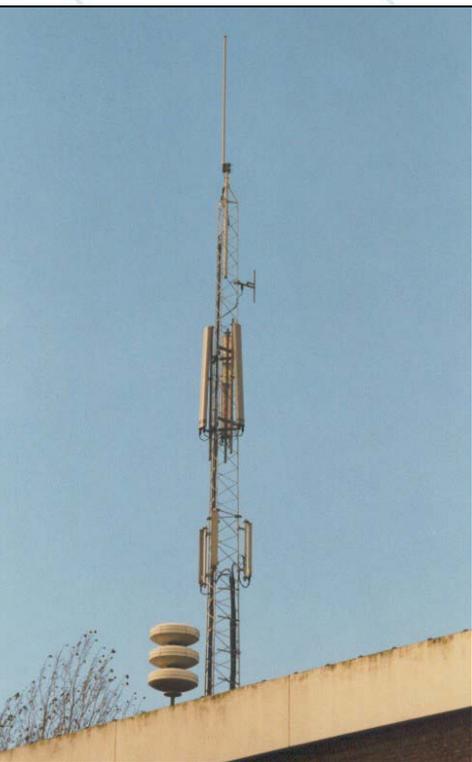


Evolutions of Spectrum Management: New Frontiers

ICC Istanbul,
Thursday June 14, 2006



**New
Paradigms
and adaptive
Policy**



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Content

- How things evolved
- The economic approach to frequency management
- The road to commons
- Flexibility in frequency management

Traditionally three domains in spectrum management can be indentified



Vital government



Open spectrum/
licence exempt

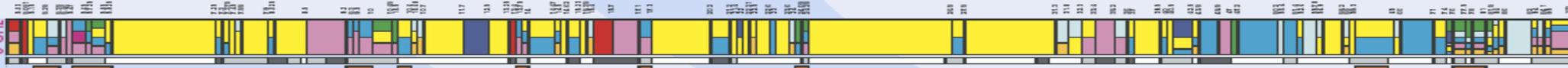
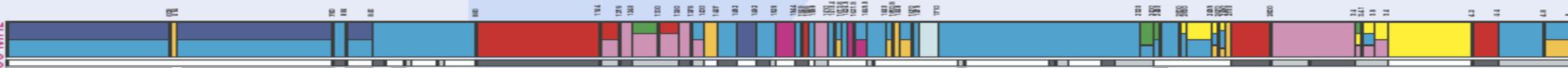
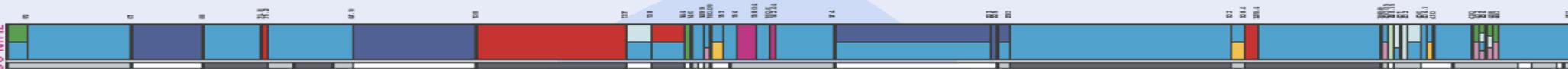
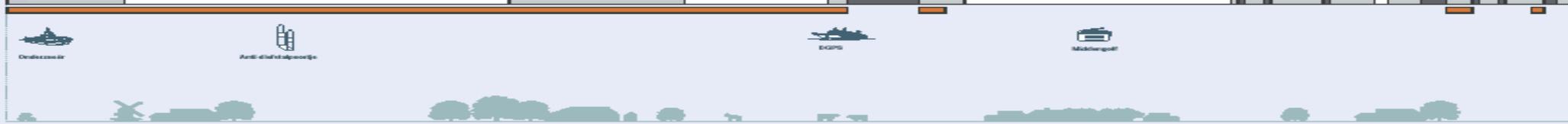
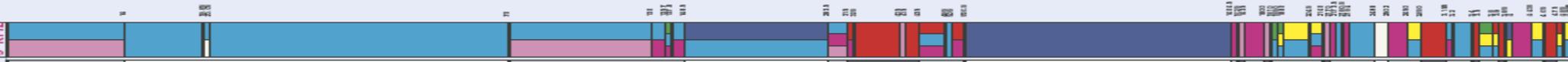


Licenced, Market
domain

Nederlandse Frequentiespectrumkaart 2005

Elektronegetisch spectrum

Het frequentiespectrum loopt van 0 MHz tot 1000 GHz en is een onderdeel van het elektronegetisch spectrum. Het frequentiespectrum wordt gebruikt voor telecommunicatie.



UNITED STATES FREQUENCY ALLOCATIONS

THE RADIO SPECTRUM

RADIO SERVICES COLOR LEGEND

- AERONAUTICAL MOBILE
- AERONAUTICAL MOBILE SATELLITE
- AERONAUTICAL RADIONAVIGATION
- AMATEUR
- AMATEUR SATELLITE
- BROADCASTING
- BROADCASTING SATELLITE
- EARTH EXPLORATION SATELLITE
- FIXED
- FIXED SATELLITE
- INTER SATELLITE
- RADIO ASTRONOMY
- RADIO DETERMINATION SATELLITE
- RADIONAVIGATION
- RADIONAVIGATION SATELLITE
- RADONAVIGATION
- RADONAVIGATION SATELLITE
- METEOROLOGICAL AID
- METEOROLOGICAL SATELLITE
- SPACE OPERATION
- SPACE RESEARCH
- MARITIME MOBILE
- MARITIME MOBILE SATELLITE
- RADIONAVIGATION SATELLITE
- MARITIME MOBILE SATELLITE
- RADIONAVIGATION SATELLITE
- METEOROLOGICAL AID
- METEOROLOGICAL SATELLITE
- SPACE OPERATION
- SPACE RESEARCH
- MOBILE
- MOBILE SATELLITE
- STANDARD FREQUENCY AND TIME SIGNAL
- STANDARD FREQUENCY AND TIME SIGNAL SATELLITE

ACTIVITY CODE

- GOVERNMENT EXCLUSIVE
- GOVERNMENT/NON-GOVERNMENT SHARED
- NON-GOVERNMENT EXCLUSIVE

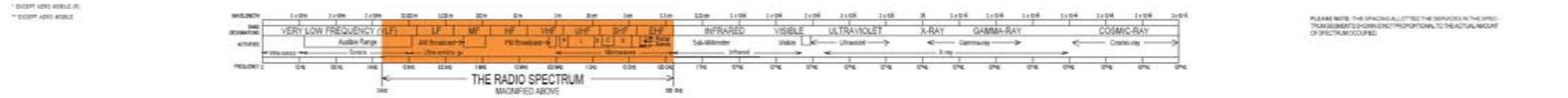
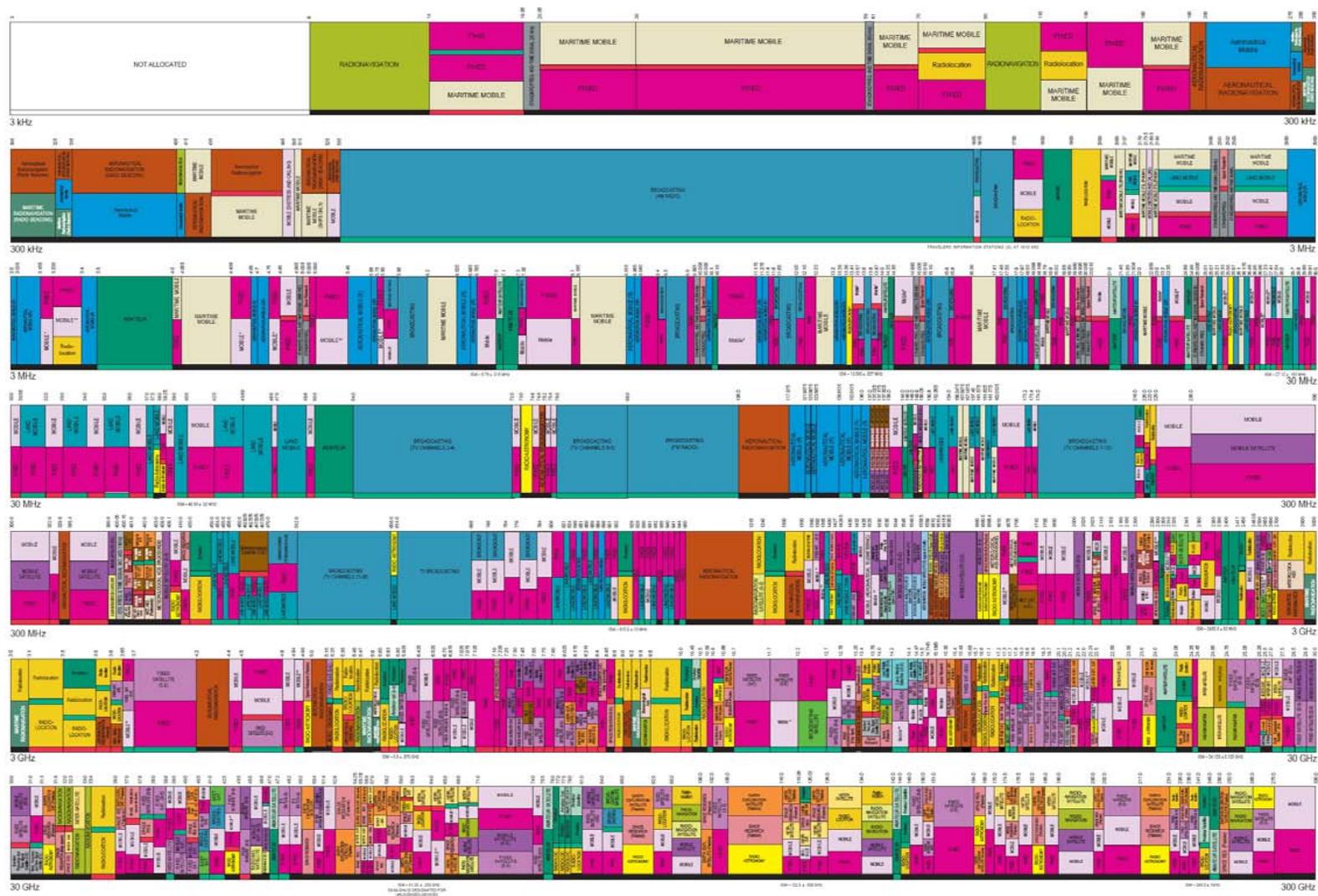
ALLOCATION USAGE DESIGNATION

SERVICE	EXAMPLE	DESCRIPTION
Primary	FIXED	Capital Letters
Secondary	MOBILE	1st Capital with lower case letters

This chart is a graphic representation of the Table of Frequency Allocations used by the FCC and ICA. As such, it does not constitute either an agency, i.e., authority or report of the FCC or the Table of Frequency Allocations. Technical or regulatory information users should consult the Table to determine the current Table of Frequency Allocations.



U.S. DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Office of Spectrum Management
October 2003



PLEASE NOTE: THE SPACED ALLOCATED SERVICES IN THE SPECIFICATION ARE NON-EXHAUSTIVE AND SUBJECT TO THE ACTUAL AWARD OF SPECTRUM LICENSES.

AUSTRALIAN RADIOFREQUENCY spectrum ALLOCATIONS CHART

The spectrum is a continuous range of electromagnetic radiation extending from the longest radio waves through infra-red, light, ultra-violet and X-rays to gamma-rays.

The **RADIOFREQUENCY SPECTRUM** is that part of the total spectrum which is used for transmitting radio waves.

The radiofrequency spectrum is a natural resource that is used but not consumed, it is used by being occupied and the efficiency

of its use depends on coordination among users in order to minimise interference to each other.

This chart illustrates how the radio-frequency spectrum is allocated among services in Australia. It is derived from the *Australian Radiofrequency Spectrum Plan (January 2002)*, which in turn is based on the *International Telecommunication Union (ITU) Radio Regulations*.

The radiofrequency spectrum is divided into several broad frequency bands for reference.

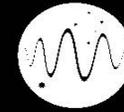
The ITU nomenclature for these bands is as follows:

- VLF Very Low Frequency 3-30 kHz
- LF Low Frequency 30-300 kHz
- MF Medium Frequency 300-3000 kHz
- HF High Frequency 3-30 MHz
- VHF Very High Frequency 30-300 MHz
- UHF Ultra-High Frequency 300-3000 MHz
- SHF Super-High Frequency 3-30 GHz
- EHF Extremely-High Frequency 30-300 GHz

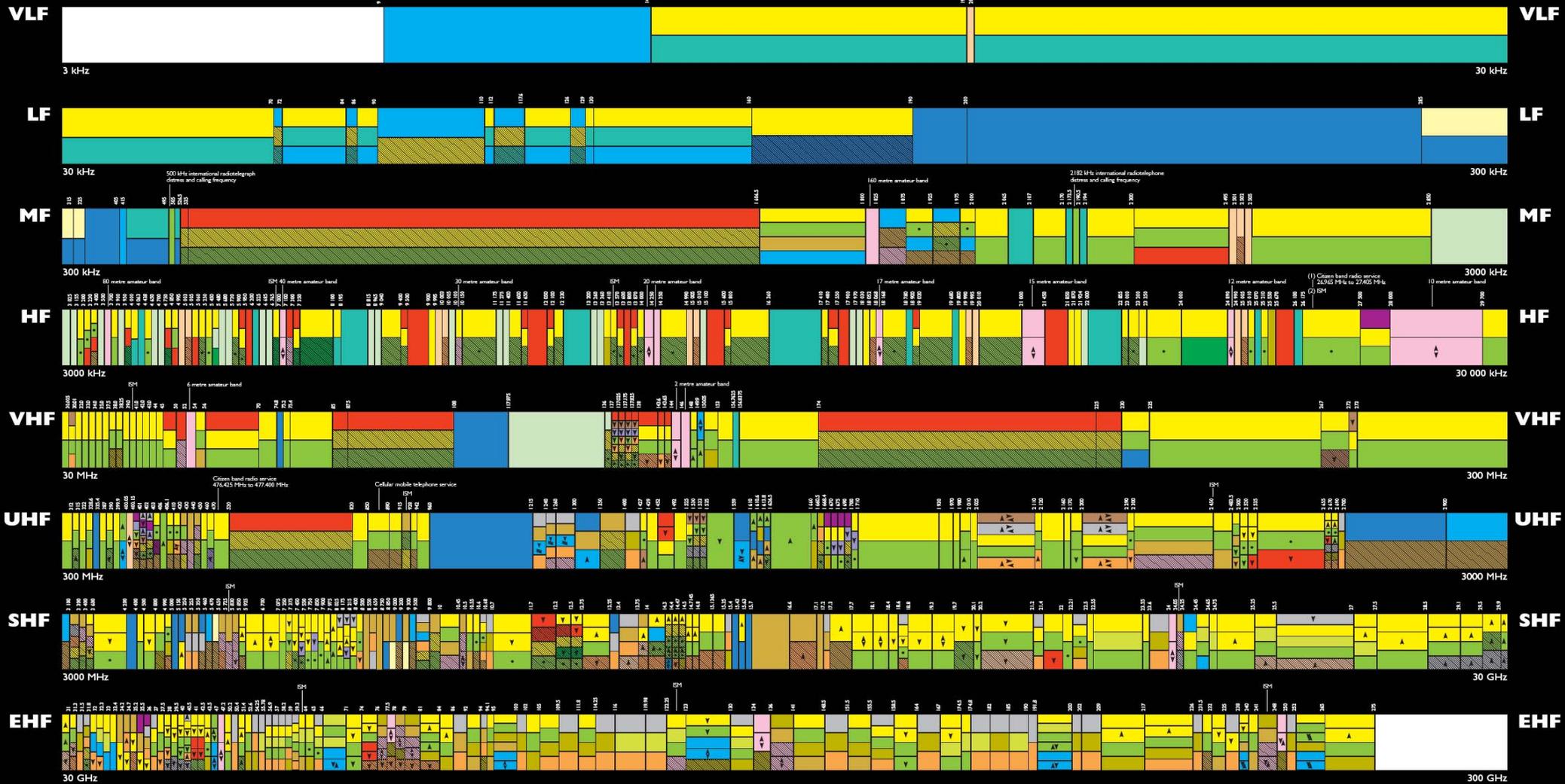
Each of these bands is divided into sub-bands which are allocated to particular services such as land mobile radio, broadcasting, aeronautical, maritime or space services — shown in the chart by different colours.

The chart is designed for quick reference. For details of frequency allocations, reference should be made to the *Australian Radiofrequency Spectrum Plan (January 2002)*, since fine details and footnotes cannot be shown on this chart.

© Australian Communications Authority 2002



Australian Communications Authority

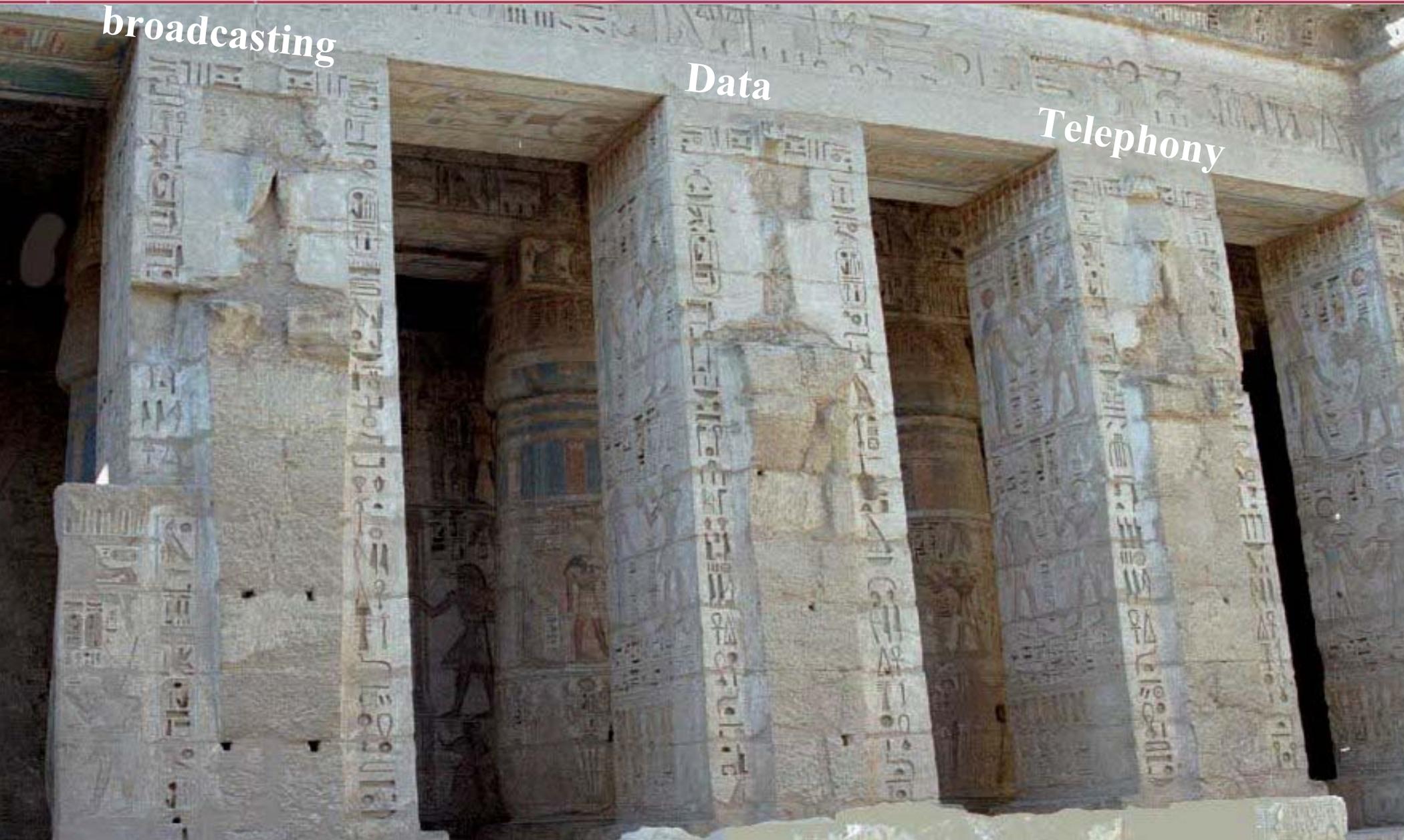


Or, the Classical vertical model

broadcasting

Data

Telephony



Advantages Command and control model

- Interference proof
- Economies of scale as a result of harmonisation

Nowadays..

- Too slow to adapt to new circumstances like
 - Globally, rapidly developing markets
 - Convergence
 - New techniques like SDR, meshed networks, smart radios, agile radio.

Therefore

- Allocation decisions should be left to players in the market (decentralised)
- Preferably led by market mechanisms like auctions, tradability *with change of use*
- Or stated otherwise:

“The economist approach to frequency management“

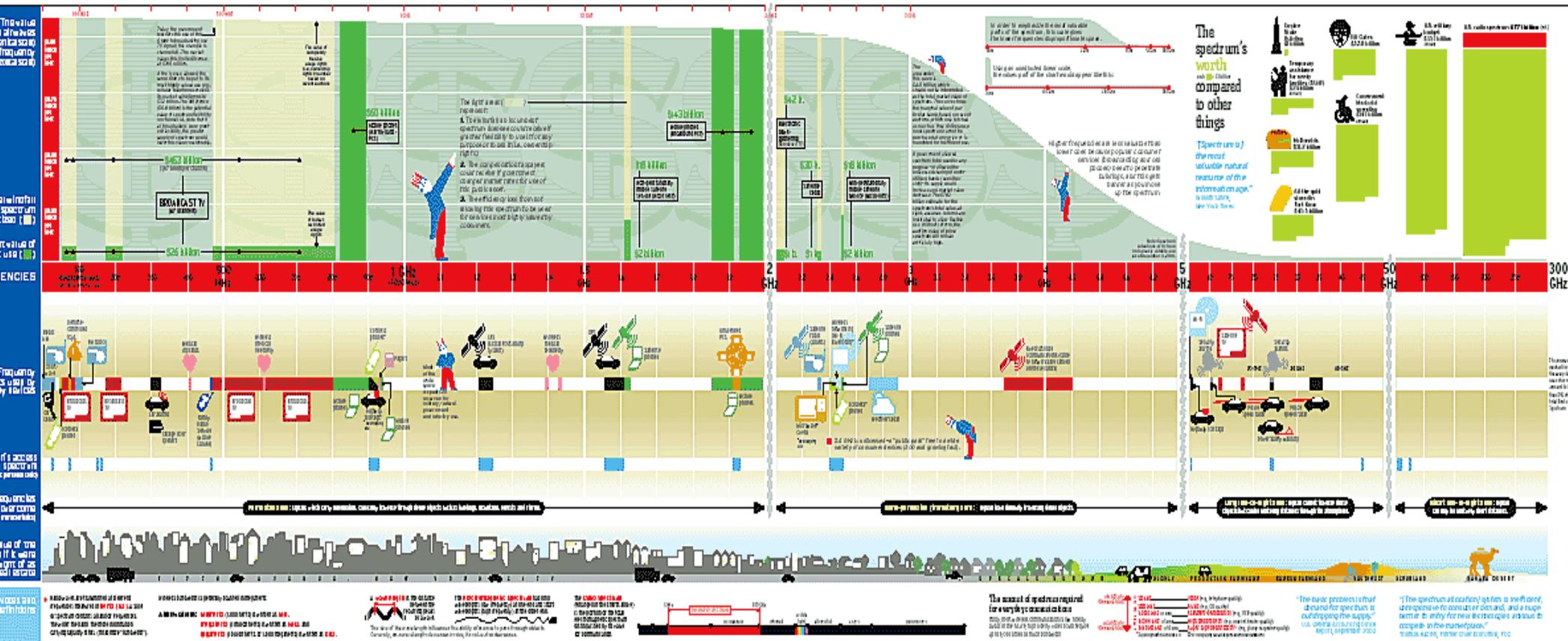
Or not?

Commons Approach to Spectrum Management

- New paradigm ('end of scarcity')
- They claim 'the economic orthodoxy'
 - Property rights *causes* scarcity
 - No incentive to innovate
- Is rather promising (see 2,4 GHz)
- "Open spectrum" attracts high interest
- Standardized equipment (IEEE standards by industry)
- Generic technical standards (e.g. low power conditions)
- Enforcement by 'etiquette'
- High confidence in development technique/equipment (analogous internet, computer technology, Moore's Law)
- UWB; SDR; cooperative networking

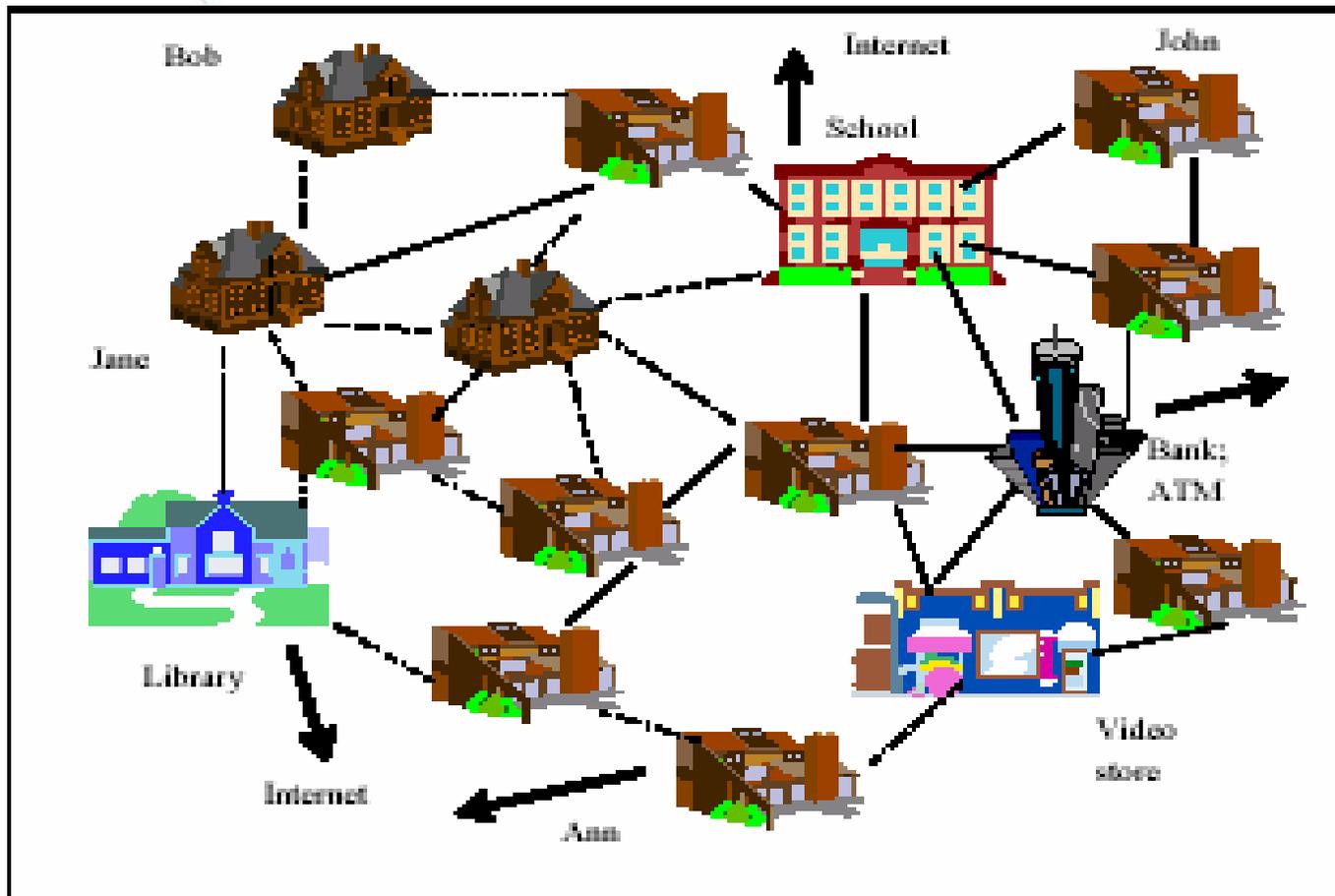
Commons Approach to spectrum management

- www.newamerica.net

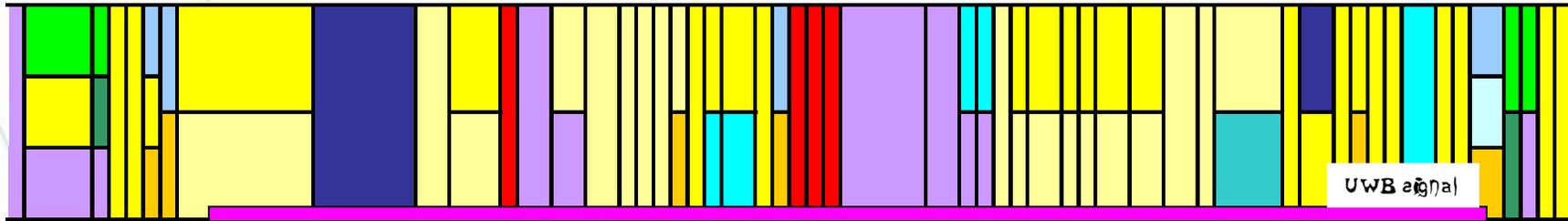


Mesh-networks

Ideal Open Wireless Network

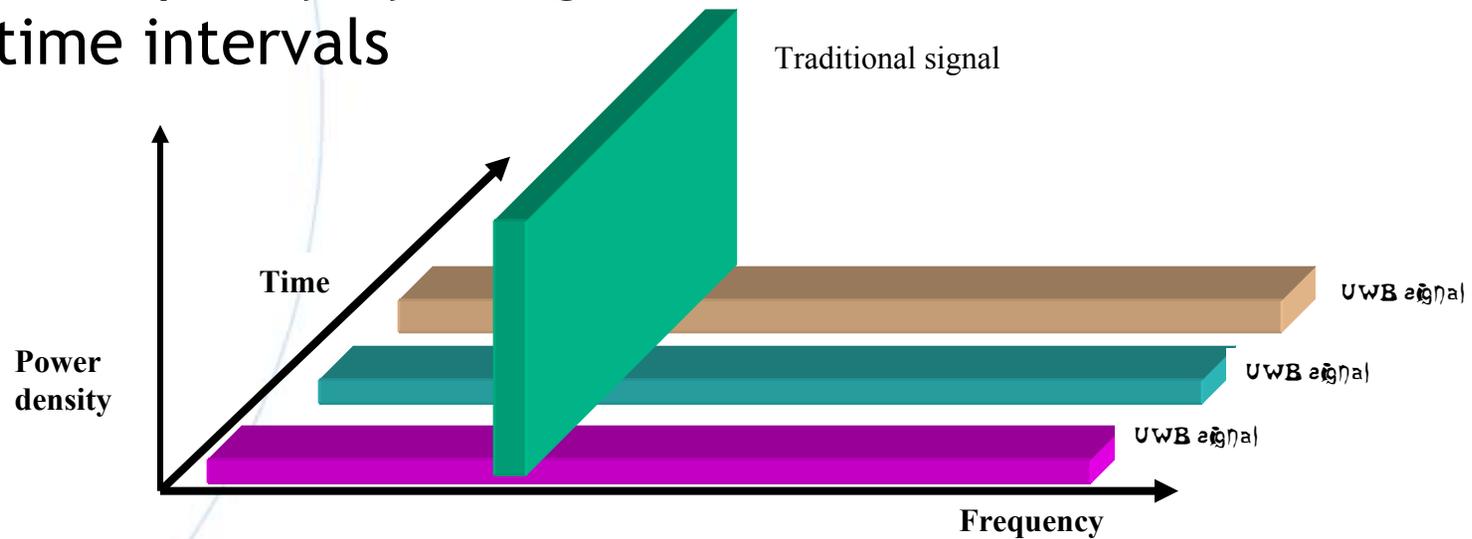


UWB



From: M. Bos 'New dynamic spectrum management: the end of scarcity? The regulation of ultra-wide band', University of Groningen, Faculty of Law, March 2003.

Increased capacity by using time intervals



Content

- How things evolved
- The economic approach to frequency management
- The road to commons
- Flexibility in frequency management

Why flexibility, or the need to investigate the regulatory framework?

- Faster technological developments require quicker spectrum access or require different regulatory models
- Convergence of telecommunications, broadcasting and internet requires different regulatory models
- Strong demand for radio services requires more efficient use and inventive sharing techniques
- Globalisation requires harmonisation of spectrum
- To find a solution for (maybe?) mutually exclusive paradigms

ECC Report 80

‘Enhancing harmonisation and introducing flexibility in the spectrum regulatory framework’

- Conduct a study on the overall direction of harmonisation policy, bearing in mind that harmonising measures should be technology neutral, flexible and include review stages;
- Investigate ways and possibilities of establishing a more flexible regulatory structure for spectrum management to better enable the introduction of new radio technologies and adapt to the changing market demand;
- Study additional opportunities of spectrum sharing, including sharing on the basis of geographical area(s), time and service, as well as the possible introduction of a flexible “noise temperature limit”;

View 1 on harmonisation and flexibility

- Harmonisation measures should be based on the results of a cost benefit analysis
- Harmonisation can also be achieved on a voluntary, industry led basis
- Flexibility creates a regulatory framework, so that market players can adapt, in a timely manner to real market circumstances

The introduction of market mechanisms, such as secondary trading and liberalisation brings real flexibility and leads to allocation decisions by the market.

This view 1 leads to

a regulatory framework characterised by

- A light touch approach of the spectrum manager
- Freedom of choice of technology and innovative sharing
- Service neutral licence conditions
- Secondary trading with change of use (liberalisation)

View 2 on harmonisation and flexibility

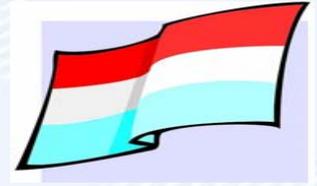
- Harmonisation should be vigorously pursued
- Harmonisation brings economy of scale benefits, enables roaming, stimulates investment, reduces risk of interference
- Flexibility could lead to fragmentation of spectrum use
- We should aim for globally harmonised spectrum and flexibility could endanger this
- Flexibility and harmonisation are mutually exclusive

This view 2 leads to

a regulatory framework characterised by

- Continued command and control by the spectrum manager
- Only use of interference free proven technology
- Only clearly defined services
- Secondary trading without change of use

The Netherlands



- Radio Spectrum Policy Memorandum end 2005
- Leave more to the market, limit government interference
- A more flexible Frequency Table and easier to adapt
- Facilitate secondary trading of licences or part of licences
- No change of use, but licences wider defined
- More shared use, no exclusive use
- Public services have to justify their frequency requirements
- Less individual licences and less licence conditions

Why is it so difficult?

- Difficult to change a practice, or culture over more than 80 years..
- As a result of the new techniques and paradigms, frequency management deals far beyond technical interference and licencing matters nowadays, and liberalisation and competition issues more and more become important.
- As a result, matters of ideology and the overall discussion of the perceived role of the state (active or absent) slips into the domain of frequency management.

WEB sites:

EU:

http://europa.eu.int/comm/dgs/information_society/index_en.htm

CEPT:

<http://www.ero.dk/>

Radiocommunications Agency the Netherlands

<http://www.at-ez.nl> <http://appz.ez.nl/publicaties/pdfs/06ET02.pdf>

E2R

<http://www.e2r.motlabs.com>