



# **Perspective on Software Defined Radio - Download and Reconfigurability for Radio Software**

**ITU Seminar on IMT-2000 and Systems Beyond  
Ottawa, 28 May 2002**

**Stephen M. Blust  
Chair SDR Forum**

**Director of Wireless Strategy  
Cingular Wireless  
stephen.blust@cingular.com  
+1 404 236 5924**



## Contents

Why “Download” in a Radio Software Context

Aspects of Radio Hardware, Radio Software, and Radio Software Download

SDR Forum Deliverables on Download

Summary

Appendix of Reference Information of SDR Forum

(Note: The Appendix material will not be spoken about in the presentation but is included as a reference section)

# **Why “Download” in a Radio Software Context and Why Now?**

## The 'Why'

- Industry Critical Aspect for Future Business Success
- Right Timing for Marketplace, Technology & Regulatory
- Radio Software Download can be in standards as required and in products to hit mass deployment cycle of 3G – must start NOW!
- Best suited to SDR Implementations and also applicable to many Non-SDR Implementations

**In short: We as a wireless industry will need this to survive in the increasingly competitive marketplace as we field evermore complex systems built to complicated standards developed by committee for rapid time to market – We don't have the time and money to keep doing products over and over again until we get it right!**



## **SDR Forum Commissioned Study by Gartner Group (Jan/02) - One Key Finding -**

- The open-ended question on the benefit of SDR resulted in a broad set of responses
  - **Wireless operators believe that SDR technology will have a great benefit in fixing bugs in handsets**
  - Military groups identified the key benefits of SDR as “Interoperability”, “Cost Effectiveness” and “Flexibility”
  - Civil groups believe that SDR will bring “New Services”, “Access to Multiple Frequencies” and “Third-party Applications”
  - Vendors see SDR as an opportunity for cost reduction and device flexibility

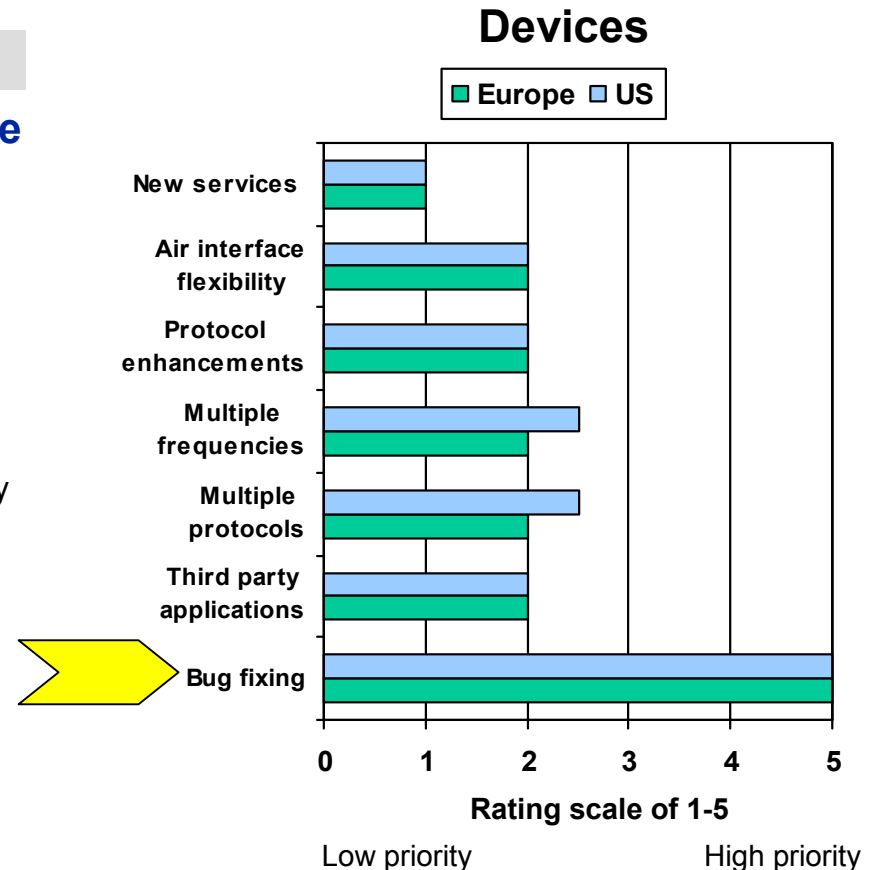


## Key Findings - Reconfigurability

- Premise:
  - **SDR will allow operating parameters of base stations and devices to be modified remotely, including software corrections**
- Conclusion:
  - Wireless operators and vendors see software “bug fixes” as most important
    - Other identified factors were “Remote Re-flash” of devices and “Over-the-air provisioning”
  - Military groups see “Remote Network Management” as most important
  - Civil groups referred to “Over-the-air provisioning” and “Band Compatibility”

## A3: Wireless Operators - SDR Benefits -

- Q4: Benefits of using SDR in devices
  - **Bug fixing was the sole top choice by all operators - US and Europe**
    - Update handsets in the field
    - Avoid recalls / exchanges
  - US operators gave multiple standards a slightly higher rating than Europe
    - Nice to have feature, not mandatory
  - All operators concerned that a software OS in handsets will raise power consumption and handset size.
    - Operator priorities for handsets are long battery life and small size



**Bug fixing is the clear top choice driven by the need to smooth the introduction of 2.5/3G services**

# Aspects of Radio Hardware Radio Software and Radio Software Download



# Definitions

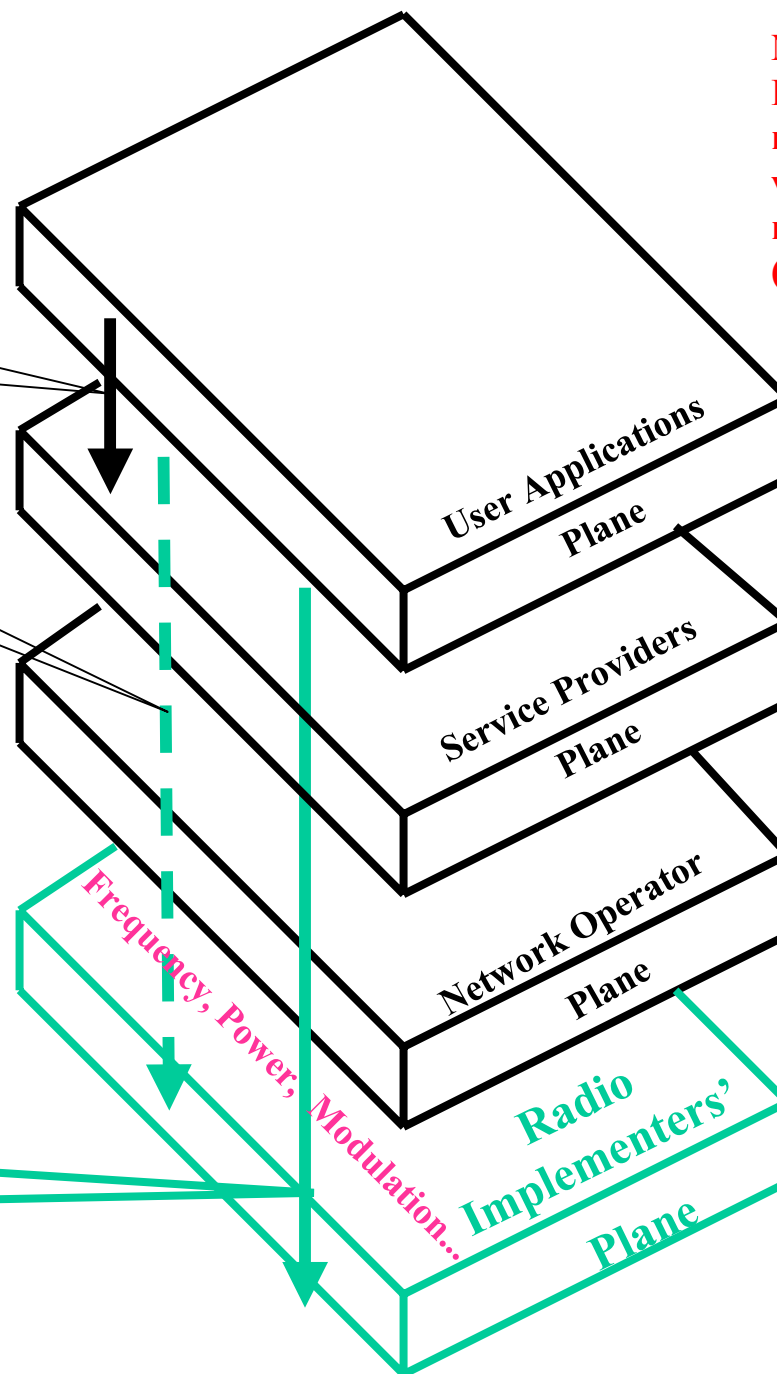
- Radio Hardware
  - The basic hardware within a wireless device that performs the radio interface functions and includes the radio RF as well as baseband signal processing.
- Radio Software
  - The primary software within a wireless device that is married with the radio hardware to derive the overall “radio” functionality. Ancillary software (such as control) that may be needed as a consequence of the primary software is an inherent part of this definition. Radio software is not to be confused with user applications, content and the like.
- Radio Software Download
  - The process of delivering information to a wireless device to alter the post manufacture operation, performance, or capabilities by causing changes in the radio hardware or software

Note: These definitions do not presume any particular method of implementation although SDR implementations may be more amenable to enjoying the benefits of these concepts.

User Request for  
New Service or  
Capability

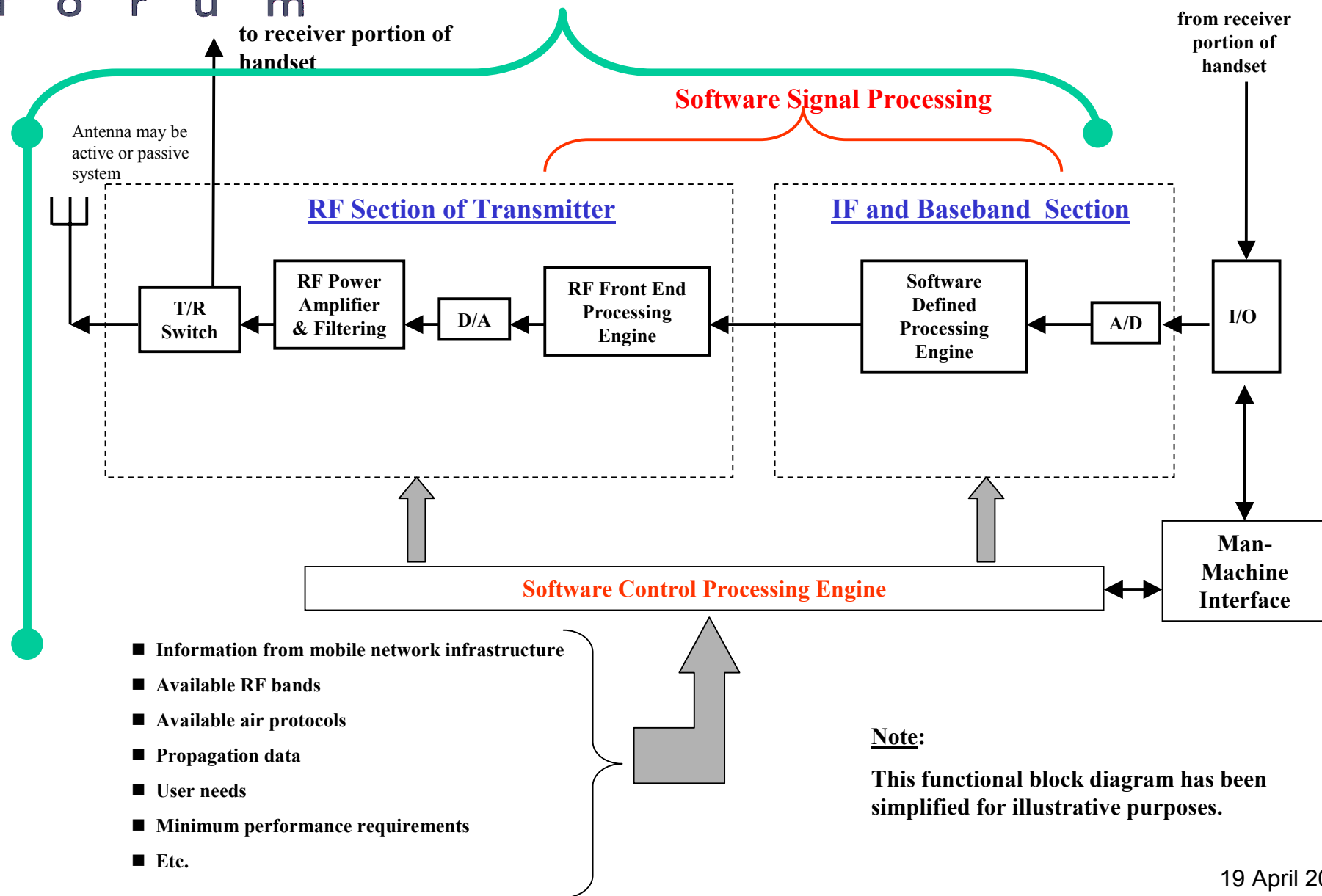
System Control

Software  
Download



**Note: In this perspective the Radio Implementers' Plane is intended to be more of a physical representation viewpoint that encompasses either a radio base station or a terminal (handset) or both.**

Radio Software





# Radio Hardware and Radio Software Combinations

- Initial radio hardware and radio software set tested together at time of initial manufacture
  - Parameters “established” at time of manufacture
    - Initial type approval, type acceptance, conformance declaration, etc....

## **Business as usual (?)**

- Initial radio hardware and revised radio software post manufacture emplaced in device via download
  - **What is the list of considerations?**
- Revised radio hardware and revised radio software
  - **What is the list of considerations?**



## Radio HW and SW Download Environments

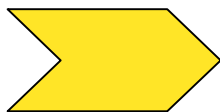
- Local Environment
  - Attached cable,
  - Infrared,
  - Bluetooth,
  - etcbut not over the radio interface
- Remote Environment
  - Over-the-airvia the actual radio interface in the device  
through the supporting core radio network

## Considerations for Radio Software Download

- Can be categorized in three distinct stages
  - Pre Download (preparatory)
  - During Download (procedural)
  - Post Download (installing)
- Each stage has a set of concerns that must be addressed both individually and collectively
- Common and standardized global solutions for these concerns preferred by stakeholders
  - Manufacturers
  - Regulators
  - Network Operators and Service Providers
  - Users

## What are the implications and tasks?

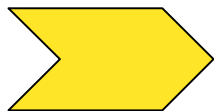
- Developments in the field of testing of radio hardware and radio software combinations
- Developments of download standards for radio software to be globally accepted and common across differing radio air interfaces and core networks to address
  - the combinations (revised sw or revised hw/sw)
  - the environments
  - the three stages (pre, during, and post download)



How do the combinations, environments and stages relate and cause the download solutions to be altered or different in design and definition?

## Pre-Download Stage Implications

- Has a measure of controllability and can be queried and communicated with
- Security and integrity of the radio hardware and software in current configuration
  - What has been done by whom and when and why in the past
- Knowledge of the state, function, vintage and status of radio hw/sw in current configuration
  - verification and auditing
- Etc.....

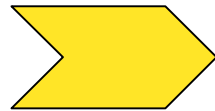


Process, protocols, procedures.....



## During Download Stage Implications

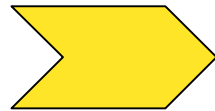
- Integrity
- Authentication
- Security
- Non-repudiation
- Etc.....



Process, protocols, procedures.....

## Post-Download Stage Implications

- Validation of downloaded software
- In-situ testing
- Mechanisms to switch from old to new
- Means to revert back
- Auditing
- Traceability
- Etc.....



Process, protocols, procedures.....



## **SDR Forum Deliverables on Download**

## **Download WG**

Mr. Jim Hoffmeyer – Western Telecom Consulting Inc.

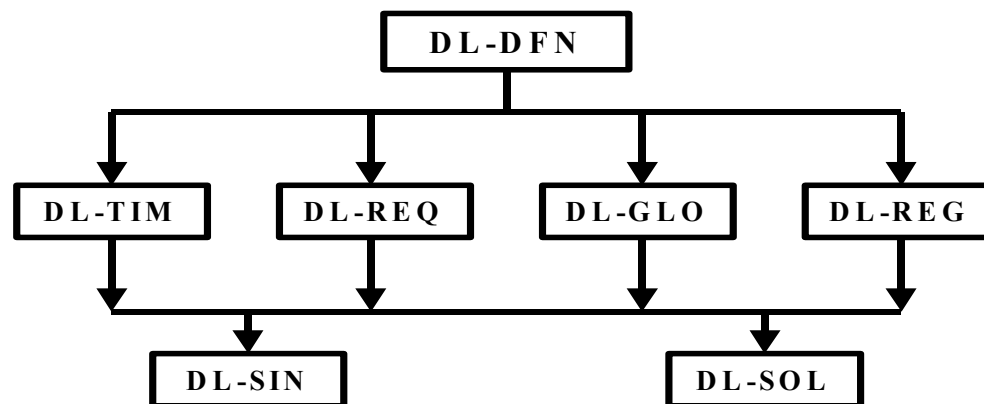
### **Deliverable:**

- **Defining download of software for reconfiguration in a technical and regulatory context**
- **Global radio technology development for software download**
- **Download timelines**
- **Global regulatory views on software download**
- **Requirements for software download for RF reconfiguration**
- **Download security and integrity**
- **Download solutions**

### **Short Title and Date**

- **DL-DFN) {6/2002}**
- **(DL-GLO) {6/2002 & 9/2002}**
- **(DL-TIM) {6/2002 & 9/2002}**
- **(DL-REG) {6/2002 & 11/2002}**
- **(DL-REQ) {6/2002}**
- **(DL-SIN) {9/2002}**
- **(DL-SOL) {9/2002}**

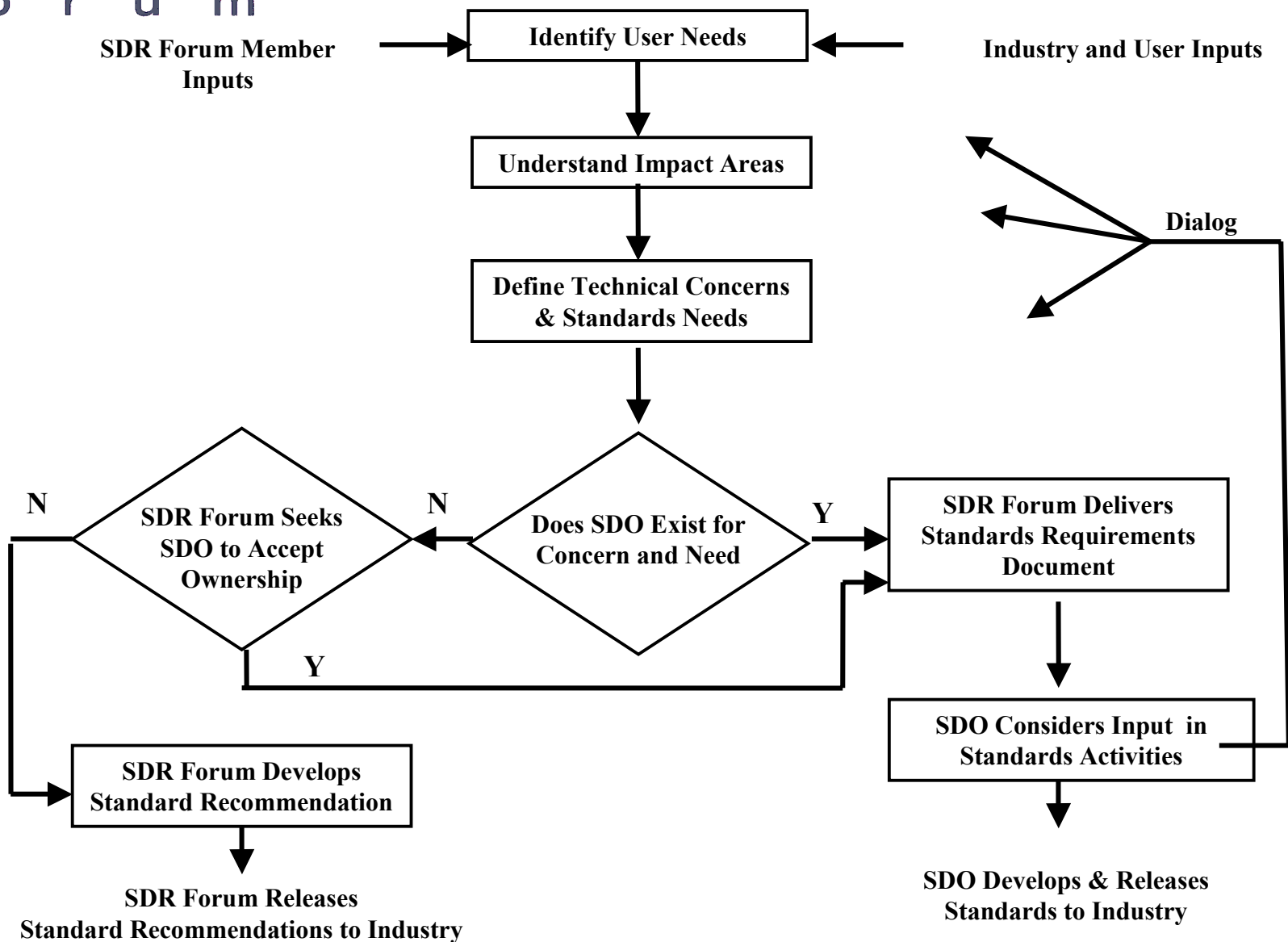
## Download Deliverables Relationships



**Relationship of SDR Forum Download Documents**



## SDR Forum Process





## Summary



## Summary (1)

- The SDR Forum is addressing the real needs of SDR development as it looks towards implementation and application of SDRs in a variety of marketplaces.
  - Download and reconfiguration are just one significant area of the many that will be critical to the wireless industry.
- The SDR Forum has an active technical specification and standards development program.
  - We invite infrastructure and terminal manufacturers, network operators and service providers, etc. to participate in the download work.
- The SDR Forum continues an active program to promote public policy decisions to facilitate SDR adoption and deployment.
  - We will continue to assist regulators in understanding these developments and in defining a coordinated global perspective on SDR.





## Summary (2)

- The SDR Forum is actively cultivating liaisons and interfaces with relevant external organizations to facilitate the production of the standards for developments such as **Radio Software Download** –
  - Forum deliverables are the catalyst; embodying the requirements, and will serve as a starting point for the initial elements of the specifications...
  - “Bits and Bytes” details are best addressed in relevant PPs, SDOs, etc, through liaison activities of the Forum and with relevant contributions from Forum members.
  - “Global perspectives on SDR, in work such as that of the ITU-R WP 8F and ITU-T SSG, is also required and appropriate.

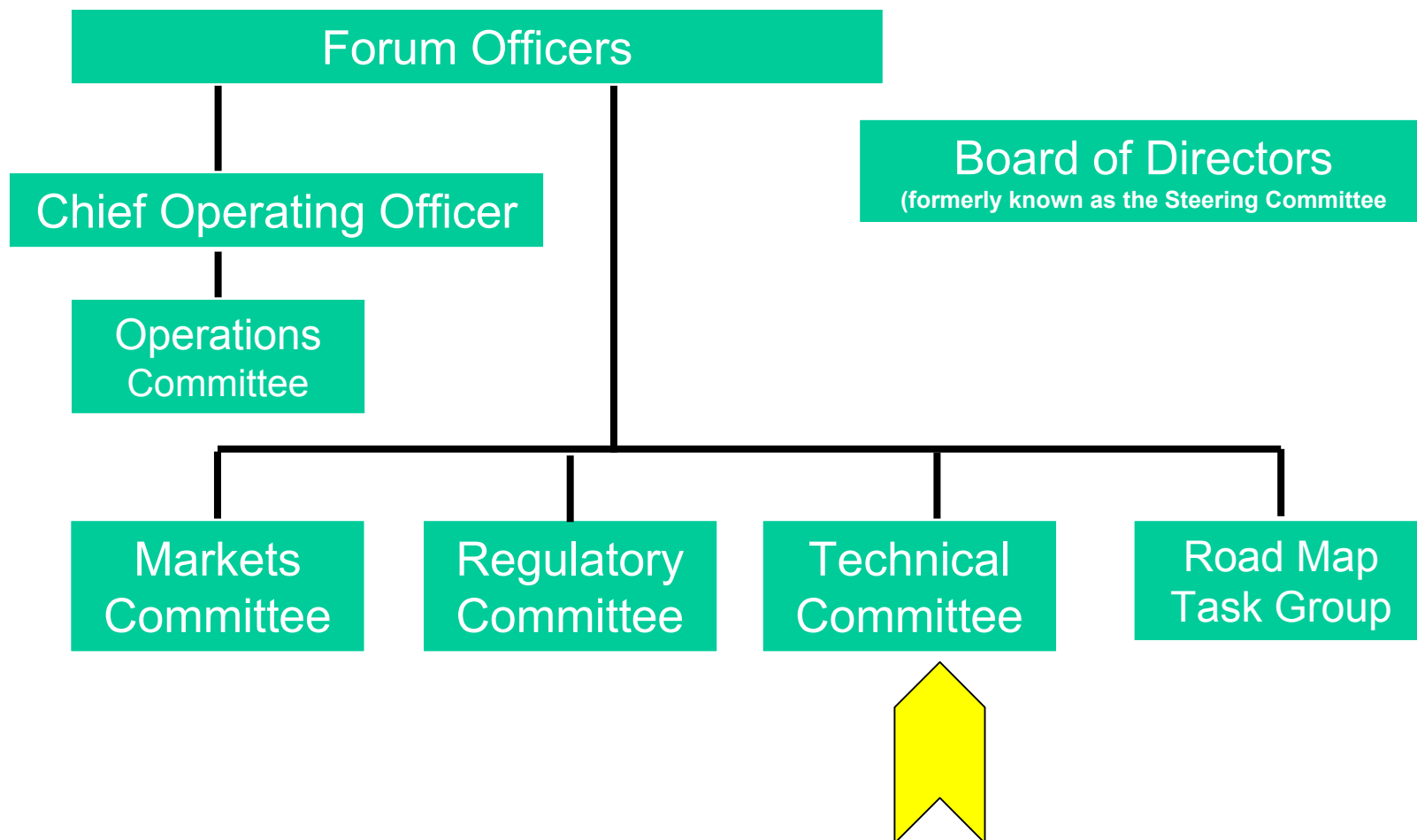
## **Appendix A: General Information for Reference**



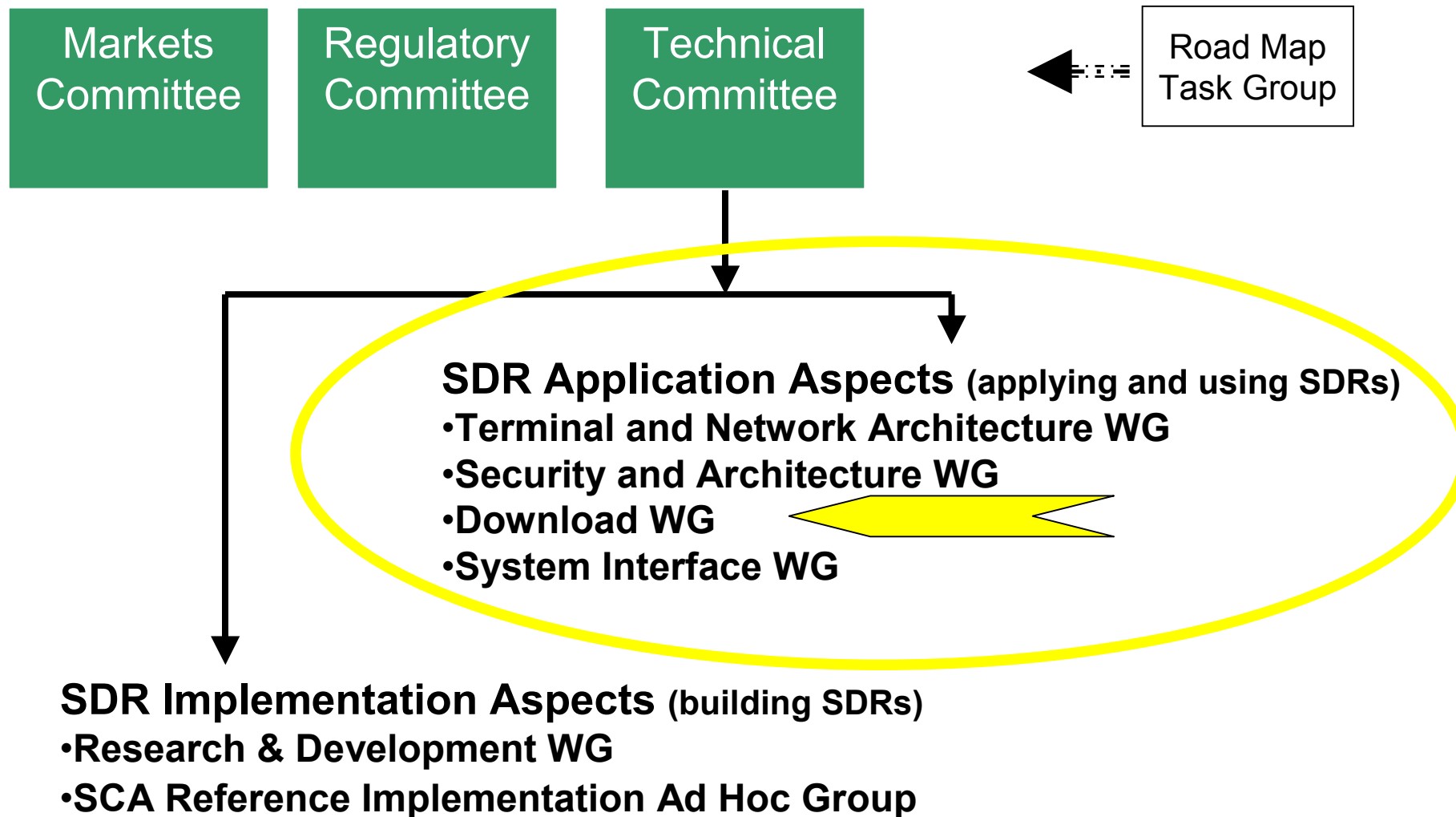
## Mission and Charter

- Mission
  - Non-profit, international, open membership corporation established in 1996 to accelerate the proliferation of software-definable radio systems
  
- Charter
  - Develop and promulgate uniform requirements and standards for SDR technologies
  - Conduct cooperative research
  - Prepare and disseminate informational materials
  - Bring together interested parties to promote global compatibility and interoperability in the wireless industry
  - Cooperatively address the unique regulatory needs of particular nations and market sectors while preserving common platforms and methodologies

## SDR Forum Structure



## ***Technical Committee Detailed View***





## **Download Working Group**

**Study principally the technical aspects of software download to SDR devices, whether over-the-air or via other means, and includes questions related to RF reconfiguration of the equipment.**

**Develop and publish information regarding definitions, requirements, concepts, timelines and other features of SDR downloads for the wireless industry to stimulate and drive the development of appropriate standards that address the ability of software based radio devices to be reconfigured in a proper manner subsequent to manufacture and/or deployment**



**SDR Forum Website**  
**<http://www.sdrforum.org>**

- **Public Area**
  - General Forum information
  - Meeting information
  - Selected documents **(including 2002 Unified Workplan Details)**
- **Member Area**
  - ID and Password required to access
  - Reports and other deliverables
  - Used for committee and working group
    - Completed work
    - Work in “ballot” review
    - Work in progress
- **Links of Interest**
  - General info
  - Member company links
  - Other



## Organization – Board of Directors

**Stephen M. Blust**  
Cingular Wireless  
*Chair\**

**Ken Riordan**  
Motorola  
*Vice Chair\**

**Christian Serra**  
Thales  
*Vice Chair\**

**Peter Cook**  
Peter G. Cook Consultancy  
*Treasurer\**

**John Fitton**  
Harris Corporation  
*Secretary\**

**Mark Cummings**  
enVia  
*Chairman of the Board\**

**Colin Phan**  
TRW  
*Markets Committee Chair\**

**John Bard**  
Space Coast  
Communications  
*Technical Committee Chair\**

**Richard Shrum**  
IITRI  
*Government/  
Non-profit  
Representative*

**Dr. Bruce Fette**  
General Dynamics  
*Large Company  
Representative*

**Jack Rosa**  
Hypres  
*Medium Company  
Representative*

**Andy Feldstein**  
Innovative Concepts  
*Small Company  
Representative*

**Mike Chartier**  
Intel  
*Regulatory  
Committee Chair*

**Calinel Pasteanu**  
Siemens  
*ITU Region 1*

**Claude Belisle**  
Communications  
Research Centre  
*ITU Region 2*

**Takuzo Fujii**  
Hitachi Kokusai  
*ITU Region 3*

**Stephen Hope**  
Orange PCS  
*Service Provider  
Representative*

**Vacant**  
*At Large Representative*

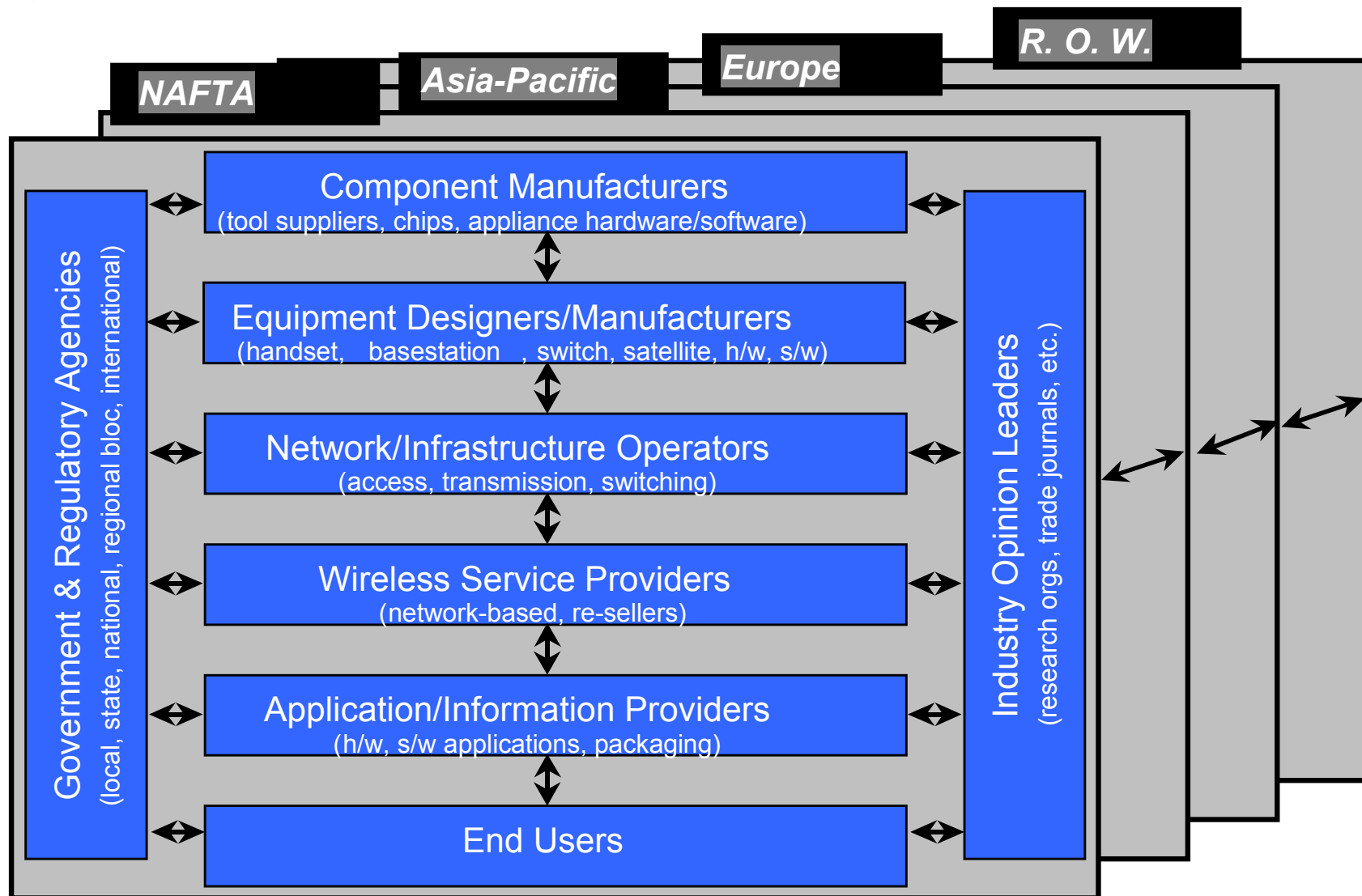
*\*Officer of the Forum*





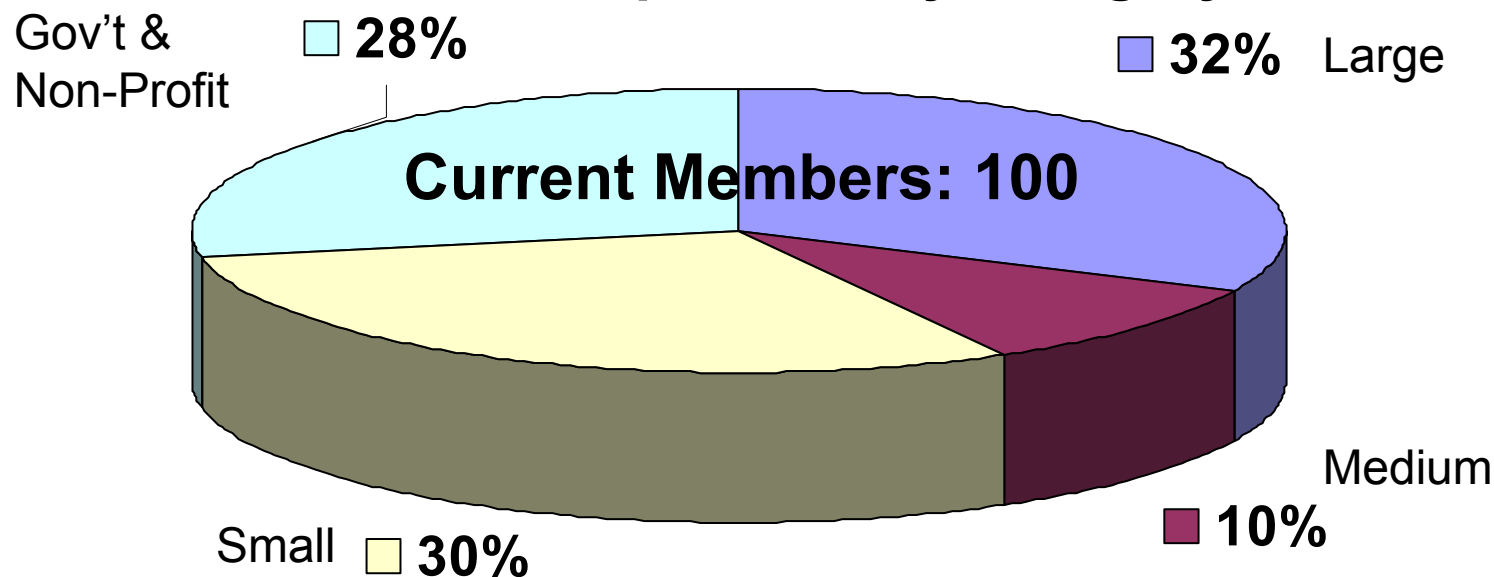
# Forum Demographics

## Members



Source: SDR Forum

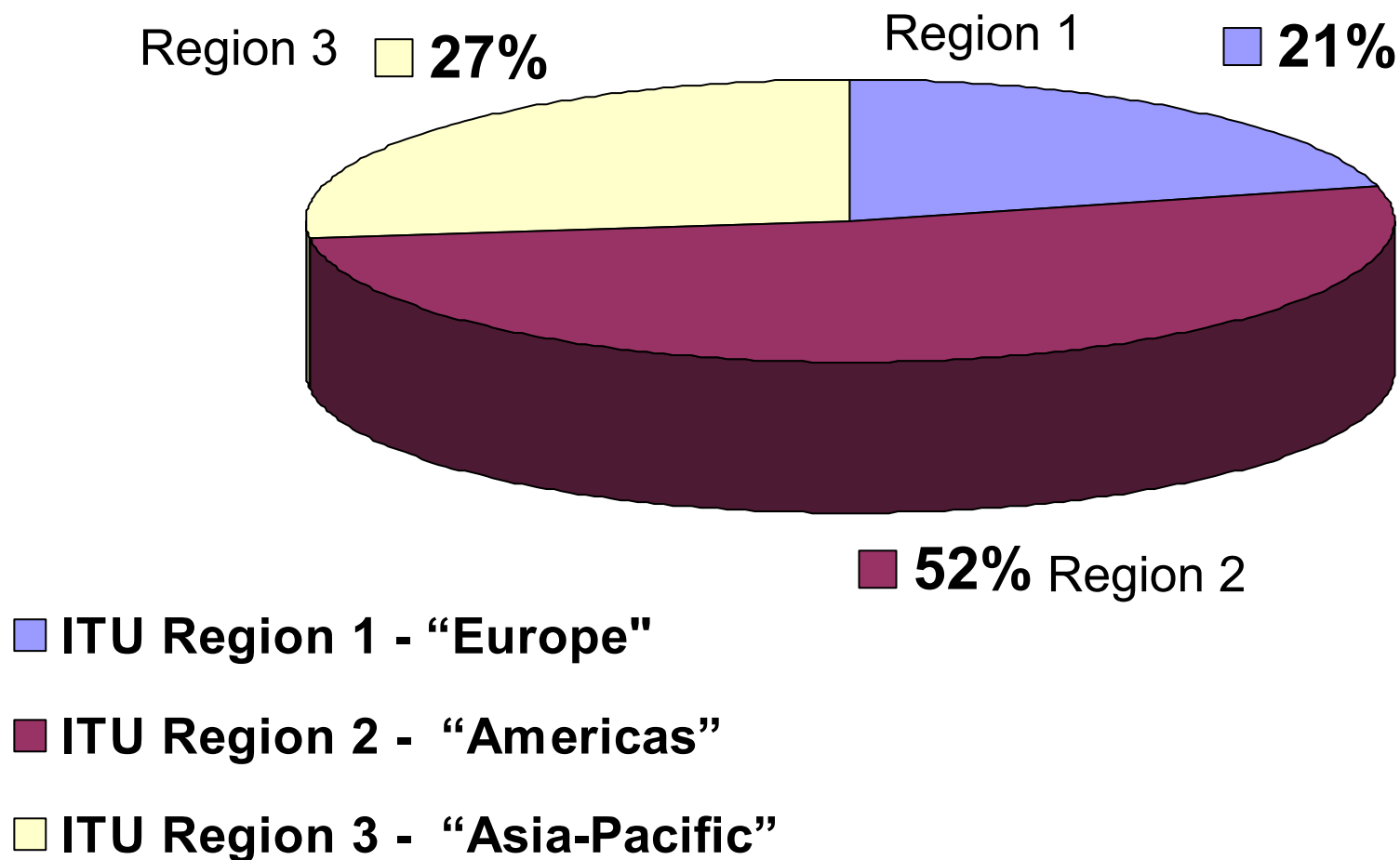
## Members Composition By Category



- Large Company - Revenues >100 million US dollars (USD)
- Medium Company - Revenues > 10 million and < 100 million USD
- Small Company - Revenues < 10 million
- Government and Non-Profit

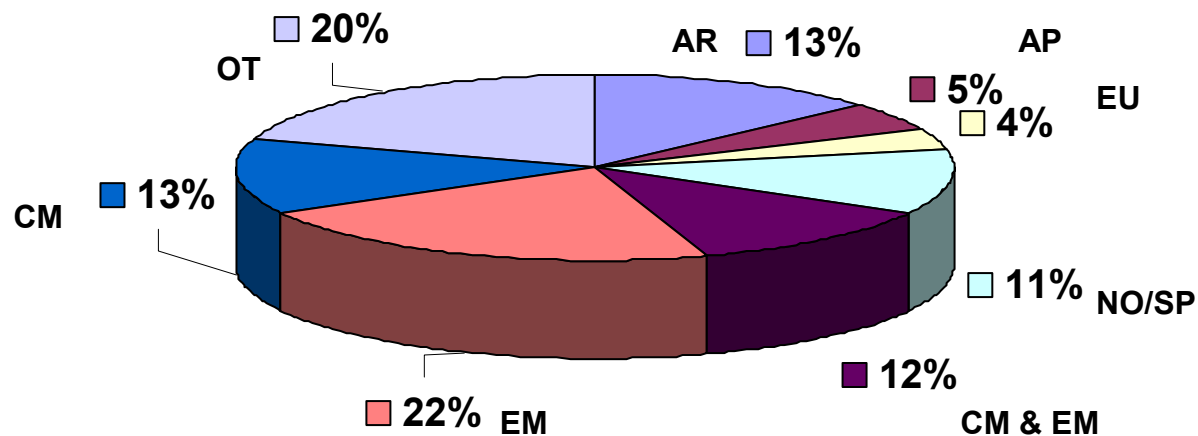
As of 1Q 02

## Members Composition By Global Region



As of 1Q 02

## Members Composition By Segment



- AR - Academia and Research
- AP - Application/ Information Providers
- EU - End Users
- NO/SP - Network Operators/Service Providers
- CM & EM - Both Component & Equipment Designers/Manufacturers
- EM - Equipment Designers/ Manufacturers
- CM - Component Manufacturers
- OT - Other

As of 1Q 02

- **Five Major Meetings Per Year**

- **February - Winter Meeting, generally held in USA**
  - 5-7 February 2002 Dallas TX USA
- **April - Spring Meeting, generally held in Asia-Pacific region**
  - 16-18 April 2002 Tokyo, JAPAN
- **June - Summer Meeting, generally held in USA**
  - 11-13 June 2002 Boston, MA USA
- **September - Fall Meeting, generally held in Europe**
  - 18-20 September 2002 Edinburgh, SCOTLAND
- **November – Regular +Annual Business Meeting+ Technical Conference generally held in USA**
  - 11-15 November 2002 San Diego CA USA



# 2002 Software Defined Radio Technical Conference and Product Exposition

<http://www.sdrforum.org/sdr02/main.html>

**11, 12 November 2002 -- San Diego, California**

The Software Defined Radio Forum will sponsor a technical conference and product exposition in San Diego on 11, 12 November 2002. This conference will focus on technology, standards, and business activity related to software radios and will provide an international perspective of the current state of the art. Papers will be reviewed by both technical peers and business leaders and only those with the best combination of technical innovation, technical quality, and potential for broad impact in practical applications will be accepted.

The SDR community is invited to participate in this program and to share research results and the status of other activities. Some suggested topics are presented below, but consideration will be given to papers on other relevant subjects. Proceedings of the conference will be provided to participants.

## **1.0 Enabling technologies**

1.1 Apertures, 1.2 Hardware, 1.3 Software, 1.4 Firmware, 1.5 User & I/O, 1.6 Circuits & Chips, 1.7 Waveforms

## **2.0 Integration with existing infrastructure**

2.1 Networking/protocols, 2.2 Signaling, 2.3 SW download

## **3.0 System design**

3.1 Security, 3.2 Stability, 3.3 Maintenance

## **4.0 System performance & optimization**

4.1 Spectral efficiency, 4.2 Latency, 4.3 Management

## **5.0 Business model**

5.1 User applications, 5.2 Retail, 5.3 Network operator,  
5.4 Business model changes

## **6.0 Evolution of SDR technology**

6.1 Commercial, 6.2 Military, 6.3 Civil,  
6.4 Forthcoming products

## **7.0 Regulatory aspects of SDR**

7.1 Global regulatory issues,  
7.2 Effects on society

## **8.0 Market analysis**

## **9.0 SDR research topics**

9.1 Languages, 9.2 Development tools

## **10.0 Radio Virtual Machine**

## **11.0 Tutorials**

## **12.0 Other**



## Biography

**Stephen M. BLUST, P.E.**

Director of Wireless Standards

Cingular Wireless

5565 Glenridge Connector

Suite 950

Atlanta, GA 30342 USA

Phone +1 404 236 5924

Fax +1 404 236 5949

E-mail [stephen.blust@cingular.com](mailto:stephen.blust@cingular.com)

### BIOGRAPHY

Stephen M. Blust (P.E.) is Director of Wireless Standards at Cingular Wireless located in Atlanta, Georgia, USA. He is responsible for wireless standards activities in support of corporate strategies related to the business impacts of evolving and future technology. His background includes more than 30 years in wireline and wireless telecommunications, and spans radio engineering, services and architecture development, standards, regulatory support, and strategic planning. Mr. Blust is chair of the Software Defined Radio Forum, an international industry association dedicated to supporting the development and deployment of software defined radio systems. He is also Chair of Working Party 8F (WP 8F), addressing IMT-2000 and beyond (3G) within the Radiocommunication Sector of the International Telecommunications Union

Mr. Blust holds a B.Sc. in Electrical Engineering from Tulane University and is a member of Tau Beta Pi and Eta Kappa Nu. Mr. Blust is a member of the IEEE and is a Registered Professional Engineer. He has authored a number of articles on software defined radio, and IMT-2000 and is a patent holder.