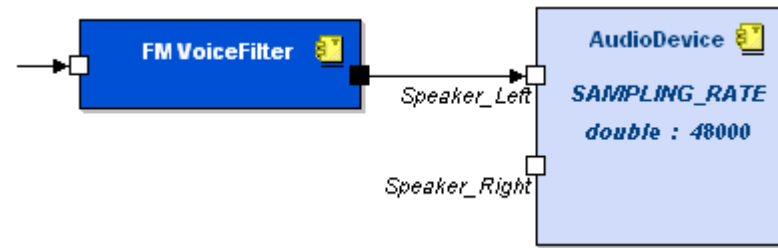
Instantiating the first Application configures the Device with a first value...

Application FM 1 Specs:

Sampling_Rate_Min: 12000

Sampling_Rate_Max: 96000

Sampling_Rate_Default: 48000



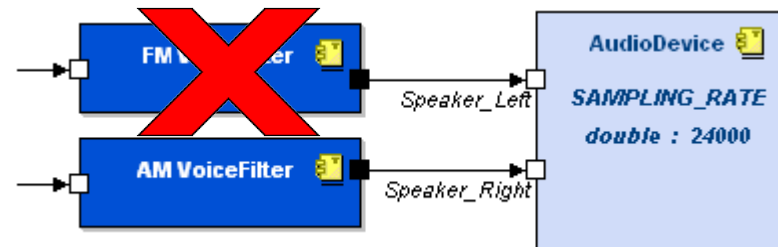
... instantiating the second Application re-configures the Device with a new value...

Application AM 2 Specs :

Sampling_Rate_Min: 10000

Sampling_Rate_Max: 24000

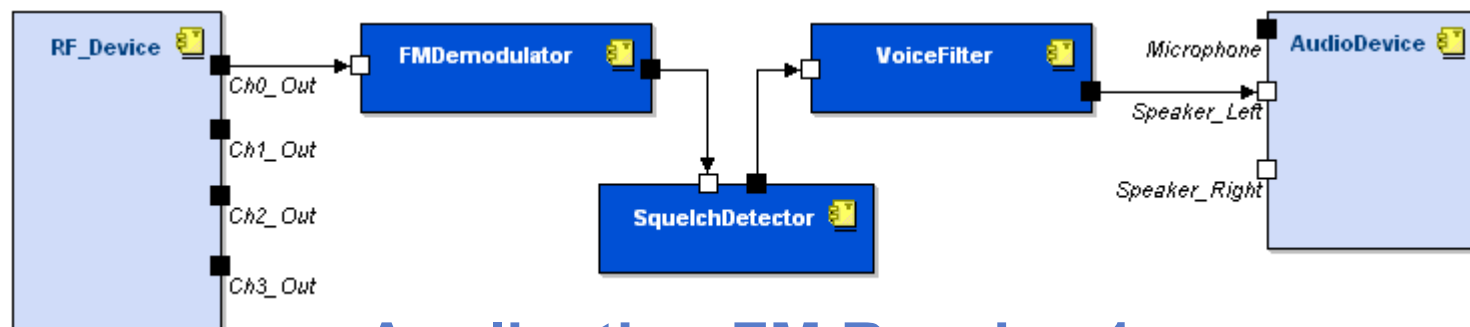
Sampling_Rate_Default: 24000



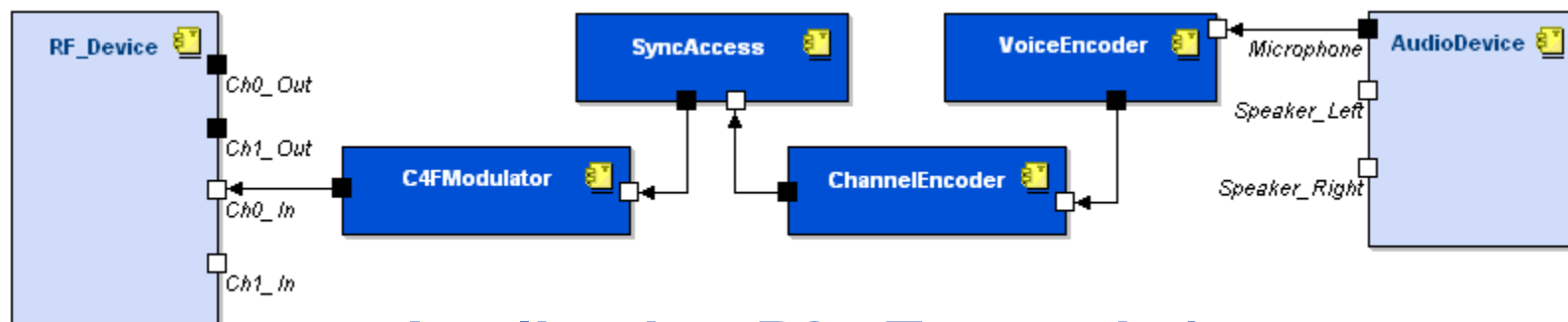
... causing the first application to stop working properly.

SCA Shortcoming 4

Bridging of Waveform Applications...



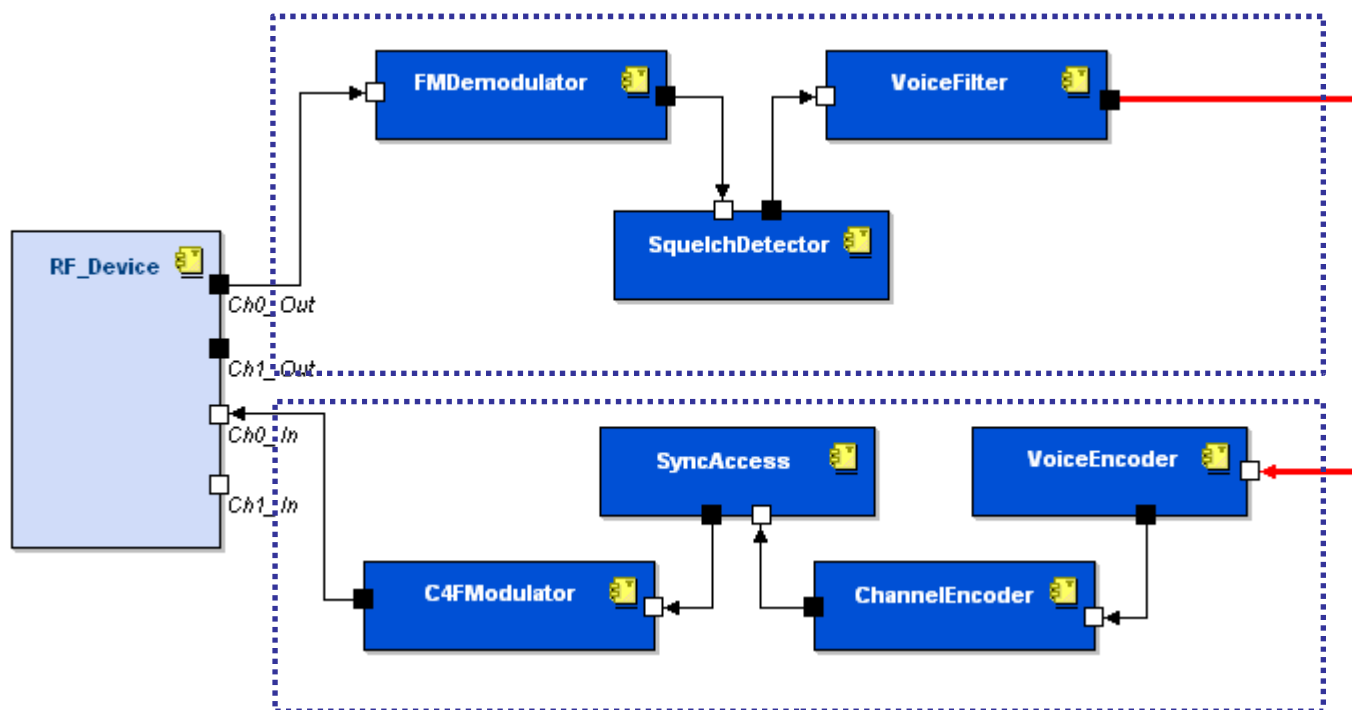
Application FM Receive 1



Application P25 Transmit 1

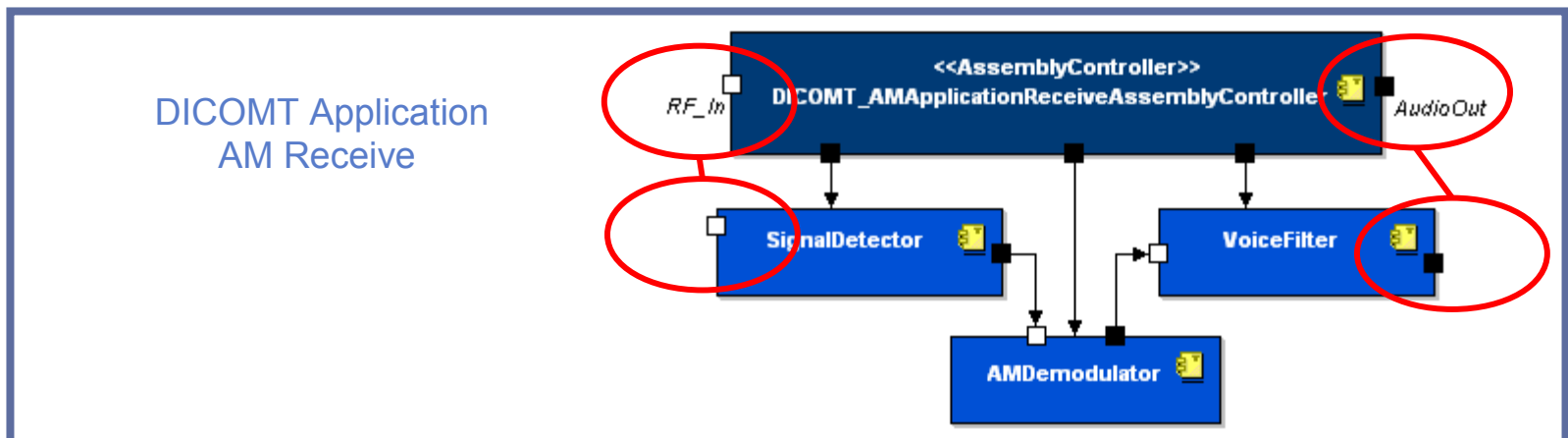
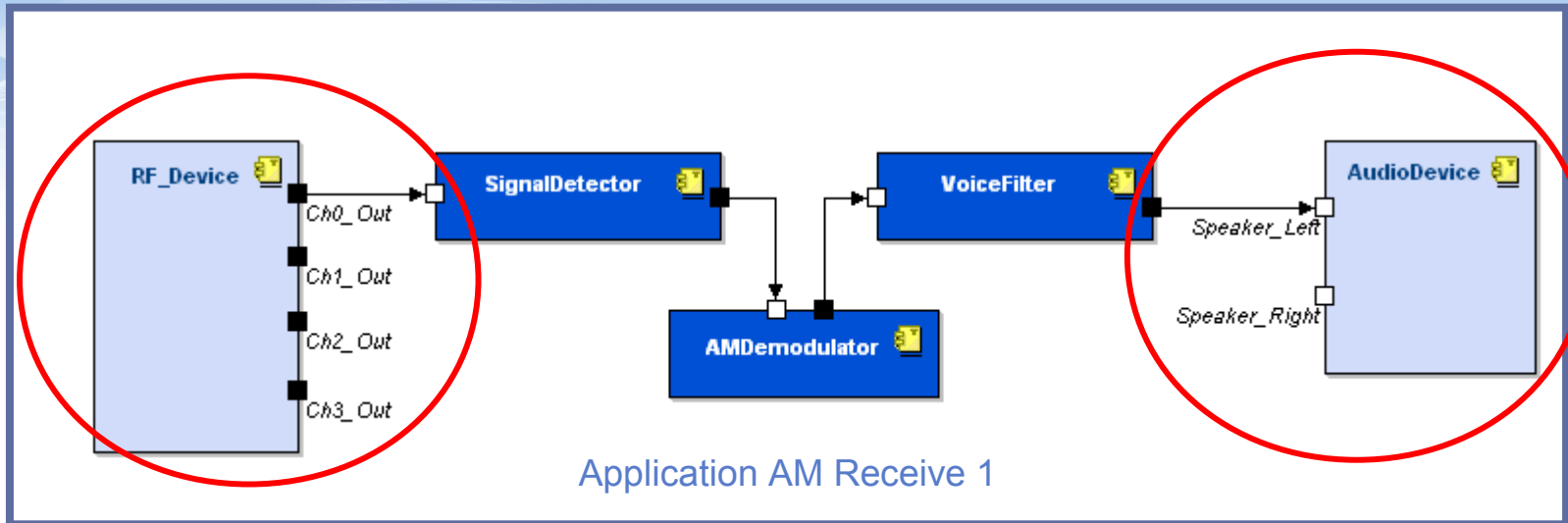
SCA Shortcoming 4

... requires new Applications.

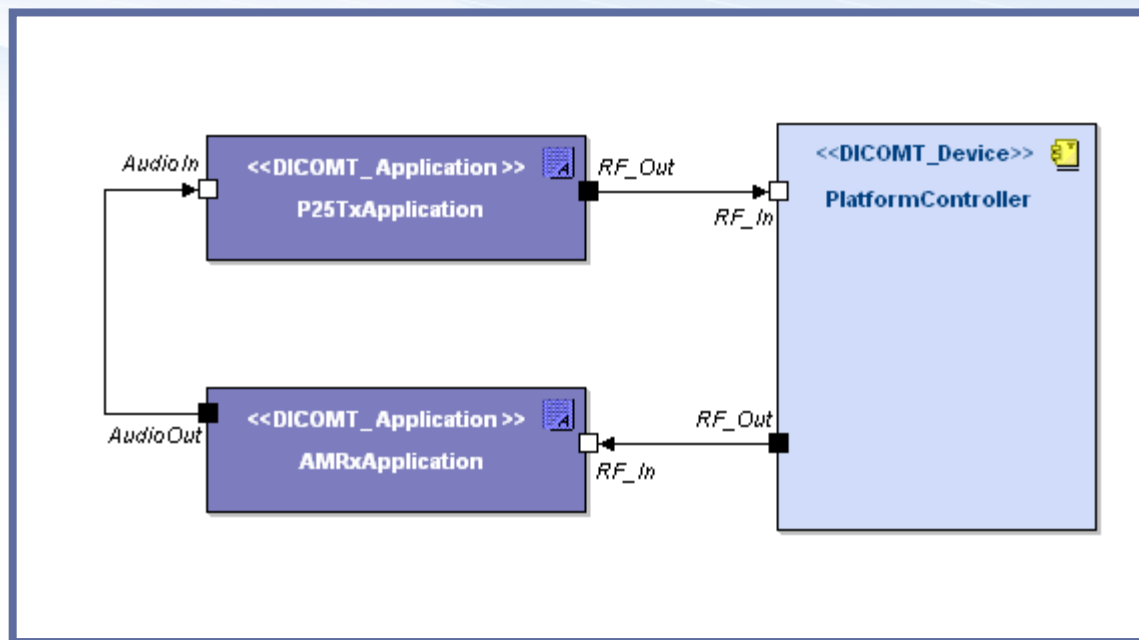


Application FM Receive bridged to P25 Transmit

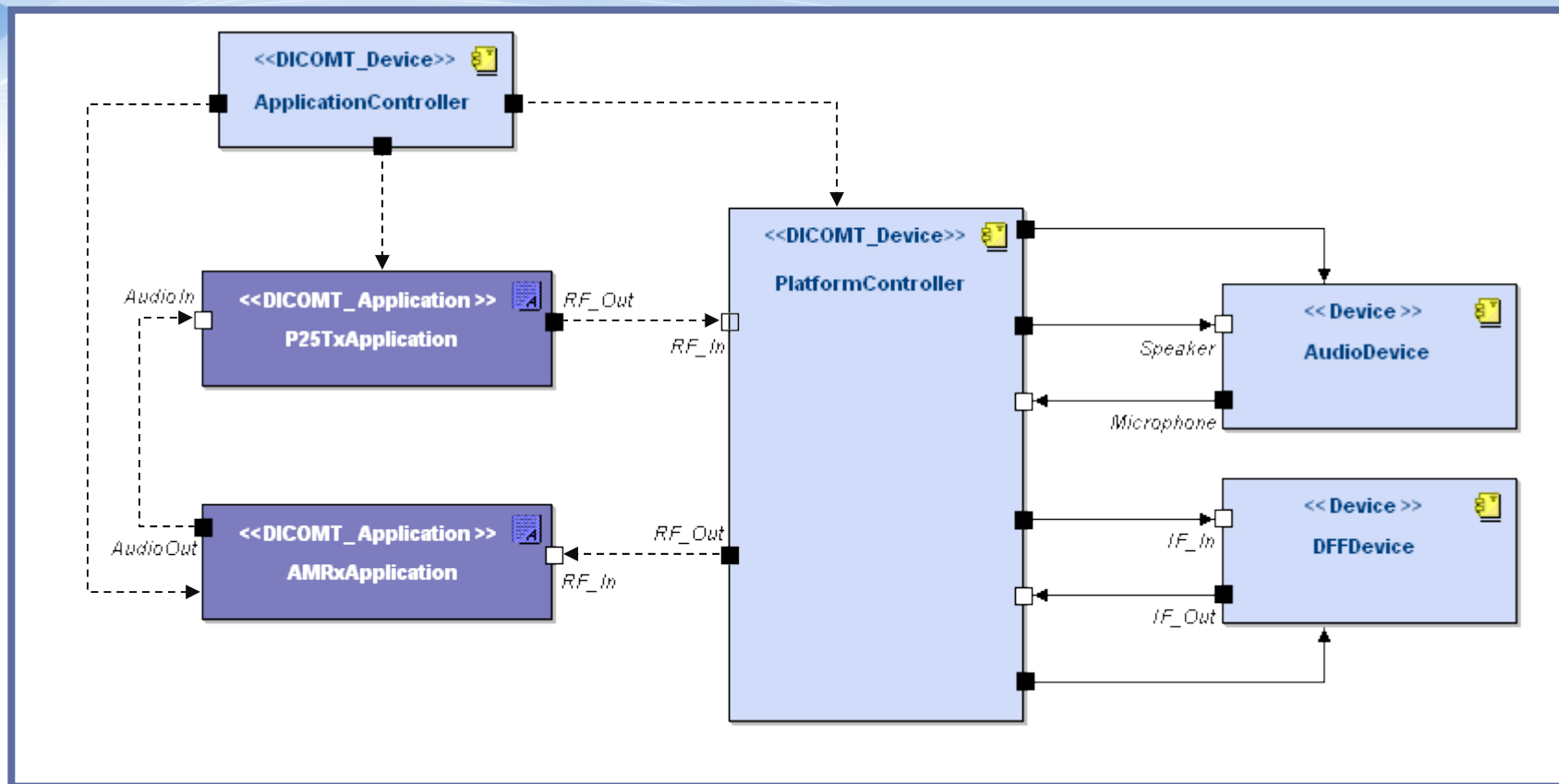
Solution: Stand-alone to DICOMT Application



Solution: DCOMT Super Application AM to P25



Solution: Deployed DCOMT Super Application AM to P25



- DICOMT new elements
 - DICOMT Application
 - an Application with external ports, reservation requests, response properties, and no Device connections
 - DICOMT Super Application
 - collection of DICOMT Applications
 - necessary connection details
 - inter-application
 - DICOMT Applications to Platform Controller
 - no executable binaries, only an XML description
 - DICOMT Software Assembly Descriptor (DSAD)

■ DICOMT Devices

■ Application Controller

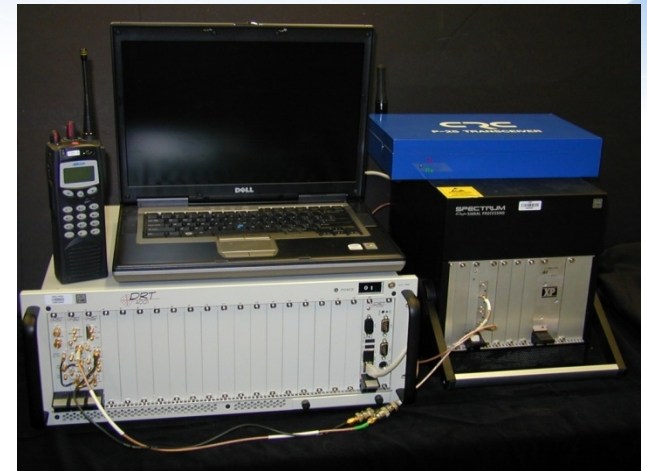
- loads and unloads Super Applications
 - loads DICOMT Applications
 - makes interapplication connections
 - makes Application to Platform Controller connections
- controlled by user interface

■ Platform Controller

- manages all devices (full knowledge and sole controller)
- responds to reservation requests, provides ports to match DICOMT Application requirements, and provides reservation responses
- supports Application Controller for interapplication connections
- active during setup, mostly passive afterwards
- in many ways acts like the Assembly Controller of the node

DICOMT Implementation

- Hardware
 - Spectrum Signal Processing SDR-4000
 - Digital Receiver Technology DRT-4001
 - Laptop computer
 - CRC digital interface board
 - integrated into SDR-4000

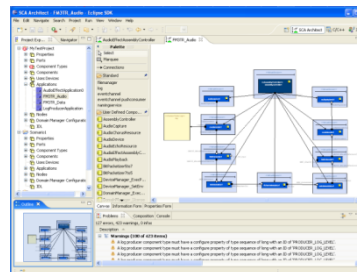


SPECTRUM
SIGNAL PROCESSING



DICOMT Implementation

- Software
 - PPC – Integrity and ORBexpress
 - GPP – Linux and TAO
 - CRC SCARI Software Development Suite
 - Waveforms
 - CRC SCA Architect
 - Xilinx System Generator and Foundation
 - User interface – based on CRC developed shell



- Successfully run stand-alone (non-DICOMT)
 - DVB-S up to 2 Mb/s against ComStream modem
 - AM voice against handheld
 - FM voice against handheld
 - P25 voice against handheld

- Successfully run Super Applications:
 - CRC's Audio Effects demonstration
 - AM Receive and AM Transmit Super Applications
 - FM Receive and FM Transmit Super Applications
 - P25 Receive and P25 Transmit Super Applications

Future Work

- Testing of bridging Super Applications
- Testing of modifying Super Applications at run-time (removing and adding Applications while other Application continue to run)

Conclusions

- Demonstrated feasibility and flexibility of a SDR solution to meet dynamic reconfigurations of waveforms at a crisis site.
- DICOMT solution, while maintaining SCA compliancy, enhances the SCA to allow better waveform portability, dynamic waveform selection and bridging of waveforms.
- DICOMT solution has been implemented and proved capable of supporting multiple waveforms and bridging.

Acknowledgements

- We would like to acknowledge
 - Funding from the Canadian Search and Rescue Secretariat
 - Contributions on signal processing from Dr. Ron Kerr
 - Contributions on Application Controller development by Dr. Juan Pablo Zamora Zapata
 - Support from the SCARl development team

Questions?