

New International Digital audio-broadcasting standard, voice coding and amateur radio applications

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Hamvention, Dayton, Ohio, USA

May 19 2002

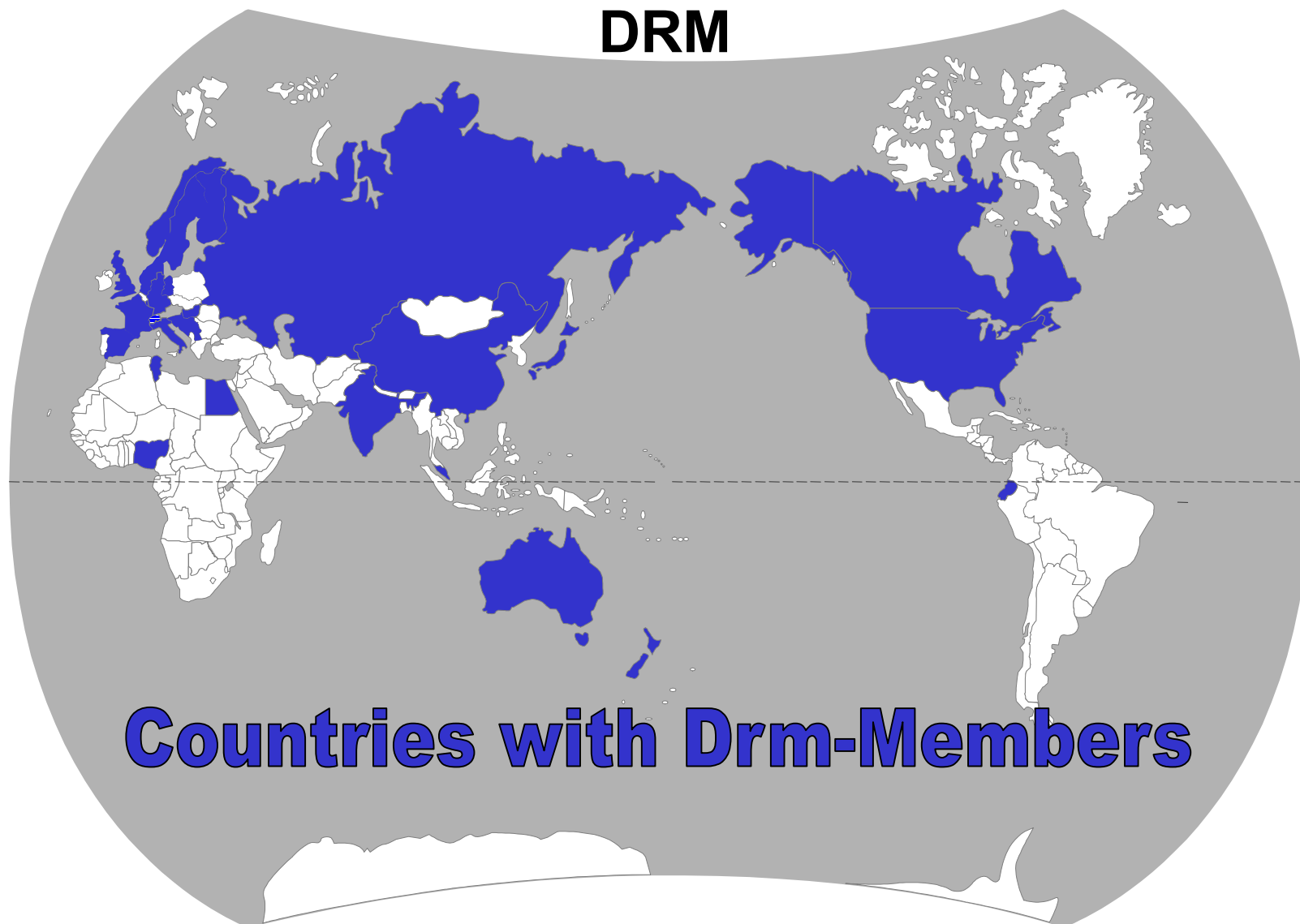
Summary

- **Digital Radio Mondiale**
- **HF High data rate Modem**
- **Speech coders**
- **Digital Amateur Radio 3 kHz demonstrator**

DRM

- **World-wide consortium to promote a unique standard for digital LF, MF & HF audio-broadcasting**
- **Members include :**
 - ➔ Broadcasters and Broadcasting associations
 - ➔ Network Operators
 - ➔ Research Institutes
 - ➔ Component, Receiver and Transmitter Manufacturers
 - ➔ Regulatory and Standardisation Authorities
- **Key features:**
 - ➔ Worldwide standard
 - ➔ Better audio quality
 - ➔ Simple to use receivers
 - ➔ Low cost equipment
 - ➔ Text message
 - ➔ Data applications
 - ➔ Provide future enhancements





73 DRM-Members from 27 countries, Feb 2002

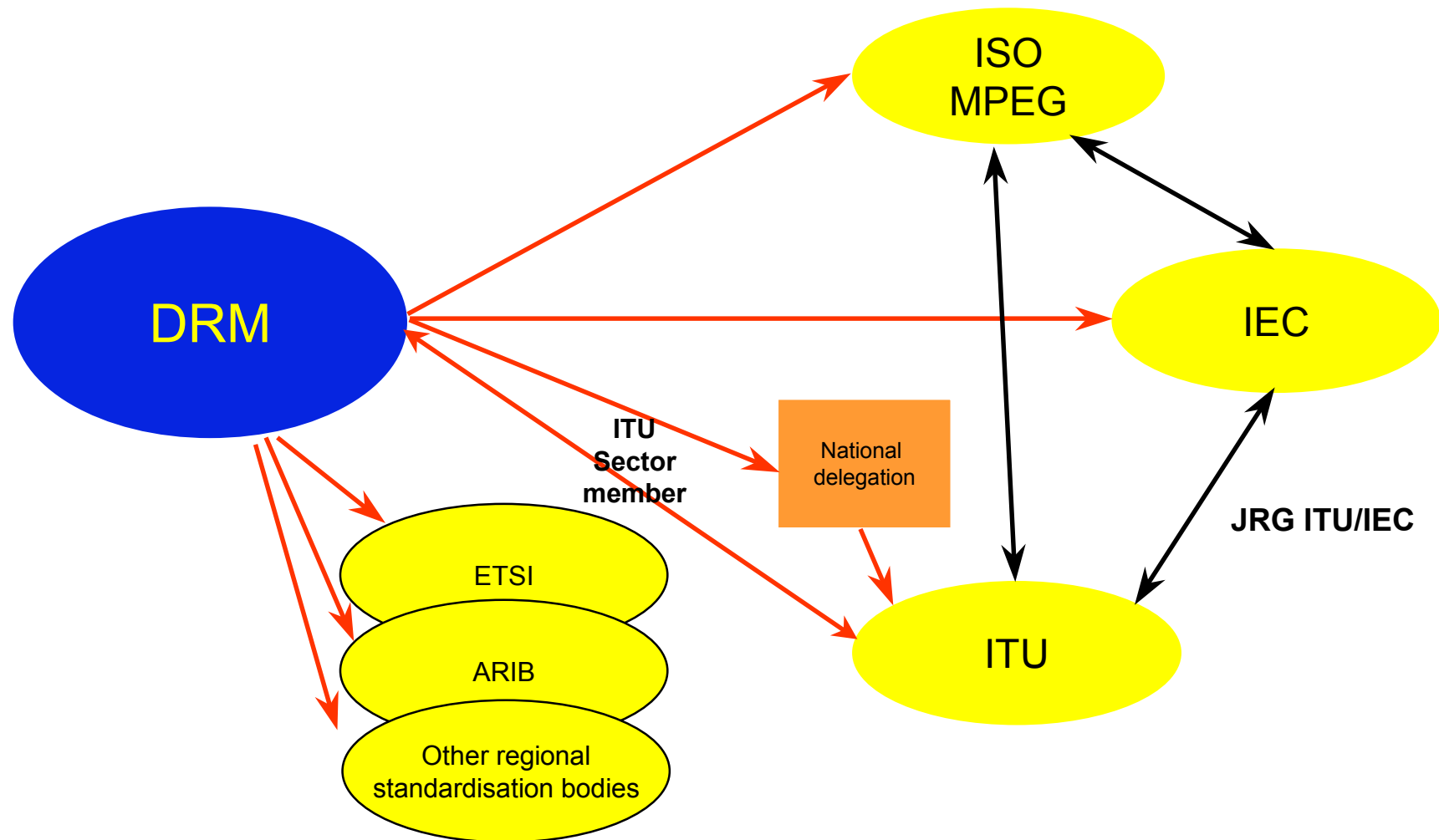
DRM Members

- **See www.drm.org for more details**

- **USA**
 - Harris Broadcast
 - International Broadcasting Bureau
 - Continental Electronics Corporation
 - Sangean America Inc.
 - Technology for Communications International

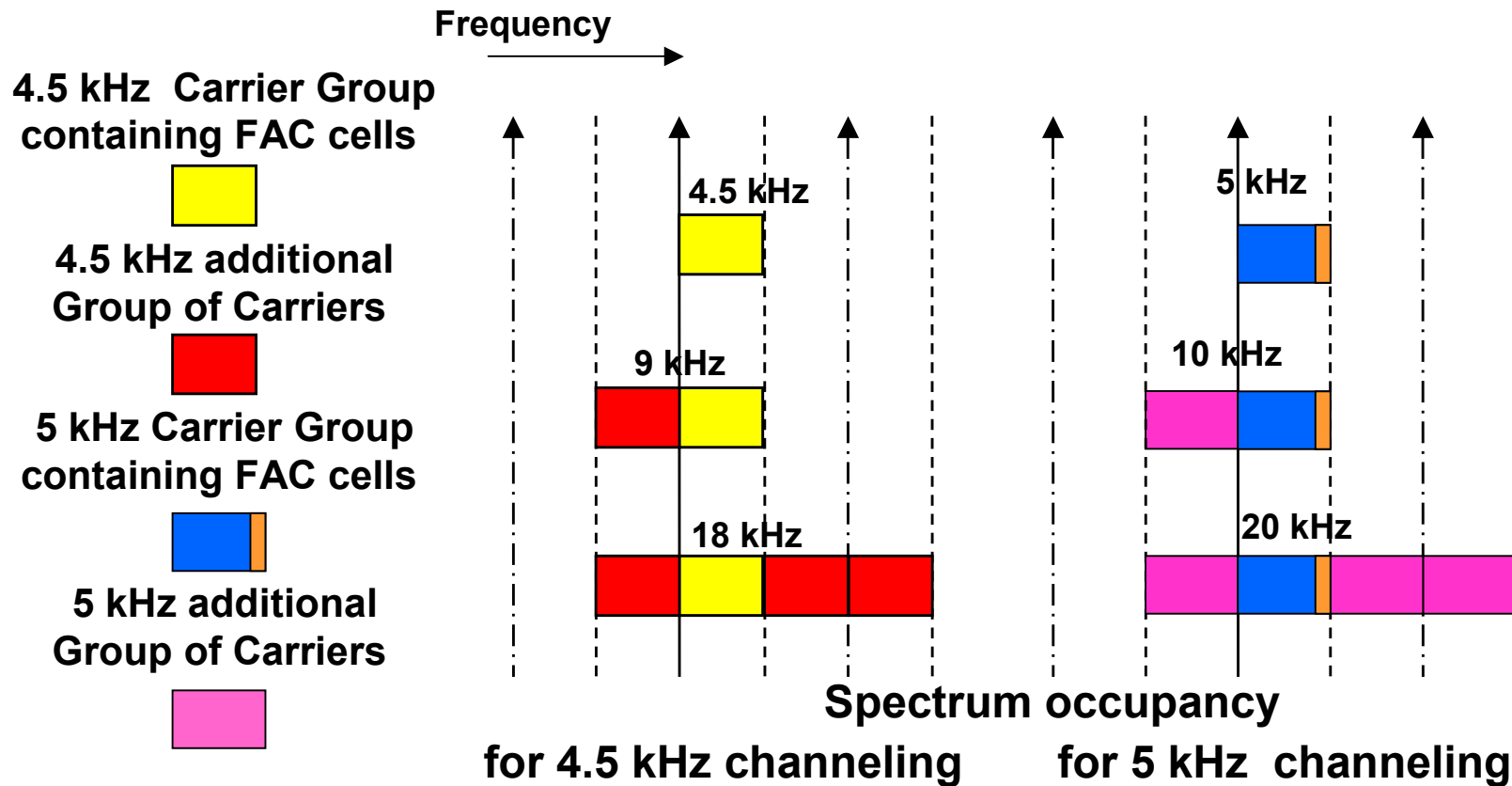
- **Others :**
 - BBC, Sony, Bosch, Thales, NHK, RFI, DW, JVC, Telefunken ...

DRM STANDARDISATION PROCESS



DRM: Different transmission modes (1)

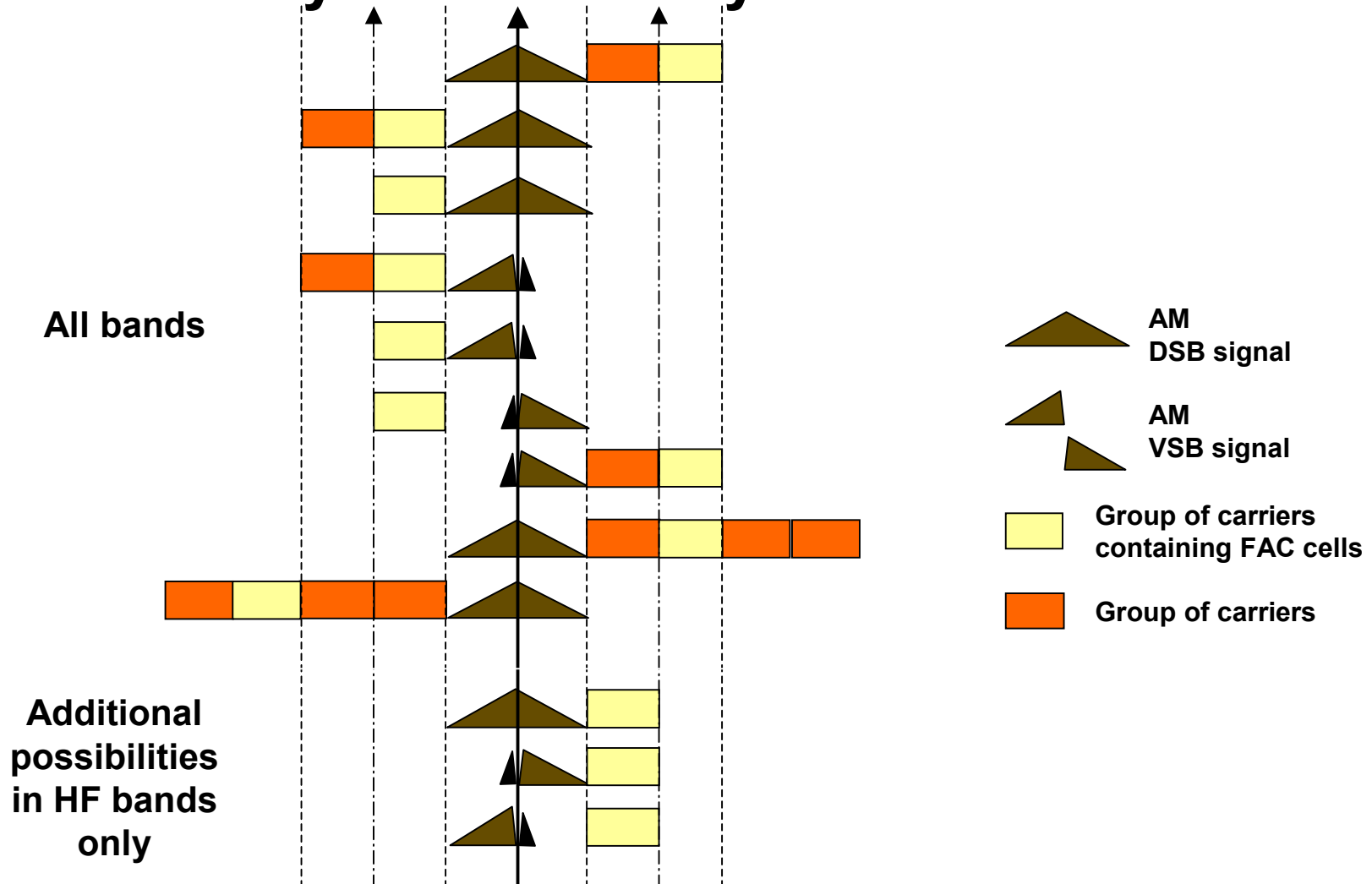
System flexibility in Digital



FAC: Fast Access Channel

DRM: Different transmission modes (2)

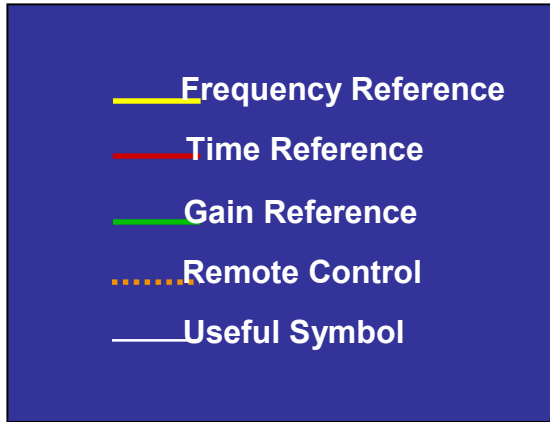
System flexibility in Simulcast



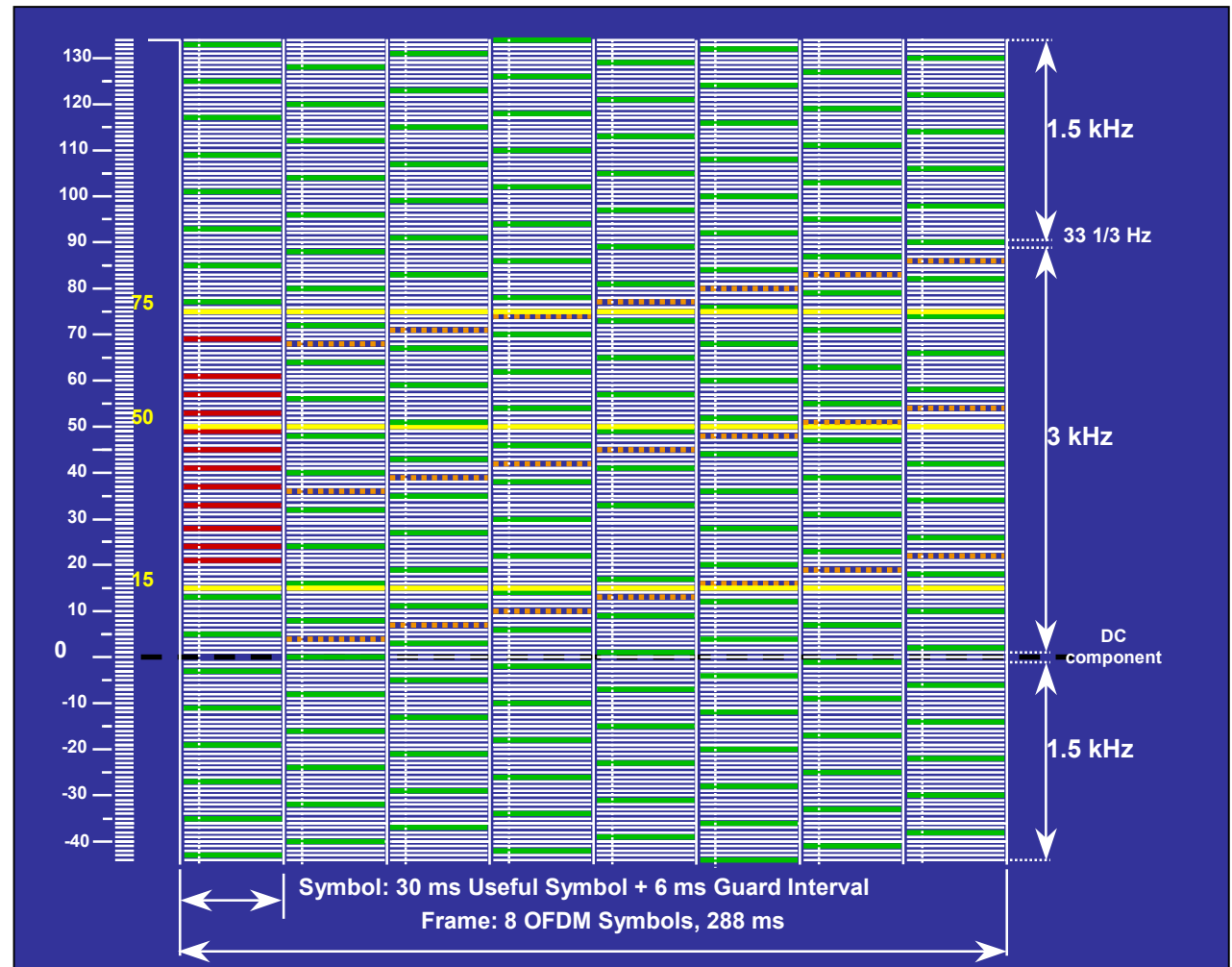
DRM Modem

- **A highly efficient and flexible OFDM modem:**
 - very high spectrum efficiency: up to 3 bit/Hz/s
 - multi-modes related to propagation and channel bandwidth
 - OFDM preferred over single carrier because of flexibility
- **Various transmission modes adapted to different Propagation types**
 - Mode A: Gaussian channels, with minor fading LW and MW during daytime
 - Mode B: Time and frequency selective channels, with longer delay spread: SW and MW nighttime
 - Mode C: Time and frequency selective channels, with greater doppler spread: bad SW channels
 - Mode D : Very robust mode

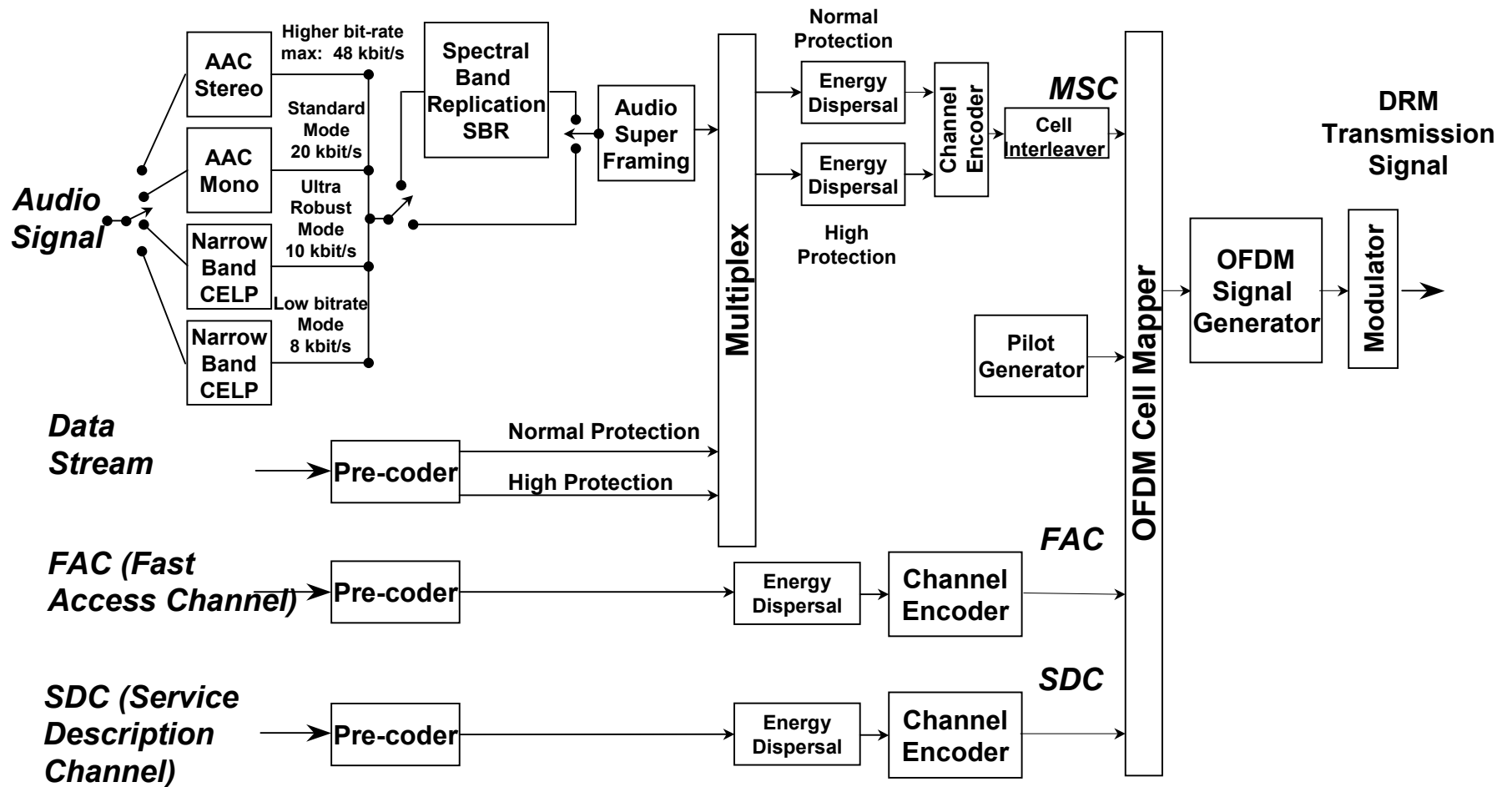
DRM Modem (3)



(old version)

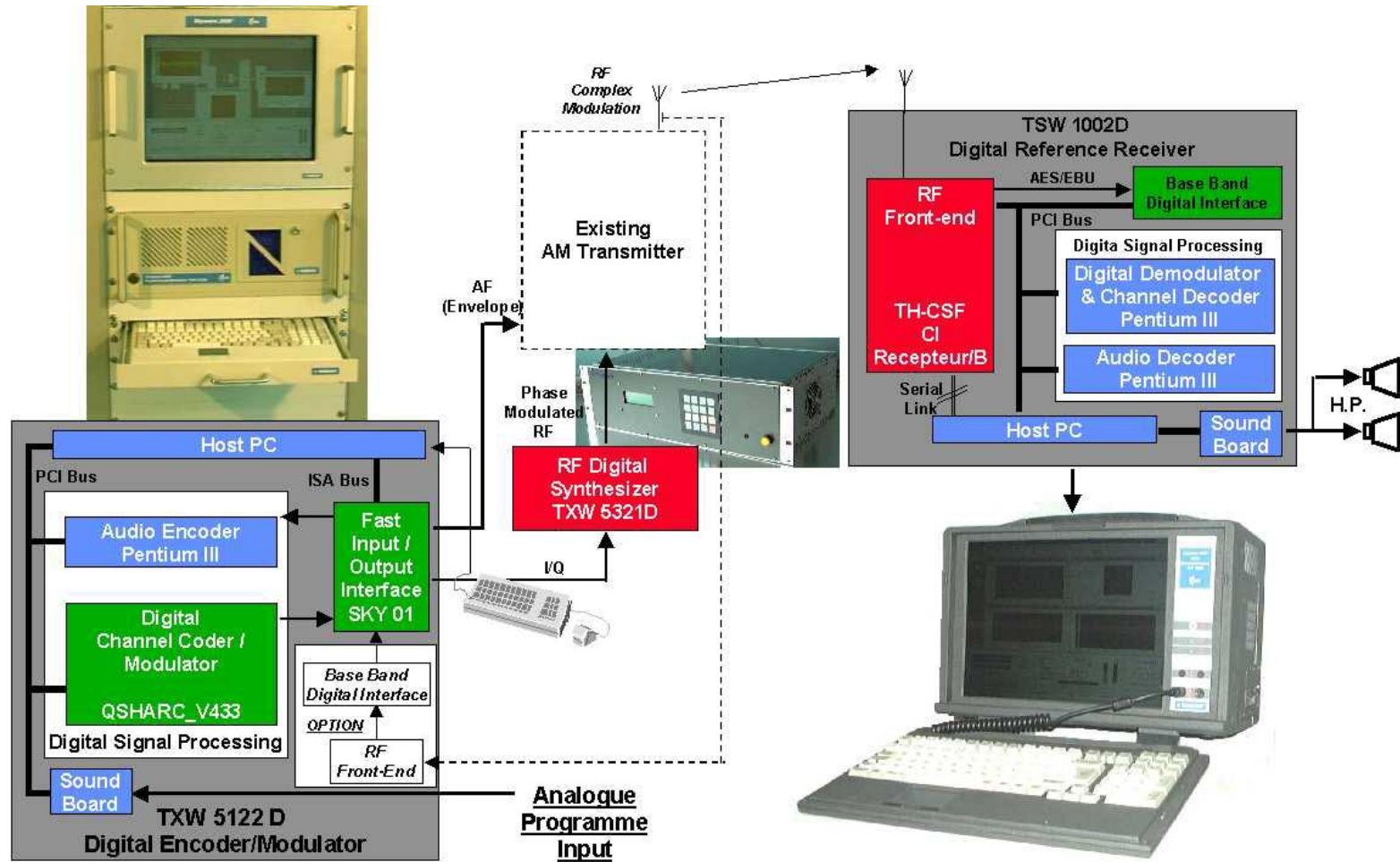


System architecture: TX side

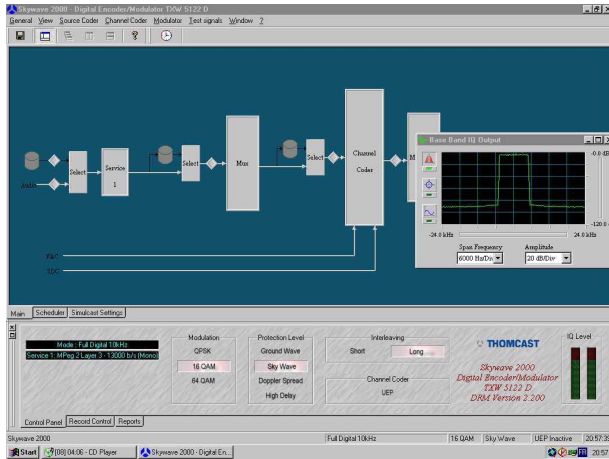


DRM Experimental System Hardware

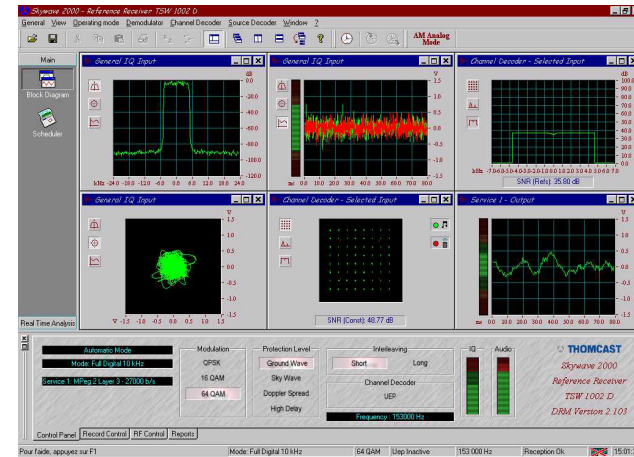
General functional block Diagram



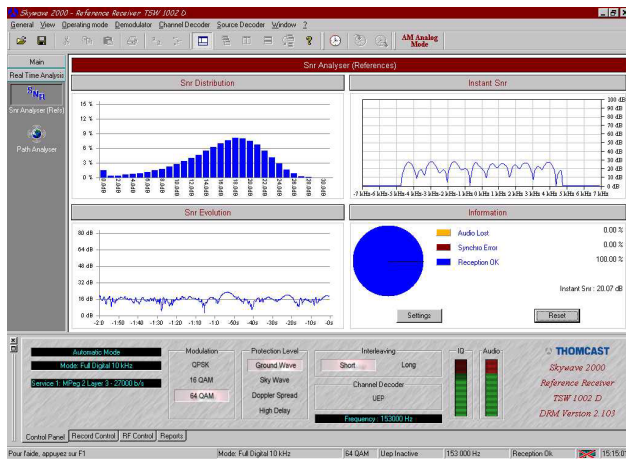
DRM Experimental system



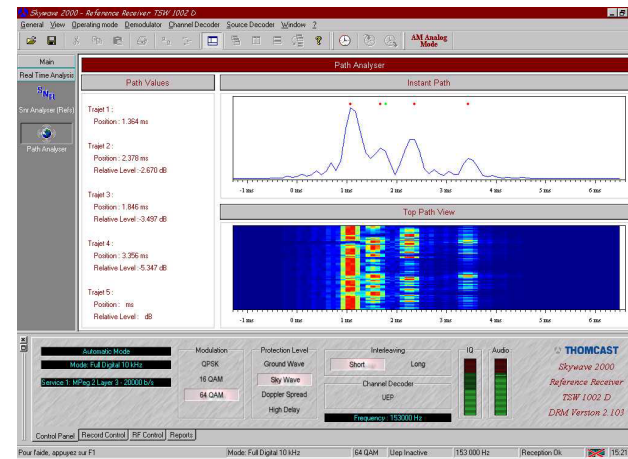
MMI transmit



MMI receive

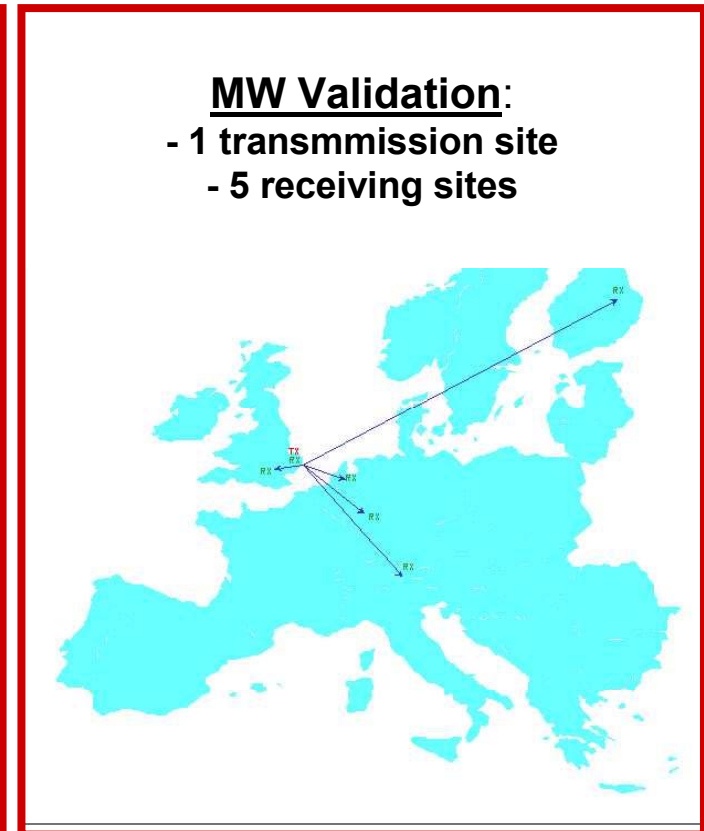
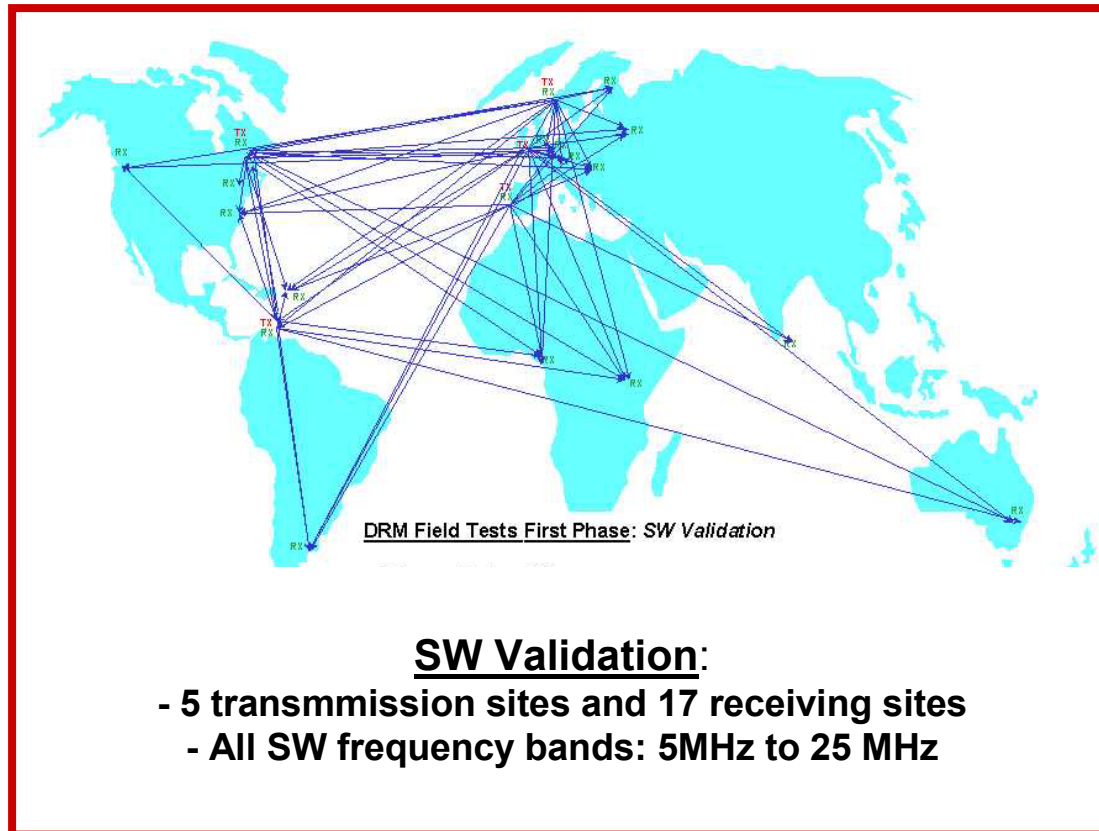


Modem Analysis tool



Propagation Analysis tool

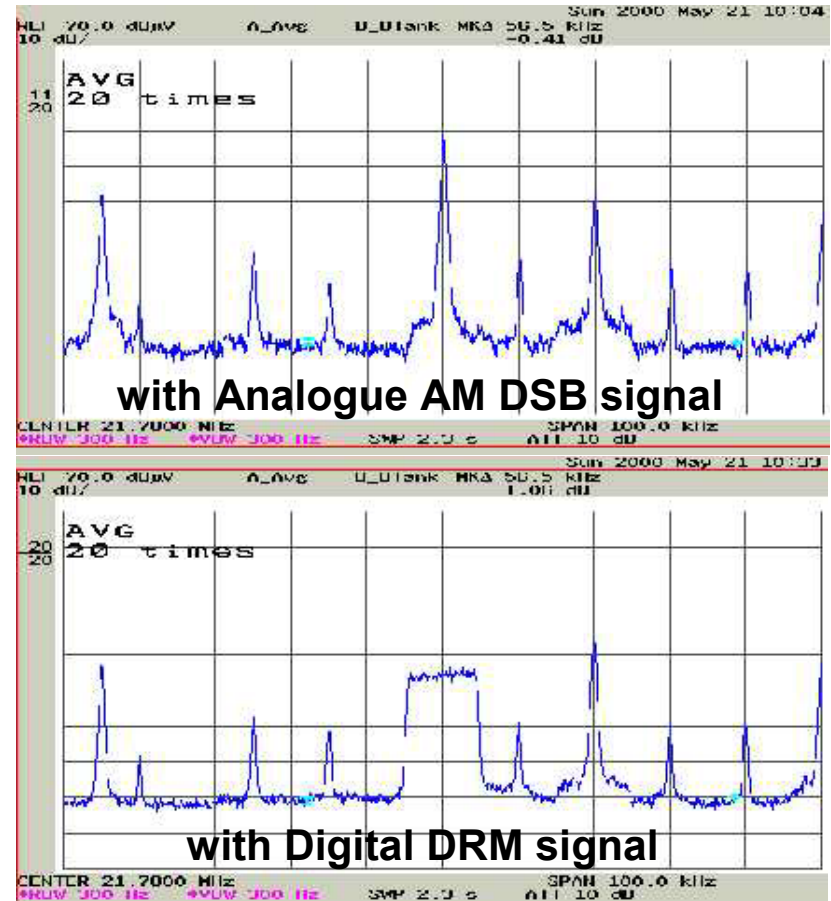
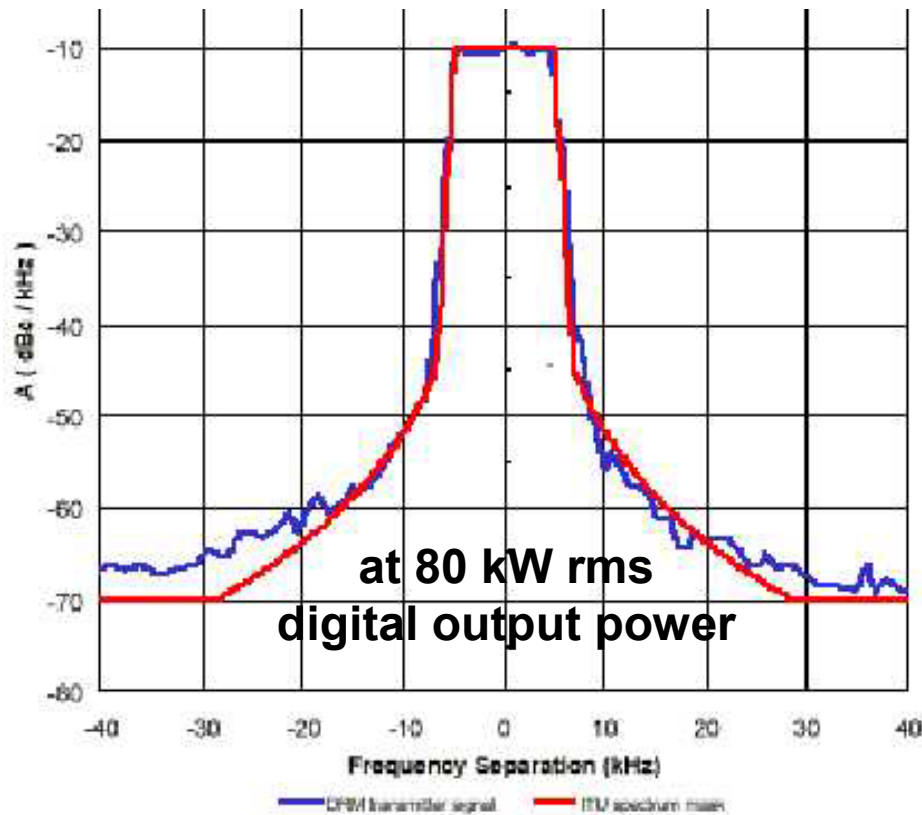
System Validation : tests



Large investigation : most critical paths validated

Compatibility with existing AM Services

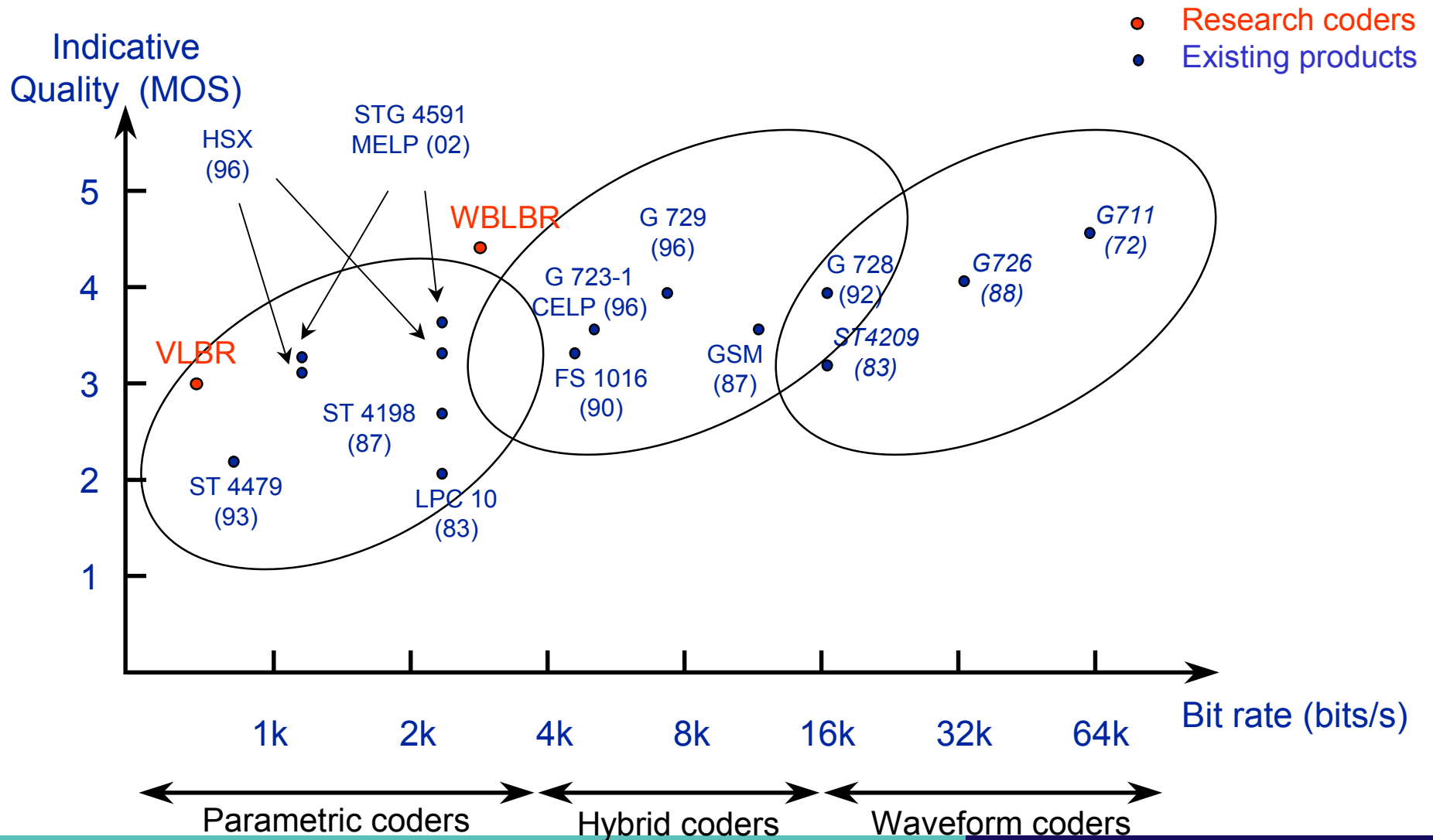
**Non-modified
250 kW PSM SW TX Output Spectrum**



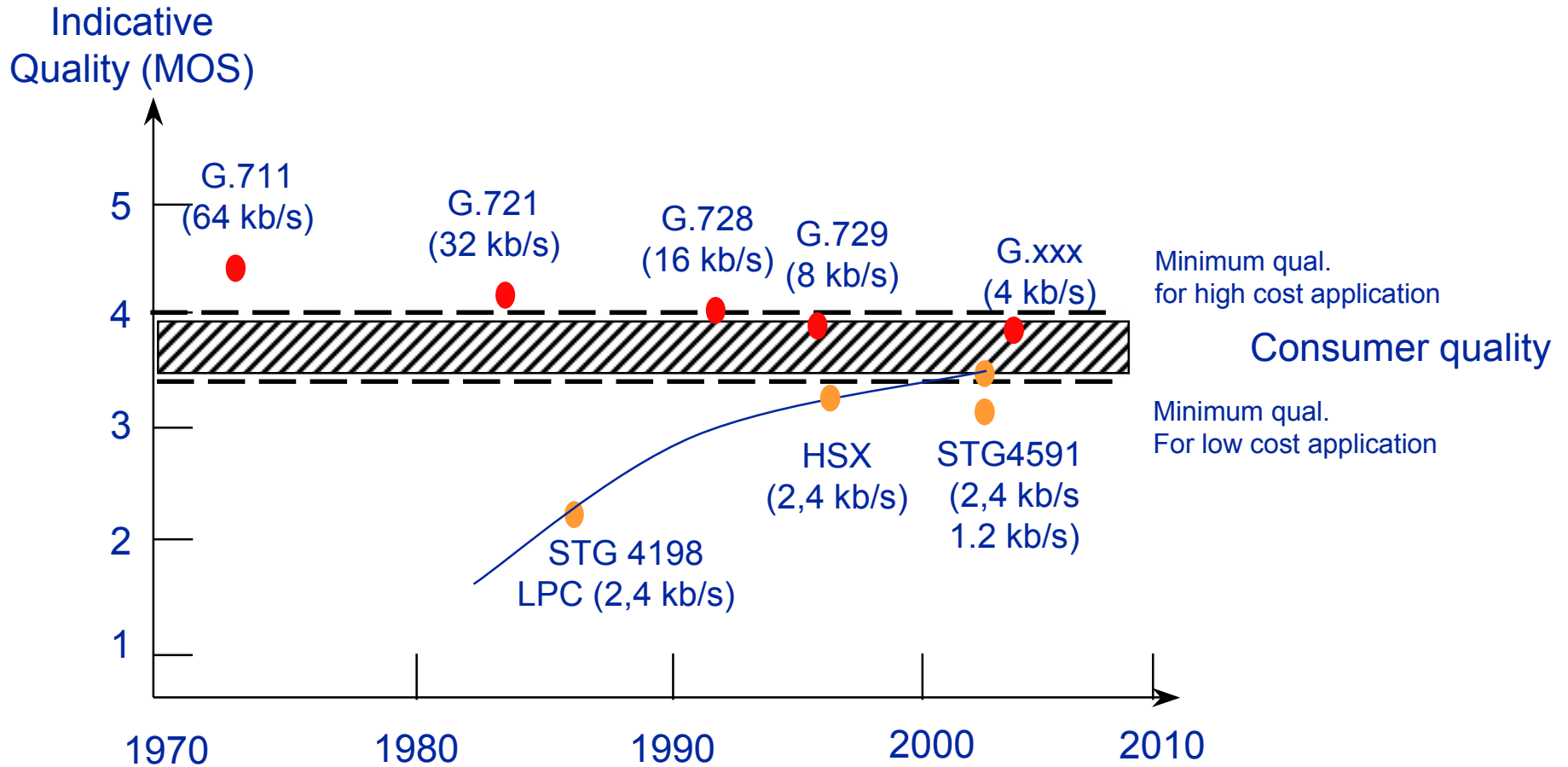
DRM Status: receiver chipset & Standard

- **Various projects to develop chip-sets**
- **Eureka (European Commission sponsored program) DIAM:**
 - ➔ Atmel, Bosch, Sony, TDF, Thales ...
 - ➔ 2 chips (1 analog RF, 1 digital), direct conversion receiver
 - ➔ Forecast Availability: end 2003
- **DRM the only worldwide ITU standard at SW**
- **DRM and IBOC ITU standard at LW and MW**
- **IBOC standard at FM**
- **Work proposed to extend DRM to FM bands**

Voice coders: Standards and Performances



Voice coders: quality



Other low rate voice coders

- **ITU 4 kbits/s : no selection yet between the various proponents**
- **DVSI : proprietary format (IMBE and AMBE: 2 to 9.6 kbits/s) mainly chosen for satellite communications systems (Inmarsat), Iridium and APCO 25**
- **Texas MELP : basis for the STG 4591 Stanag**
- **Except for ITU 4kbits/s, all have rather high processing delay implying long PTT return time**

Amateur Radio Demonstrator

- **Adaptation of the DRM reference receiver for 3 kHz channels**
- **Push-to-talk**
- **Various modes according to :**
 - ➔ Voice coder rate : 1200, 2400, 3200 bits/s (4000-4800 pending)
 - ➔ Modem robustness
 - ➔ Choice will be made during lab and fields experiments
- **100% PC based for simple integration**
- **Full demonstrator working with Ten-Tec and Kenwood off-the-self transceivers**
- **Across the Atlantic tests planned for 2002 with ARRL**

MMI
in transmit
mode

The screenshot shows the 'DRM 300-3000 Transceiver' software interface. At the top is a menu bar with 'Program', 'Mode', 'Transmitter', 'Channel', 'AutoTest', and 'Help'. The main area is divided into several sections:

- Signal Spectrum:** A graph showing a signal peak at 0 Hz on a scale from -12000 to 12000 Hz and -60 to 10 dB.
- Input Audio:** A graph showing a flat line at 0.0 on a scale from -1.0 to 1.0.
- Constellation:** A graph showing a grid of points on a scale from -1.5 to 1.5 on both axes.
- Transmitted Signal:** A graph showing a complex waveform on a scale from -1.0 to 1.0.
- Audio In Gain (%):** A slider set to approximately 50%.
- Signal Output Gain (%):** A slider set to approximately 50%.
- Control Panel:** Includes a 'Text message' field with 'e first version', an 'Information' box showing 'DRM 300-3000 demonstrator', 'Vocoder (without CRC) : 3200 b/s', and 'Free for user : 371.9 b/s'. It also features a 'Receiving' indicator, 'OFF for normal use' status, 'F9 F10 F11 F12' buttons, and 'TRANSMIT', 'STOP', and 'QUIT' buttons. A green 'On Air...' indicator is active.

A blue box at the bottom of the interface contains the text: **Vocoder + simple text** and **No Channel Simulator**.

At the bottom of the window, it reads: **DRM 300-3000 Modem, by THALES-Communications V2.1**

MMI
in receive
mode

GAIN	Estimated Doppler	0.1 Hz
IMP.RESP.	Estimated SNR	14.1 dB
Average Frame Error Rate		6.21 %

DRM 300-3000 Modem, by THALES-Communications V2.1

CONCLUSIONS

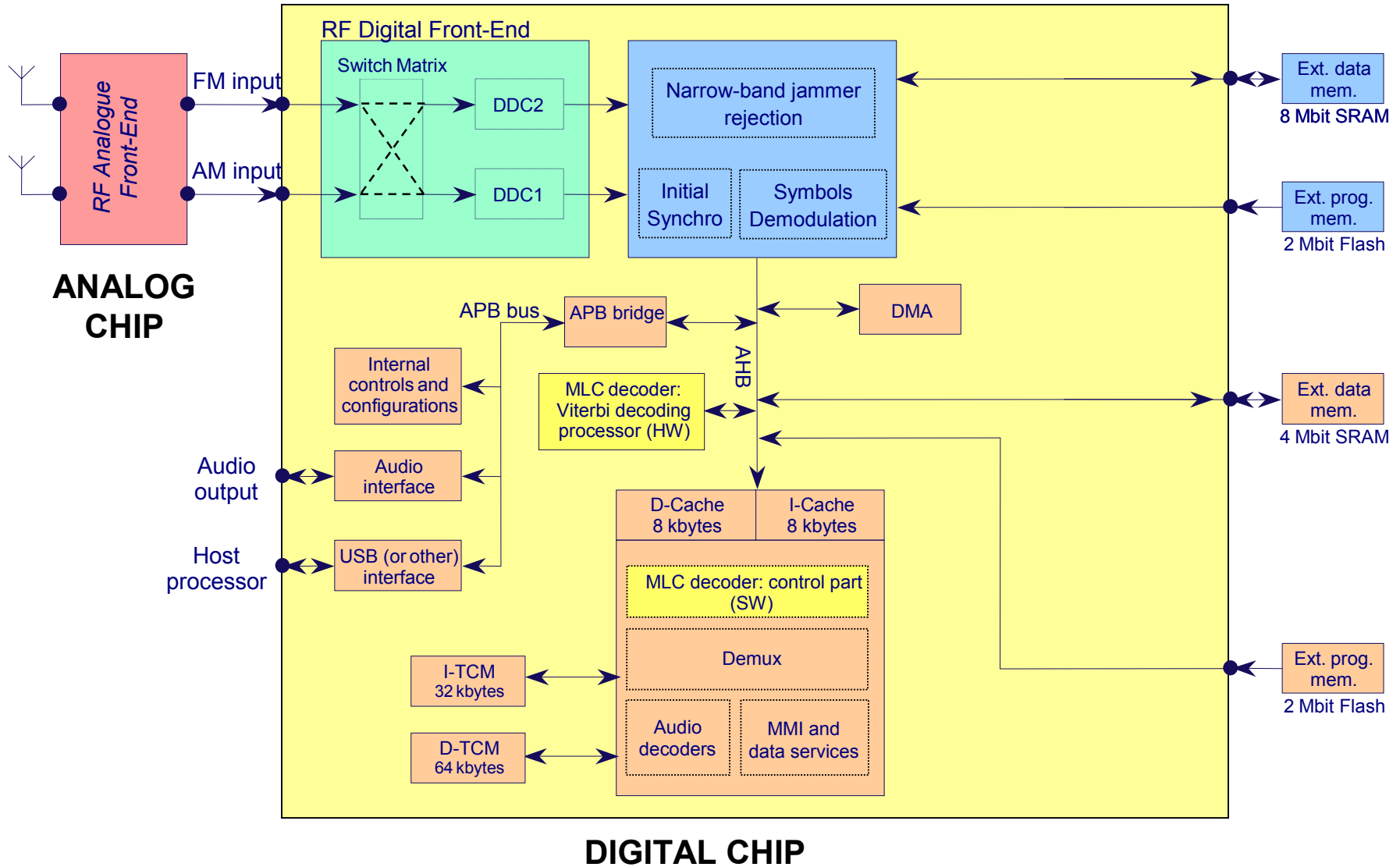
- **DRM World-wide standard is a good technology basis for Ham**
- **Narrow band, PTT mode easily derived for HF Ham use**
- **Available low bit rate vocoder quality reached acceptable quality**
- **ARRL plans lab tests then trans-atlantic tests in 2002**

Thank you for your attention

Questions ??

<u>Australia:</u>	FARB
<u>China:</u>	Academy of Broadcasting Science
<u>Canada:</u>	Radio Canada International, Nautel Ltd
<u>Czech R.</u>	HFCC
<u>Croatia</u>	RIZ
<u>Egypt:</u>	Egyptian Radio and Television Union
<u>Ecuador:</u>	ESPOL, HCJB
<u>France:</u>	Atmel, CCETT, Europe 1, Radio France, Radio France Int., TDF, Thales
<u>Finland:</u>	Kymenlaakso Polytechnic
<u>Germany:</u>	APR, Digitalrundfunk Sachsen Anhalt, DLM, DTAG, DW, DLR, FHG, IRT, Micronas, Robert Bosch, Sony Intern., SWR, Telefunken Sendertechnik,, U. of Hanover, U. of Merseburg, U. of Ulm, VPRT
<u>Hungary:</u>	Communication Authority, Antenna Hungaria
<u>India:</u>	All India Radio
<u>Italy:</u>	RAI
<u>Japan:</u>	Hitachi Kokusai, JVC, NHK
<u>Luxembourg</u>	Broadcasting Centre Europe (RTL-CTL)
<u>Malaysia:</u>	ABU
<u>Netherlands:</u>	Nozema, Radio Nederland Wereldomroep
<u>Nigeria:</u>	Voice Of Nigeria
<u>Norway:</u>	Telenor
<u>New Zealand:</u>	Radio NZ Int.
<u>Russia:</u>	Main Centre for Control of Broadcasting Networks and the Voice of Russia
<u>Spain:</u>	Retevisión, Universidad del País Vasco
<u>Sweden:</u>	Coding Technologies, Radio Sweden Int., TERACOM SE, Factum Electronics AB
<u>Switzerland:</u>	EBU, ITU, ICRC
<u>Tunesia:</u>	Arab State Broadcasting Union
<u>UK:</u>	BBC, Christian Vision, LSI Logic, Merlin Com. Int., Qinetiq Ltd, Roke Manor Research Ltd., RadioScape
<u>USA:</u>	Continental Electronics Corp., Harris Corp., Sangean America, TCI, IBB/VOA, NASB

DIAM Chipset



Demonstrator Description

- Can transmit at the same time vocoded voice + data (text message, text files, image files...)
- available HSX vocoders : 1200 b/s, 2400 b/s, 3200 b/s (easy addition of other vocoders)
- Can receive both DRM and SSB
 - ↗ SSB : audio output is the SSB audio
 - ↗ DRM : audio output is the vocoder output. In this case, also displays frame error rate, frequency offset, estimated SNR, estimated channel impulse response (in 3D representation)
- 3 degrees of protection :
 - ↗ GND (Ground-wave) for short distance communication
 - ↗ SKY (Sky Wave) for long distance
 - ↗ ROB (Robust) for difficult conditions
- Choice between short and long interleaving

Demonstrator Main Features

- A simple hardware interfacing system with Radio-Amateur transceivers
 - ➔ **levels adaptations**
 - ➔ **Push-To-Talk detection**
 - ➔ **an adjustable VOX system**
 - ➔ **receiving level monitoring (if available)**
- Easy personalisation
 - ➔ **one editable text file defines the preferred starting options**
 - ➔ **one additional editable text file (Settings.cmd) allows adjusting other parameters (thresholds, gains, squelch level...)**

Other features

- Automatic re-programming of the receiver according to the currently received message
- Integrated auto-test
- Sophisticated channel simulator (for checking performances in terms of SNR, frequency offset, channel severity)
- PTT test
- Monitoring level test
- Transmission of a pure tone instead of the DRM signal
- Local vocoder auto-test