

A decorative graphic on the left side of the slide shows a blue and white globe with a white airplane flying across it, leaving a white contrail. The globe is partially obscured by a blue and yellow geometric shape at the bottom left.

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# **Software Radio (R) Evolution and Its Application to Aeronautical Mobile Communications**

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**May 19-22, 2003**

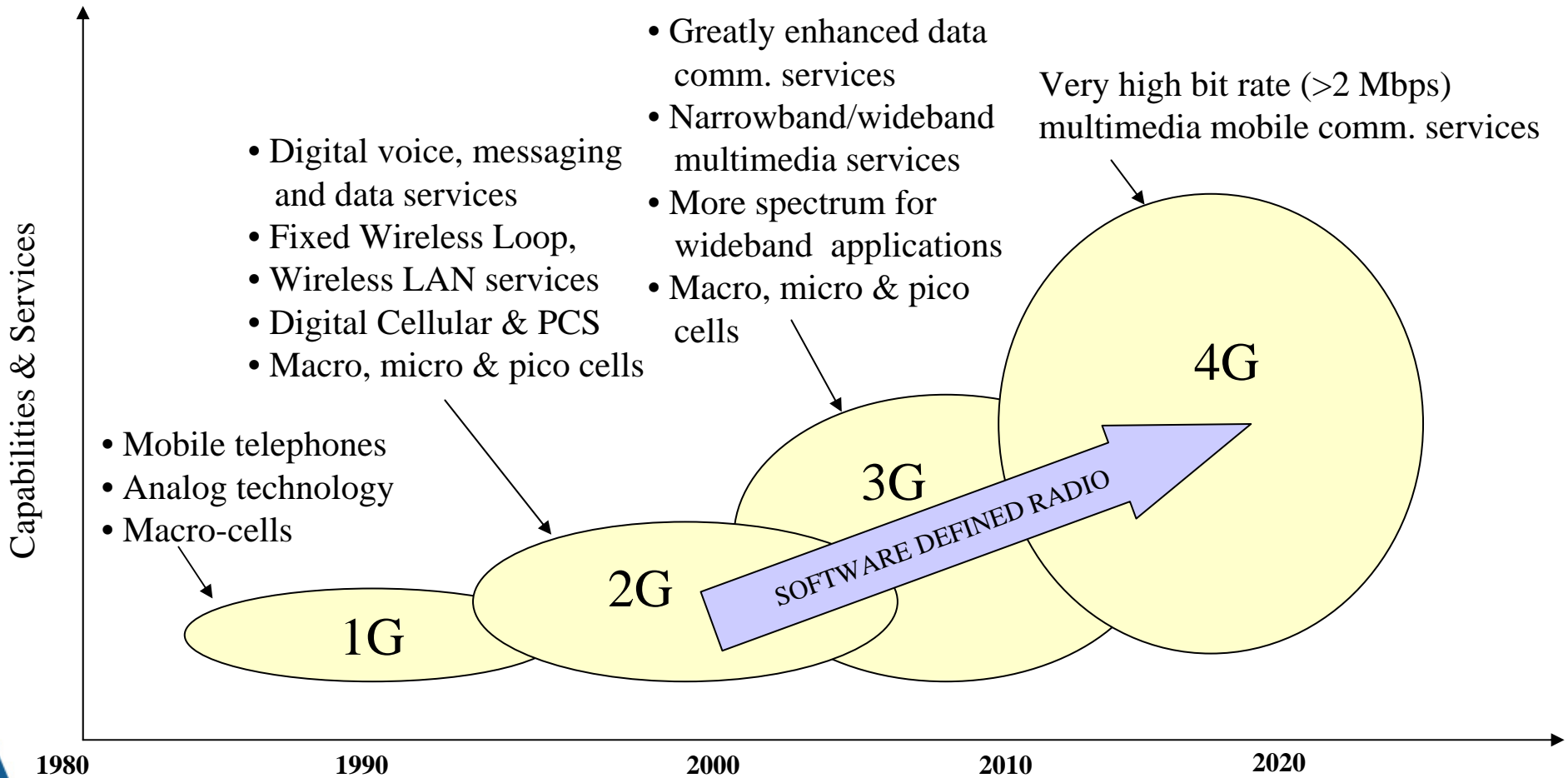
**Integrated CNS Conference**

# Topics

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- **Background**
- **Software Radio Definition**
- **Software Radio Evolution: A Worldwide Migration toward Software Radio Technology**
- **Software Radio for Aeronautical A/G Communications**
- **Summary**

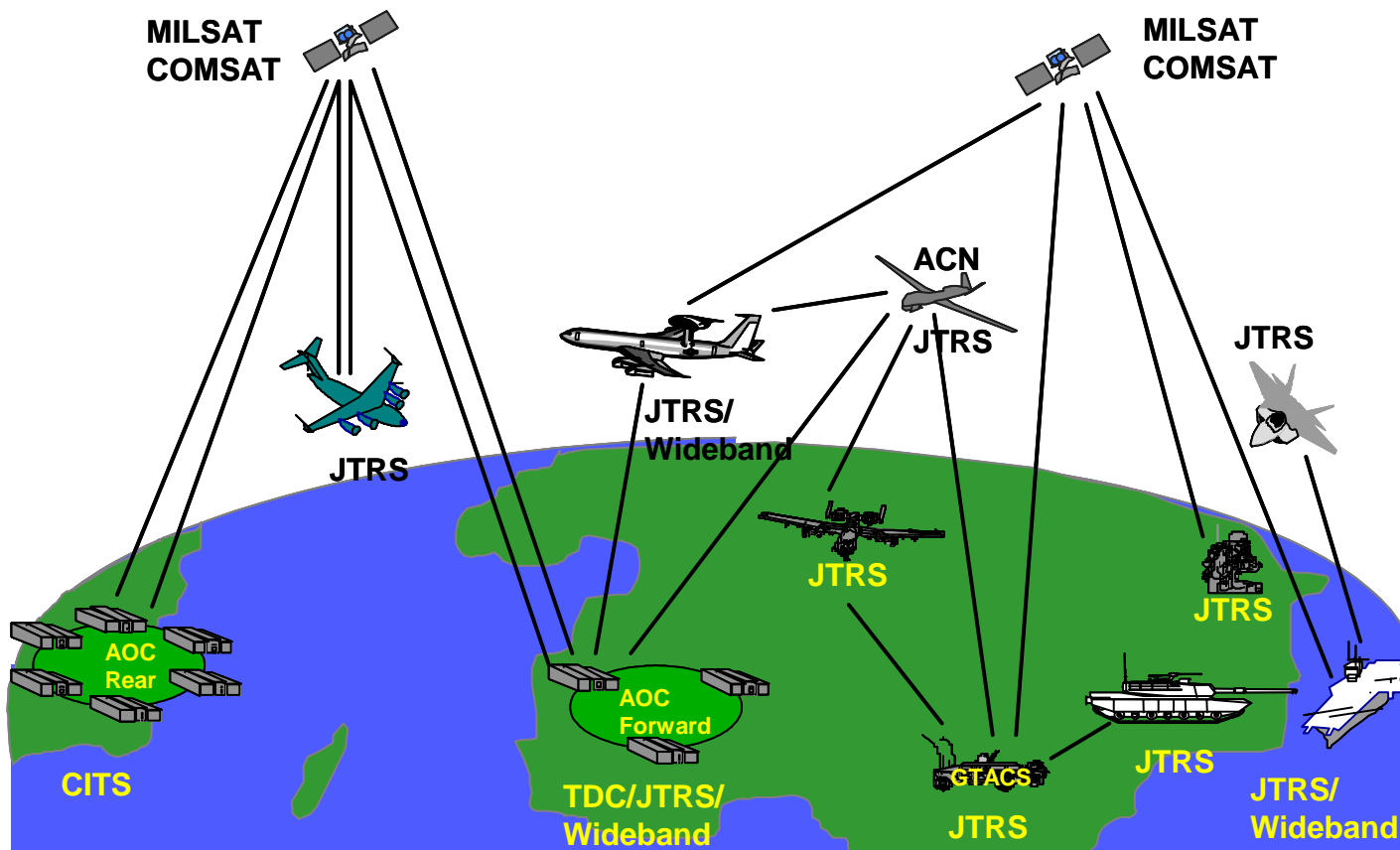
# Global Commercial Telecommunications Industry is Migrating to Software Radio Technology



**MITRE** Source: SDR Forum, “Perspective and Views on Regulatory Aspects of Software Defined Radio” Working Paper, January 2002.



# The U.S. Government is Migrating to Software Radio Technology



Source: Campbell, William, "JTRS Industry Day" presentation

# What is Software Radio?

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- **The FCC and Software Defined Radio (SDR) Forum are working together to formulate an official definition**
  - Various definitions of SDR exist today (e.g. NTIA/ITS, SDR Forum)
- ***“Software Defined Radio is a radio that is flexible (programmable) to accommodate various physical layer formats and protocols”***
  - **Joe Mitola (MITRE) coined this working definition in 1991**
  - **Implied from the definition, SDR is a multiband multimode radio with dynamic capability defined through software covering all layers of the OSI protocols stack**

**NTIA: National Telecommunications and Information Administration**  
**ITS: Institute for Telecommunication Sciences**

# SDR Evolution in the United States

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- **SDR concept started in the late 1970s with the introduction of multimode radios operating in VHF band**
- **U.S. Air Force Avionics Laboratory initiated the Integrated Communication, Navigation, Identification and Avionics (ICNIA) program in the late 1970s**
  - **Developed an architecture to support multifunctional, multiband airborne radios in the 30 MHz -1600 MHz band**
  - **Successful flight test and final report delivery in 1992**
  - **ICNIA radio was the first programmable radio**
- **In the late 1980s, the Air Force Research Laboratory initiated the Tactical Anti-Jam Programmable Signal processor (TAJPSP)**
  - **Developed a processor capable of simultaneous waveform operations using modular approach**
  - **TAJPSP later evolved into the SPEAKeasy program**

# SDR Evolution in the United States

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- **SPEAKeasy** was a joint U.S. Government program to develop the architecture and technology to meet future military requirements for multimedia networking operations
  - The first significant military investment to integrate various existing radio families into one family
  - COTS-based architecture
  - Demonstrated multiband, multimode radio capabilities in 1998
  - SPEAKeasy evolved into the Joint Tactical Radio System (JTRS)
- **JTRS Joint Program Office** was established in 1999
  - Envisioned to be the next generation tactical radio for future advanced military operations
  - Mission is to *“acquire a family of affordable, high-capacity tactical radios to provide interoperable LOS/BLOS C4I capabilities to the war fighters”*
  - The SDR Forum provides expertise in software radio technology for the JTRS program
  - The Object Management Group is working toward building an international commercial standard on the Software Communications Architecture (SCA)

# SDR Evolution in Europe

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- **R&D in Advanced Communications in Europe (RACE) and Advanced Communications Technology and Services (ACTS) programs**
  - ACTS projects, **FIRST** and **FRAMES**, used software radios to investigate next-generation air-interfaces
- **RACE and ACTS focus on incorporating 3G and potentially 4G standards into its Global System for Mobile (GSM) Communications network**
  - Pave the way for more capable and more powerful products and flexible services
  - Key research areas include receiver architecture, baseband DSP architecture, enabling technologies

**FIRST: Flexible Integrated Radio System and Technology**



**FRAMES: Future Radio Wideband Multiple Access System**





# SDR Evolution in ASIA

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- **In 1999, Japanese Institute of Electronics, Information and Communication Engineers (IEICE) software radio group was formed**
  - **Held technical conferences, workshops, panel discussions and symposia, in conjunction with SDR Forum Radio**
- **In 2000, Korea Electromagnetic Engineering Society (KEES) sponsored a workshop to monitor software radio activities in Korea, Japan and Taiwan**
- **IEICE and KEES mission:**
  - **Promote R&D in SDR**
  - **Allow protocol, software, hardware to be easily integrated for future radio system**
  - **Foster cross-organization and collaboration among academia, industries and governments**
  - **Organize symposia and workshops on SDR**

# **SDR for A/G Communications:**

## **Why should the aviation community be interested in SDR technology?**

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- **SDR can provide potential benefits for aviation community**
  - **Accommodate multiple air-interface standards**
  - **Facilitate transition by bridging legacy and future technologies**
  - **Allow multiple services – incentives for equipage**
  - **Implement “future-proof” concept – capable for insertions of future technologies and allow easy upgrades**
  - **Implement open-architecture to allow multiple vendors to supply or participate, offer declining prices**
  - **Reduce product development time**
  - **Enable other advanced commercial technologies to be adapted to offer user’s services and benefits**

# Future Outlook

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- **Software Defined Radio is a promising technology and has gained worldwide interest and support from commercial industries and government agencies**
- **Is the Software Communication Architecture (SCA) as used in JTRS applicable for commercial aviation ?**
  - 25 kHz AM, 8.33 kHz AM, VDL have been included in the JTRS waveform library
- **Questions remain to be addressed for using software radio for aviation**
  - Cost
  - Certification