DRM – Digital Radio Mondiale

A Practical Look at DRM's Functionalities to Help Visegrad 4 Countries with Digitisation of Radio

Banska Bystrica,
Slovakia
18th February 2015

DRM – The Digital Standard for All Frequency Bands

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DRM Consortium

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Product Specialist Transmission
GatesAir

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The DRM Consortium

- **Founded in 1998** by international organizations to promote the adoption of the DRM standard worldwide
- **Not-for-profit**
- **Around 100 international members**
  (broadcasters, manufacturers, network operators, regulators, research institutes, etc.)
- **Experts and technologists**
  ready to give expert, objective advice on the technology
- **Open** to companies, organisations, associations and individuals who can join at any time

For joining the DRM Consortium, write to: **projectoffice@drm.org**

DIGITAL radio mondiale

Selection of DRM Consortium Members

AMPEGON
babcock
BBC WORLD SERVICE GROUP
JVC KENWOOD
JAGUAR
LAND ROVER
BOSCH
radio france
Parrot
THOMSON BROADCAST
Continental Electronics
Dolby
HARMAN
nautel Making Digital Radio Work.
Fraunhofer IIS
GATESAIR
RFmondial
Visteon
SENTECH connecting You
riz TRANSMITTERS Co.
rfi
TRANSRADIO SenderSysteme Berlin
Radio Vaticana
NXP
SONY
BT BROADCAST TRANSMITTERS tecnologia incomparável
PTPC телерадиосеть россии

The not-for-profit DRM Consortium
supports and promotes the DRM Standard and its take-up globally

DRM Received ITU Award - 1st Oct 2014
For its Outstanding Contribution in The Last 10 years
In the Field of Telecommunications

DRM signs the EBU Smart Radio Memorandum of Understanding (MoU)

- Signed by leading European Public Service and Commercial Broadcasters (BBC, Deutschland Radio, public broadcasters from Belgium, Italy, Sweden, Norway, Poland, Switzerland etc…) and other organisations
- Improve popularity, access to and the experience of radio
- Launch and promote free-to-air digital radio services
- Availablity in various devices and especially in cars and mobiles phones
- Coordination of the activities of broadcasters and organisation members

http://www3.ebu.ch/files/live/sites/ebu/files/Programming/Radio/Digital%20Radio/MOU_signed.pdf

DRM Signs The EBU Smart Radio Memorandum of Understanding (MoU)

ARD
APR Arbeitsgemeinschaft Privater Rundfunk
BBC
Český rozhlas
Deutschlandradio
DIE NEUE WELLE the broadcasters
fun radio LE SON DANCEFLOOR
klassik radio
MTG
NRK
NPO Netherlands Public Broadcasting
4
POLSKIE RADIO
rtbf.be
REGIOCAST Deutsches Radiounternehmen
RTL.be
Rai
Sky Radio
SRG SSR
vsp Verband Schweizer Privatradios
sveriges radio
drm DIGITAL radio mondiale
EBU OPERATING EUROVISION AND EURORADIO
SNRL SYNDICAT NATIONAL DES RADIOS LIBRES
WORLD DAB

http://www3.ebu.ch/files/live/sites/ebu/files/Programming/Radio/Digital%20Radio/MOU_signed.pdf

What is DRM?

- **Digital Radio Mondiale (DRM)** – global, open digital radio for **all frequency bands** (AM & VHF)
  - **DRM30:** DRM below 30 MHz, i.e. LF, MF, HF (or LW, MW, SW) – *the AM bands*
  - **DRM+:** DRM above 30 MHz, i.e. VHF (Band I, II, III) – *including the FM band*

- **DRM standard** for all coverage needs:
  large geographic areas – rural & local markets – and on the move
- **More content and choice**:
  up to 3 programmes + multimedia on one frequency (max. 4 services)
- **Easier tuning and selection of programming**:
  station selection by its name (no longer band + frequency),
  automatic switching between different transmitters/standards for continuous service
- DRM complements and works seamlessly with other digital standards

DRM: GLOBAL, GREEN, OPEN, EFFICIENT Digital Radio STANDARD

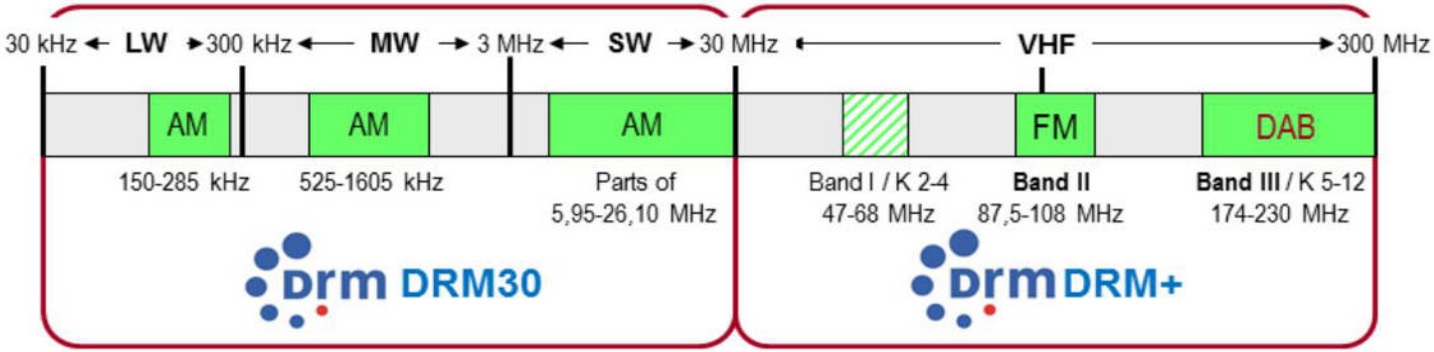
DRM – Global Standard for all Bands

DRM above 30 MHz VHF
(Band I, II – FM band, III)

30MHz

DRM below 30 MHz LF, MF, HF
(or LW, MW, SW) – the AM bands

DRM



BOTH MODES (DRM30 and DRM+) OF THE DRM STANDARD SHARE ALL DRM FEATURES!

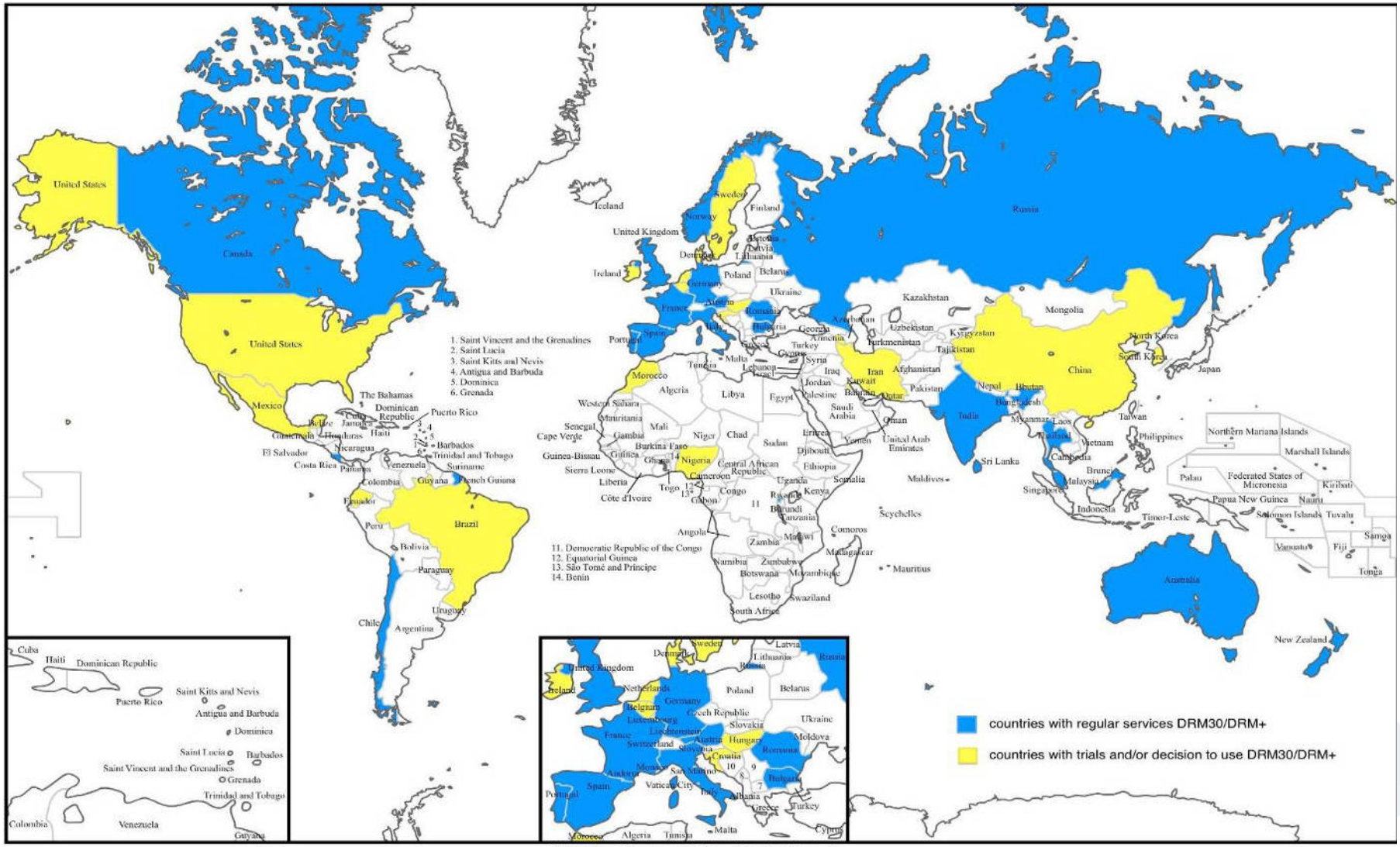
DRM in the AM Bands (DRM30 Mode)

- **Originally developed as a digital broadcast standard for the AM bands**
  - Using similar techniques developed for Digital Terrestrial Broadcast Television (DVBT)
  - **ETSI standard ratified** in 2003: ETSI ES **201 980 V4.1.1**
  - **Endorsed by the ITU** in 2002: (service requirement ITU-R BS.1514 and system ITU-R BS.1348)
- **Covers large areas using a single frequency:** good for rural coverage and on the move
- **Offering FM like sound quality** (no more fading, crackling, distortions)
- **Low power, local service option** available: regulated by ITU, HFCC for **community radio**
- **Many modes of operation** (levels of ruggedness) to counter propagation issues in MW/SW
- **Green** with significant energy and cost savings

DRM in the VHF Bands (DRM+ Mode)

- **Most recent global digital radio broadcasting option in all the VHF bands**
  - **Endorsed by the ITU** in 2011
    ITU-R Rec. BS.1114 (system),
    ITU-R Rec. BS.1660 (planning parameters)
  - **ETSI standard ratified** in 2011: ETSI TS 102 820 V3.1.1 (2010-12)
- **Worldwide spectrum compatibility:** 100 kHz bandwidth
- **Useful content bit rate:** 37—186 kbps
- **Worldwide tests:** already tested in Asia Pacific, Europe and Latin America

* **More about all the DRM ETSI and ITU specifications and related documents by visiting: http://www.drm.org/?page_id=112**



7. Macedonia 8. Montenegro 9. Serbia 10. Bosnia and Herzegovina

DRM Key Features

- **More choice** for listeners
  - Up to 4 programmes on 1 frequency
  - Simulcast analog / digital
- **Excellent audio** quality
  - No distortion
  - Stereo and 5.1 surround sound
- **Multimedia Applications**
  - Great listener benefits
  - Extra revenue opportunities for broadcasters
- **Good coverage** area and robust signal
  - Supporting SFN (Single Frequency Networks)
  - Green and energy efficient
- **Automatic tuning**
  - by station name, no longer by frequency
  - re-tunes when leaving coverage area
- **Emergency warning & alert**
  - All stations switch, present audio and text information

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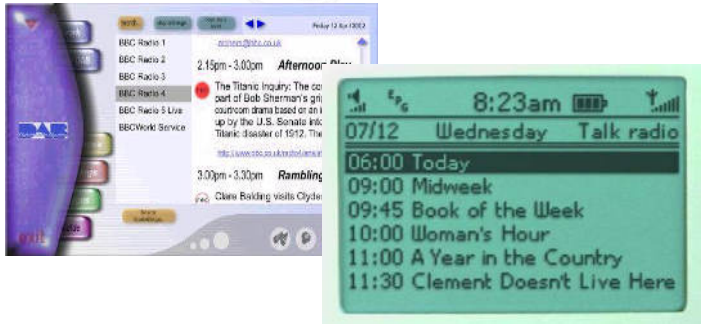

DRM TextMessages
programme accompanying labels (Unicode), max. 128 characters, max. every 20 sec.

Journaline
text based information service (Unicode), supporting all classes of receivers, triggers interactivity and geo-awareness

MOT Slideshow
programme accompanying images + animation

EPG – Electronic Program Guide
What's up now & next;
Search for programs and schedule recording

TPEG / TMC Traffic Information

→ **Great listener benefits & revenue source!**

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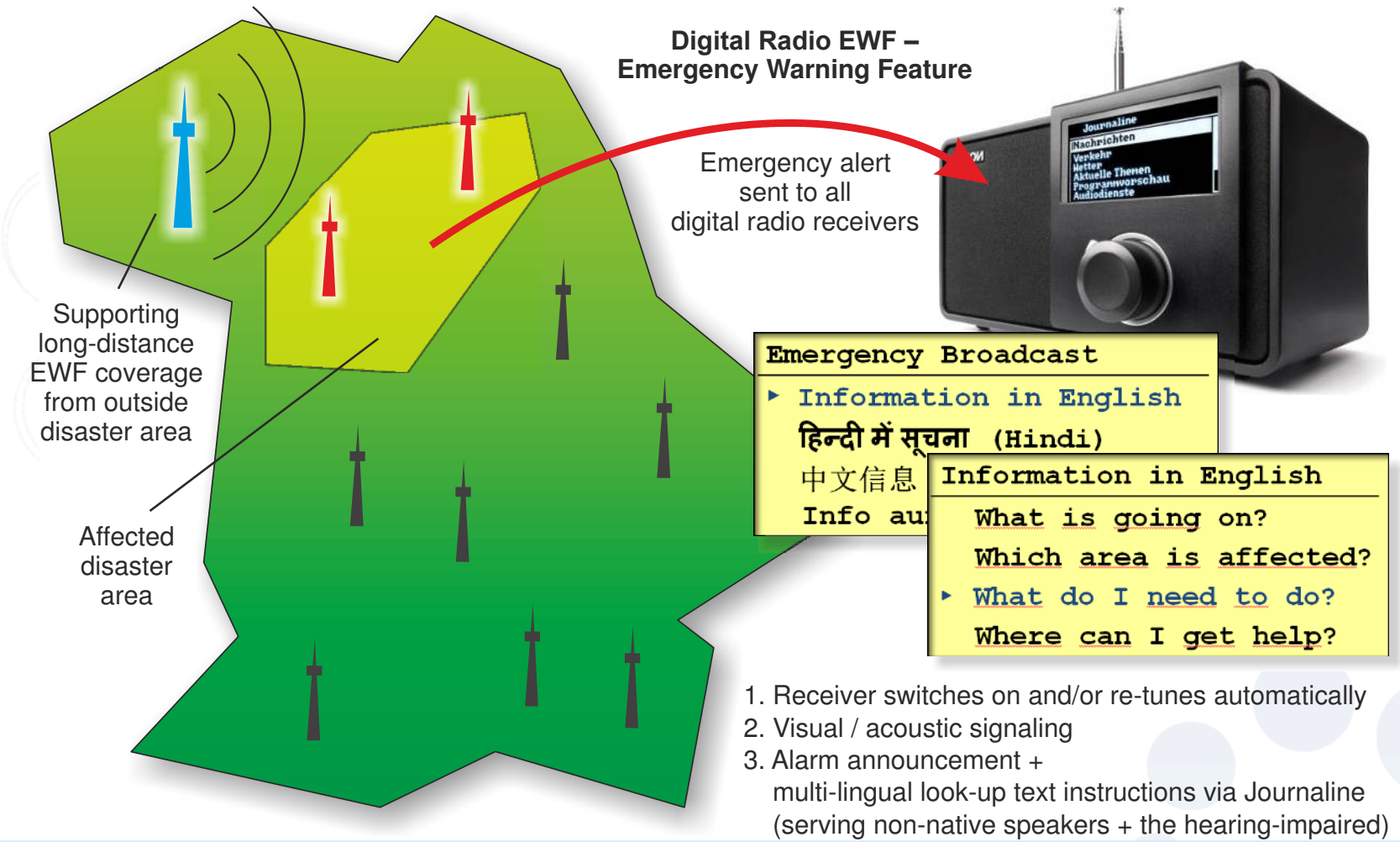
DRM EWF – Functional Overview



1. Receiver switches on and/or re-tunes automatically
2. Visual / acoustic signaling
3. Alarm announcement +
   multi-lingual look-up text instructions via Journaline
   (serving non-native speakers + the hearing-impaired)

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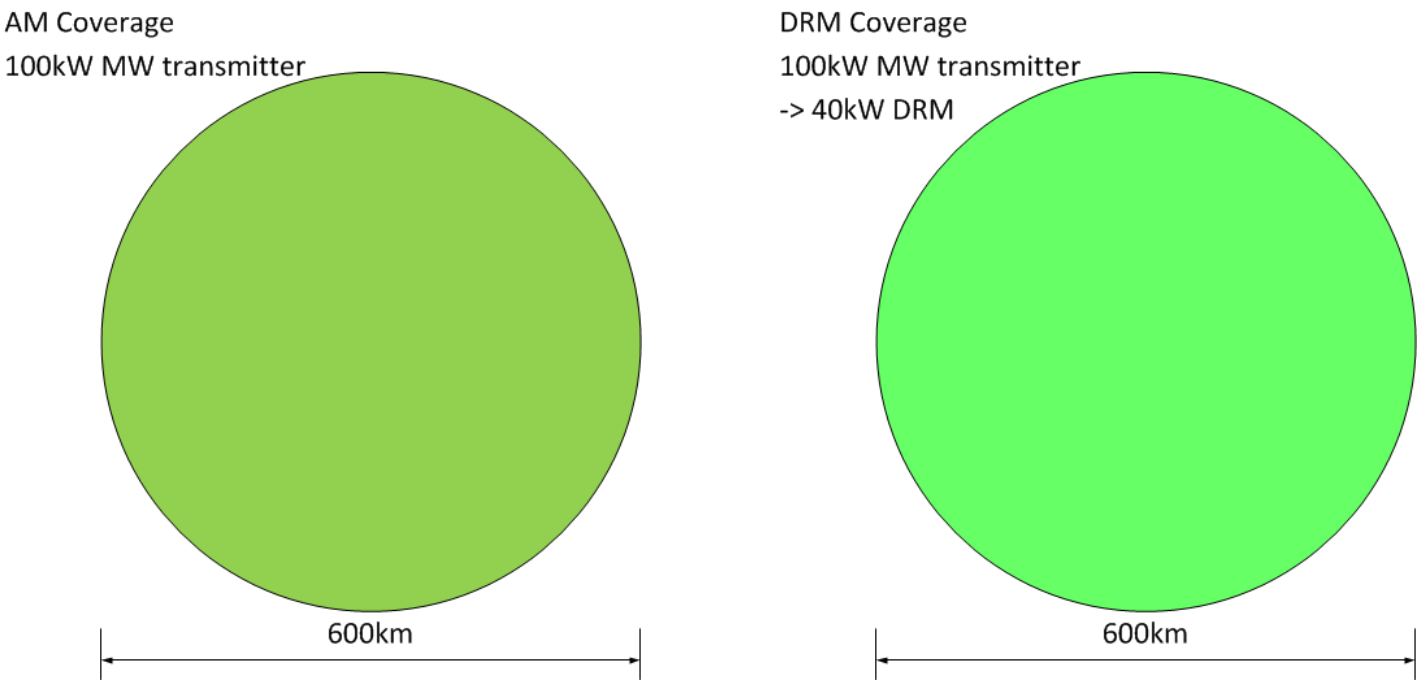
Coverage AM analog vs DRM30

AM analog vs. DRM – same coverage, 1 tx



235 000 km^2

235 000 km^2

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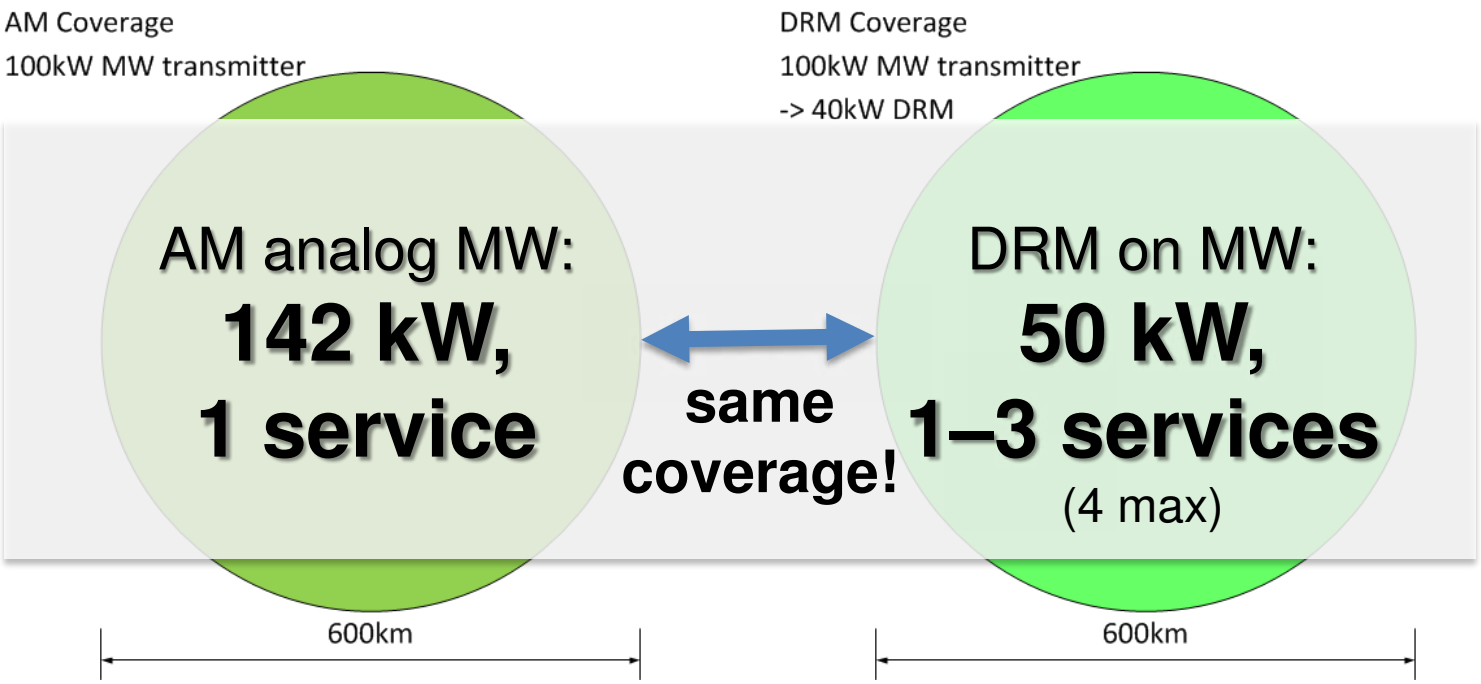
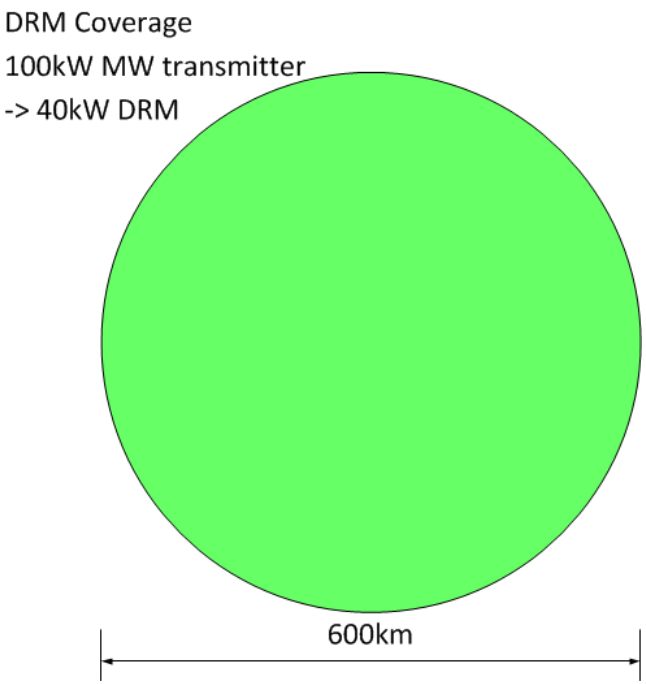
AM analog vs. DRM – same coverage, 1 tx

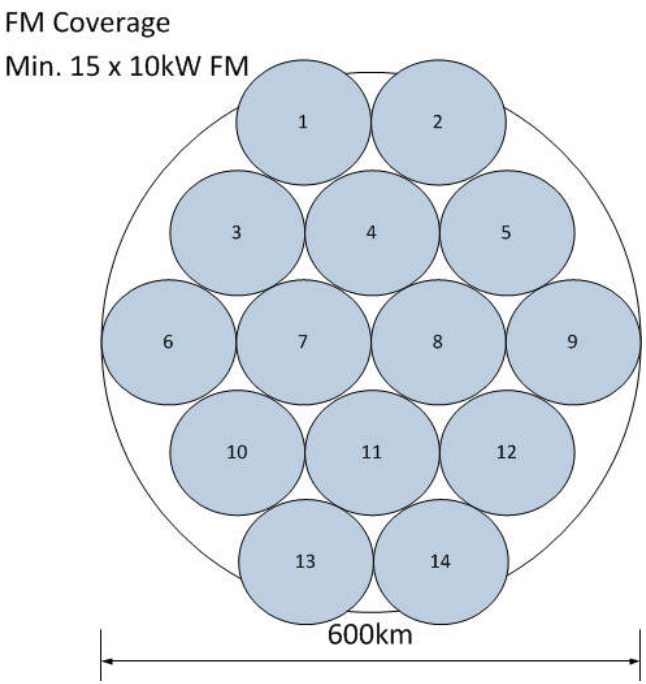


Same coverage – FM vs DRM30

1 DRM transmitter (MW)



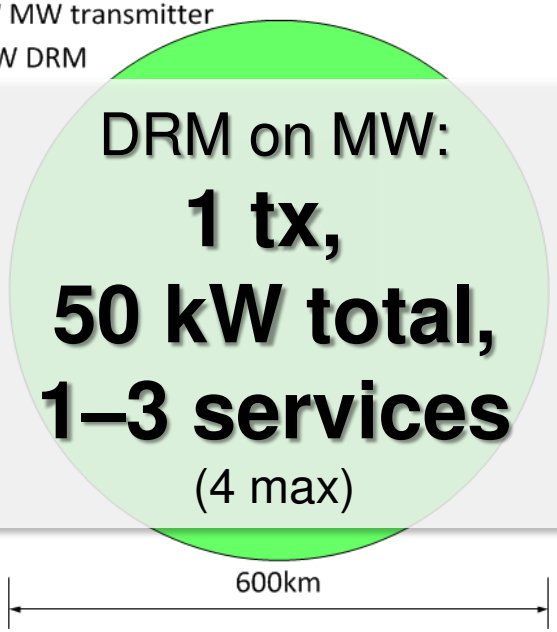
Min. 15 FM transmitter



Same coverage – FM vs DRM30

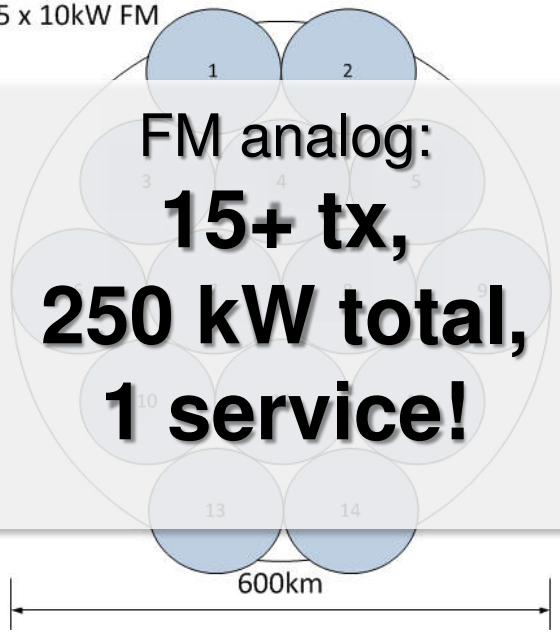
1 DRM transmitter (MW)

DRM Coverage
100kW MW transmitter
-> 40kW DRM



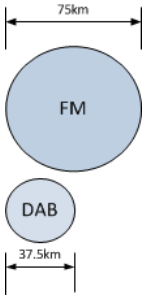
Min. 15 FM transmitter

FM Coverage
Min. 15 x 10kW FM



DRM on MW:
1 tx,
50 kW total,
1–3 services
(4 max)

FM analog:
15+ tx,
250 kW total,
1 service!



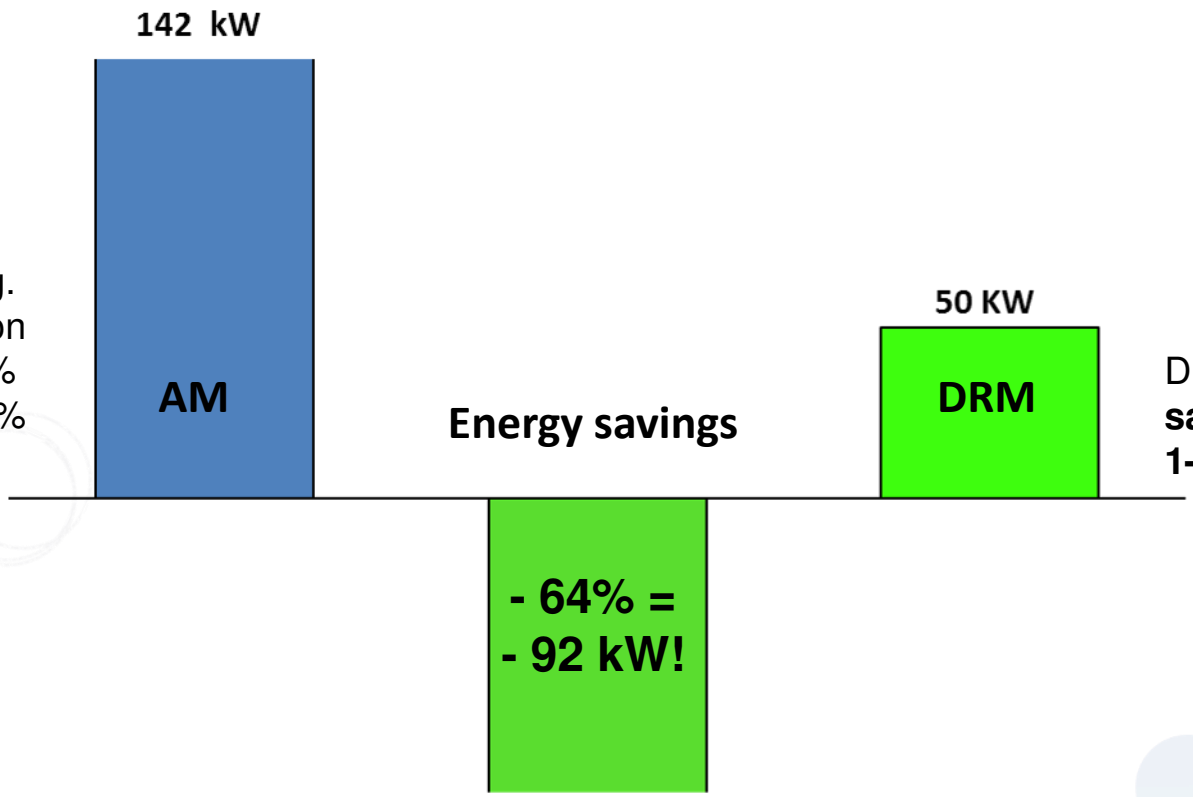
40kW @ 80% efficiency
-> 50kW (up to 4 service)

150kW @ 60% efficiency
-> 250kW (+ modulation)

Coverage AM analog vs DRM30

TX on air power in kW

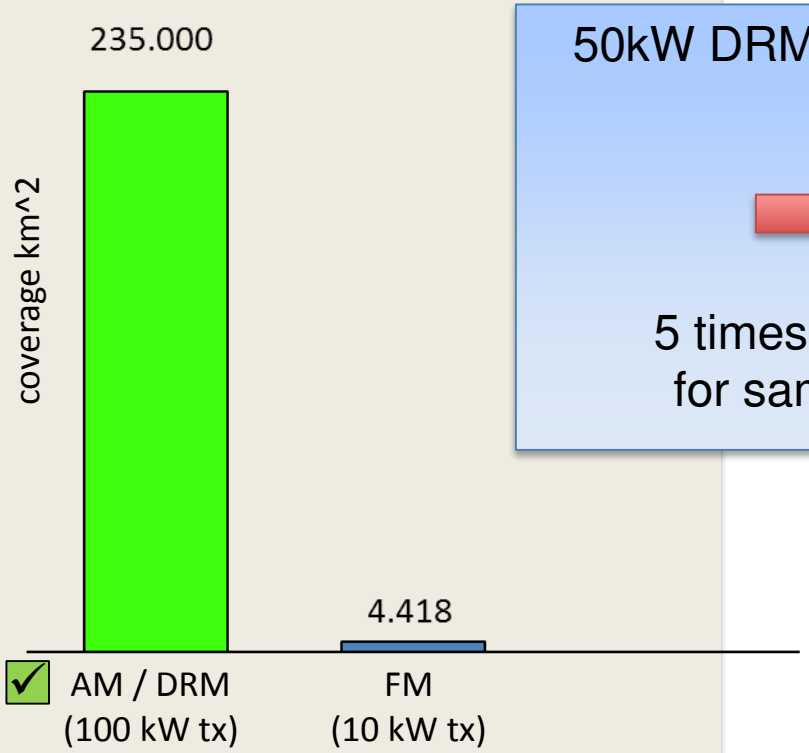
Incl avg.
AM modulation
m = 75%
Efficiency n = 90%



DRM operation:
same coverage,
1—3 services

Same coverage – FM vs DRM30

Coverage of 1 Tx (km²)

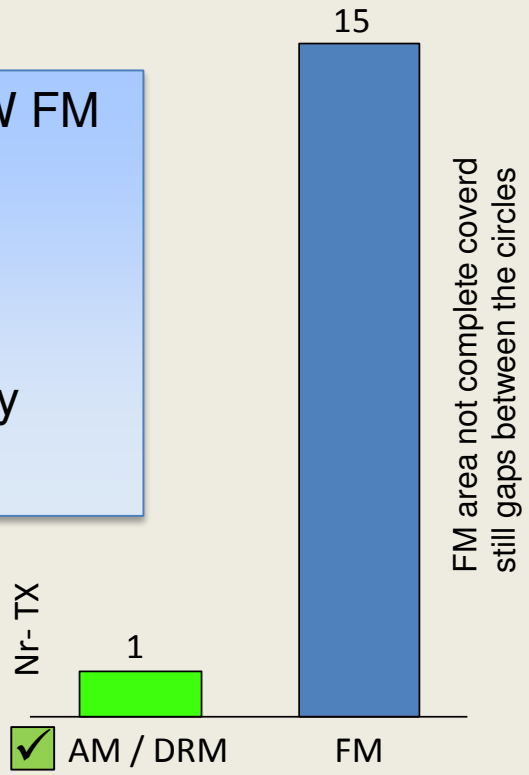


50kW DRM ←→ 250kW FM

!

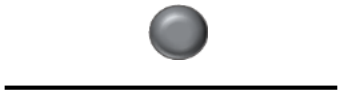
5 times more energy
for same coverage

Tx (same coverage)



Migration – AM to DRM30

Transmitter



Feeder Lines

Antenna

Transmitter station DRM upgrade:

1. **Add DRM ContenServer** (audio/data encoder/multiplexer; on-site/in studio) **and DRM Modulator** (part of DRM-ready transmitter)
2. Transmitter needs to be DRM capable: **Check exciter** (RF generator)
3. **Check antenna** linearity and group delay (optimised for best coverage and signal [MER] on air)

→ **90% of transmitter station remains un-changed**
(housing, power, cooling, feeder lines, antenna, etc.)

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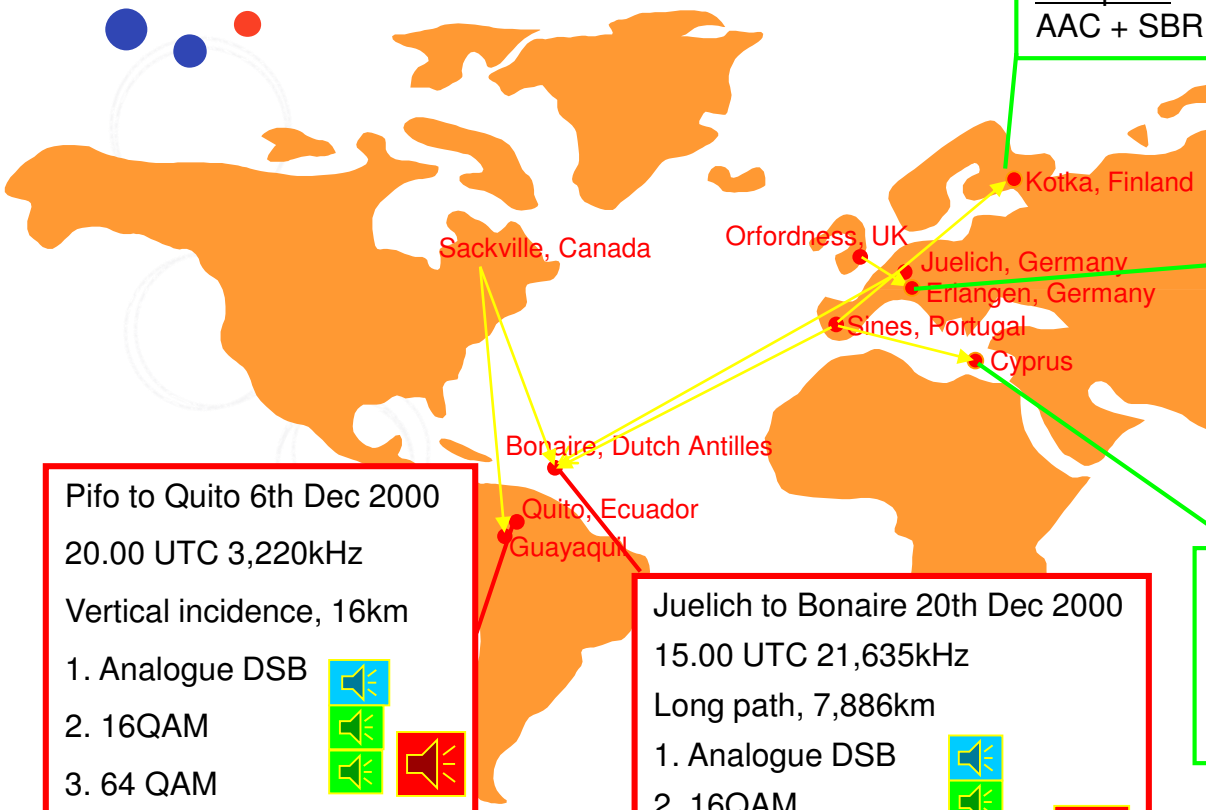
Audio Quality Demonstration – AM



Sines Kotka
17740 kHz 08 Aug 15.00-15.30
Sample 4: AM DSB
Sample 5: High Quality SW 64 QAM
AAC + SBR 22220 bit/s

Orfordness Erlangen
1296 kHz 25 Jul 03.30-04.00
Sample 7: High Quality MW 64 QAM
AAC + SBR 25080 bit/s
Sample 8: AM DSB

Pifo to Quito 6th Dec 2000
20.00 UTC 3,220kHz
Vertical incidence, 16km
1. Analogue DSB
2. 16QAM
3. 64 QAM

Juelich to Bonaire 20th Dec 2000
15.00 UTC 21,635kHz
Long path, 7,886km
1. Analogue DSB
2. 16QAM
3. 64QAM

Sines / Limassol
21630 kHz 11 Aug 10.30-11.00
Sample 9: Robust Quality SW 16 QAM
AAC 15960 bit/s
Sample 10: AM DSB

DRM Has Adopted MPEG xHE-AAC

MPEG xHE-AAC is added to the DRM system specification, replacing the speech-only codecs HVXC and CELP.

→ HE-AAC v2 also remains as a valid audio codec option for DRM

Benefits:

→ **Un-restricted audio content even in most robust DRM configurations**

→ **More services in a single transmission signal**

→ **Aligns with latest technology for mobile phones**

MPEG xHE-AAC – Extended HE-AAC

Listen for yourself to DRM xHE-AAC!

DRM+ Key Features

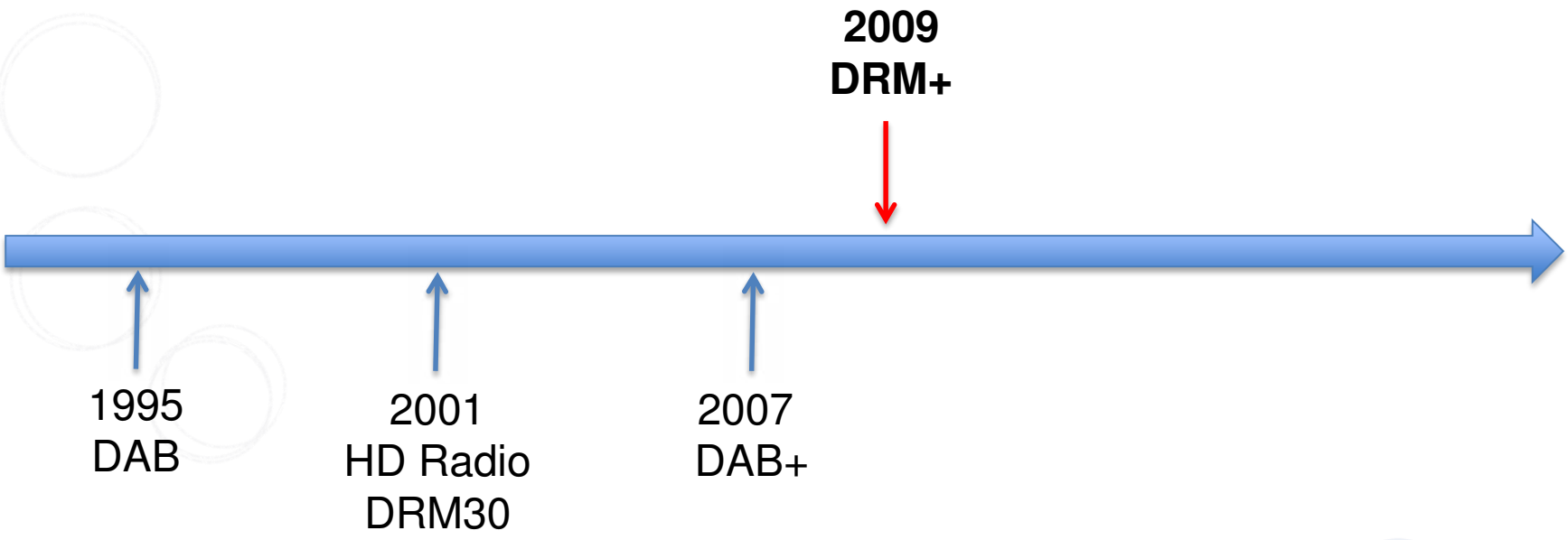
Jens Stockmann
Product Specialist Transmission
GatesAir

Topics

- DRM System Overview
- Migration scenarios
- Coverage
- SFN
- Implementation
- Cost advantages

DRM+ Is the Latest Digital Technology

- DRM+ is the most recent ITU confirmed Digital Radio Standard



DRM works in all frequencies

- DRM30 in the AM frequencies
- DRM+ covers VHF 30 MHz until 230 MHz (VHF Band I, II, III)

Long Wave	Medium Wave	Short Wave	VHF Band I	VHF Band II	VHF Band III	L-Band
AM Radio	AM Radio	AM Radio		FM Radio		
					DAB+	DAB+
drm	drm	drm	drm +	drm +	drm +	
	HD Radio			HD Radio		

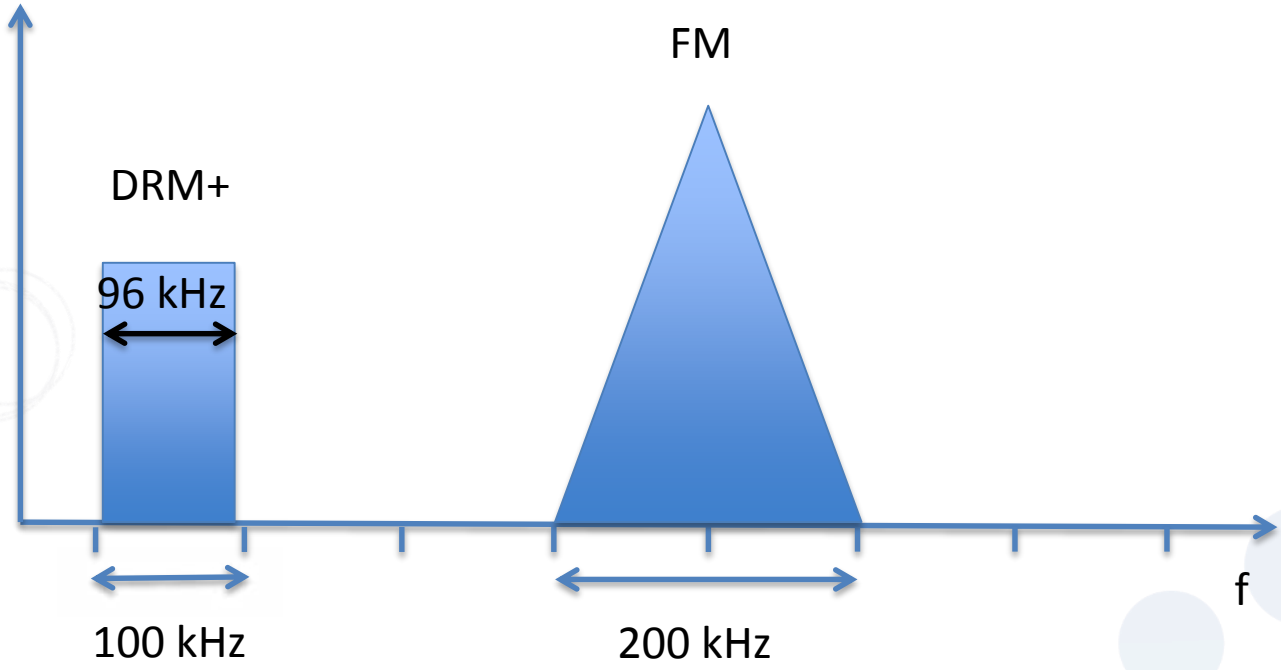
DRM+ Key Parameter

Most important general parameter of DRM+

General Parameter	
Frequency Range	47MHz to 240MHz
RF Channel Bandwidth	96 kHz, conform to FM raster (100kHz)
Audio Coding	MPEG xHE-AAC; MPEG 4 HE AAC (sourround),
Data Rate	37 kbit/s to 186 kbit/s (scalable)
Modulation	COFDM
Sub-Carrier Modulation	4 QAM / 16 QAM
Transmission Power	-8 dB to -20 dB to coordinated FM Power
Services	Up to 4 (Audio, Data)

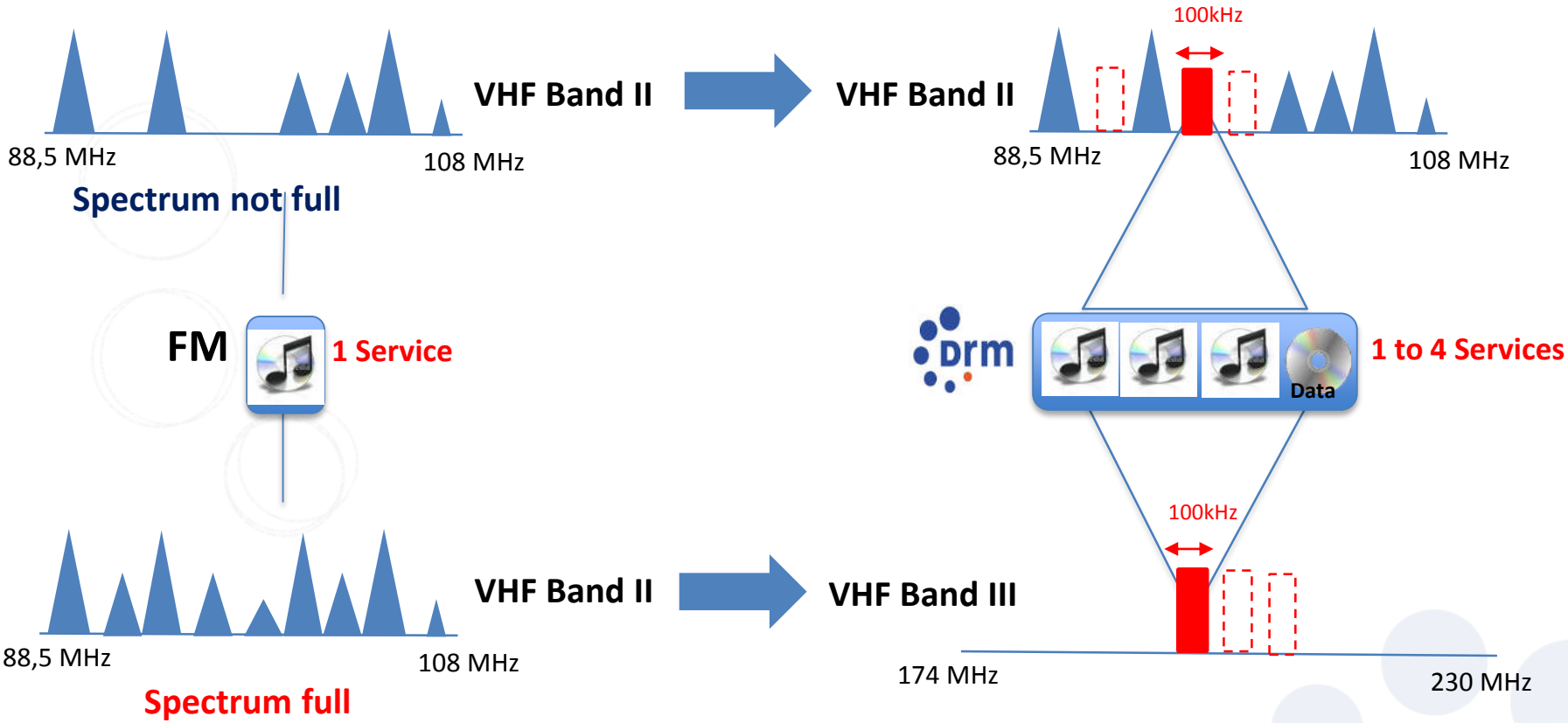
DRM+ fits in existing FM raster

- DRM+ fits into the FM channel raster
- DRM+ RF signal needs less Spectrum bandwidth compared to FM
- More RF channel possible in VHF Band II as for FM (spectrum efficient!)



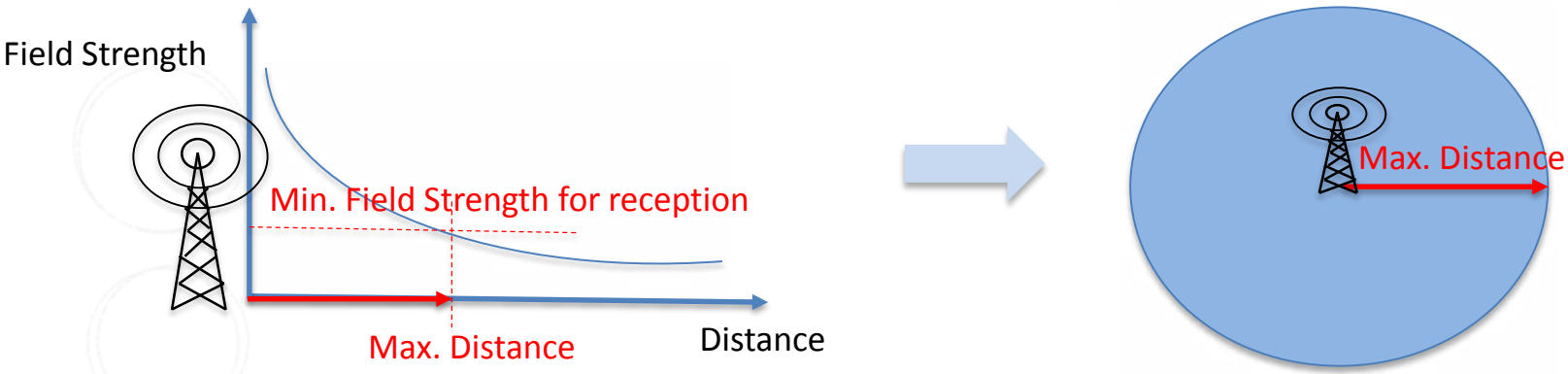
Migration Scenarios for DRM+

DRM+ flexible for different spectrum situations using VHF Band I, II and III



DRM+ coverage, minimum field strength

- Minimum field strength marks the max. distance from the Transmitter with reception in defined quality (max. coverage)

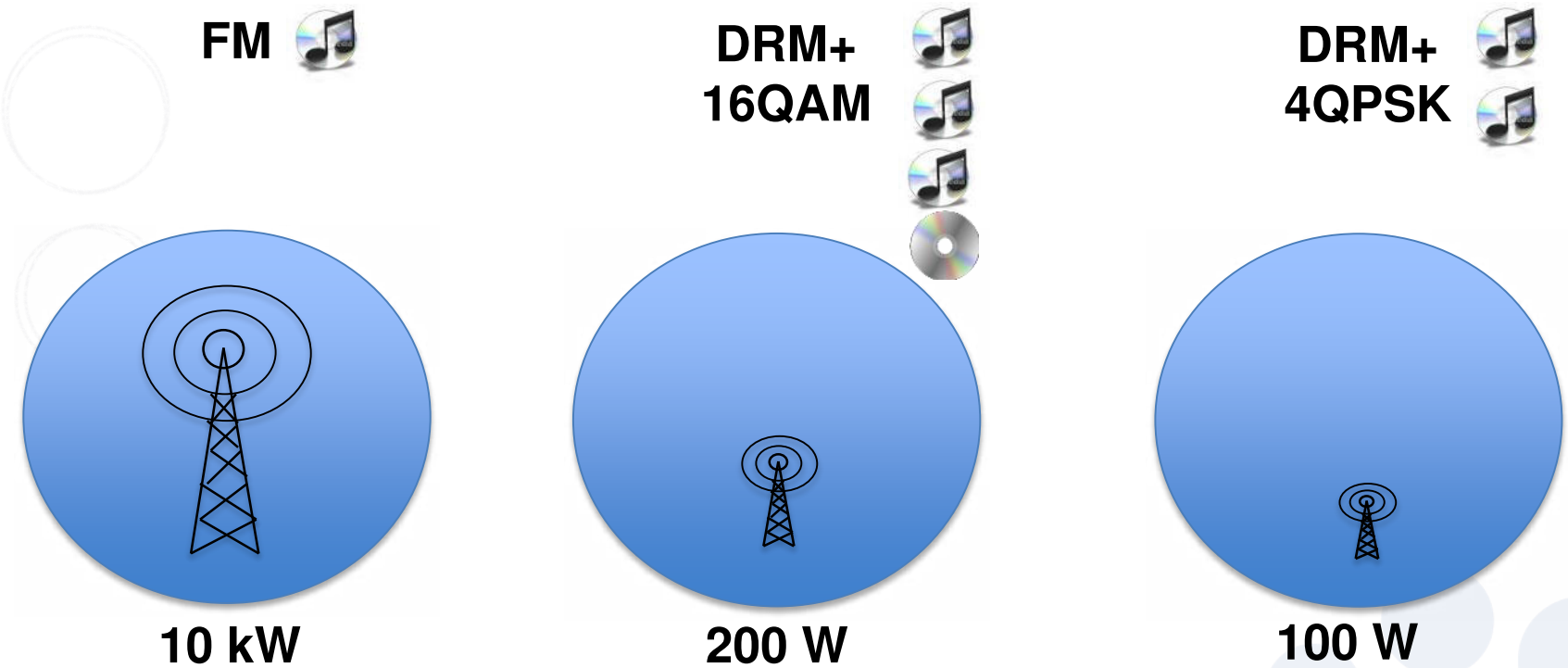


- ITU min. Field Strength Limits for **DRM+ with 20 dB below FM**:

	ITU-R BS.1660-6		ITU-R BS.412-9
DRM+	**4 QAM**	**16 QAM**	**FM stereo Cities**
Portable Indoor	**50,92 dBµV/m**	**57,01 dBµV/m**	Not defined
Mobile Outdoor	42,27 dBµV/m	48,41 dBµV/m	Not defined
Stationary Outdoor (10m)	17,32 dBµV/m	24,75 dBµV/m	**74 dBµV/m**

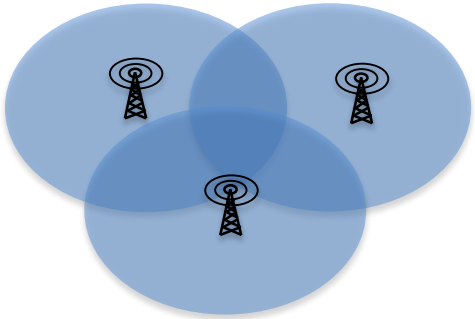
Coverage DRM+ vs. FM

- DRM+ with more services but significant reduced RF power compared to FM
- That enables savings in equipment and energy with DRM+



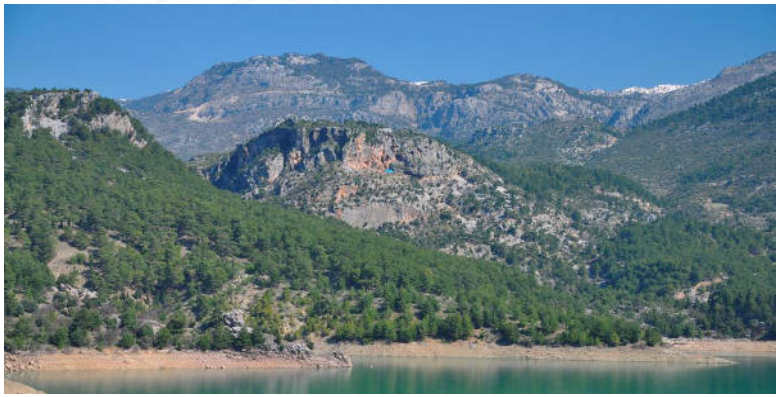
Assumption:
- Same coverage
- Same Antenna Gain

Single Frequency Network (SFN)



Single Frequency Networks with DRM+

- challenge to cover sky scraping downtowns and mountain areas
- many high buildings blocking the signal
- reception gaps behind buildings
- Reception blocked from mountains



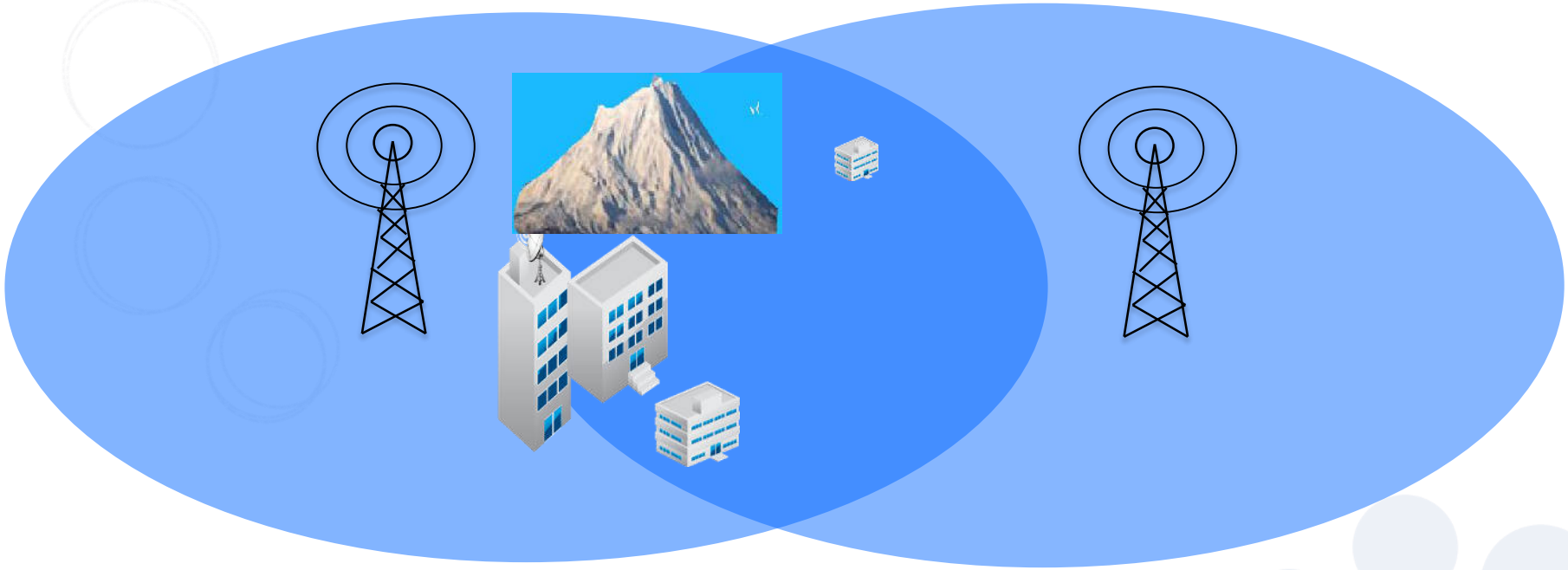
- Radio signals from two or multiple directions reduce this effect
- **(Single Frequency Network SFN)**

- **DRM allows Single Frequency Network Operation for both DRM30 and DRM+**
- **Gap filler on same frequency**

Single Frequency Networks

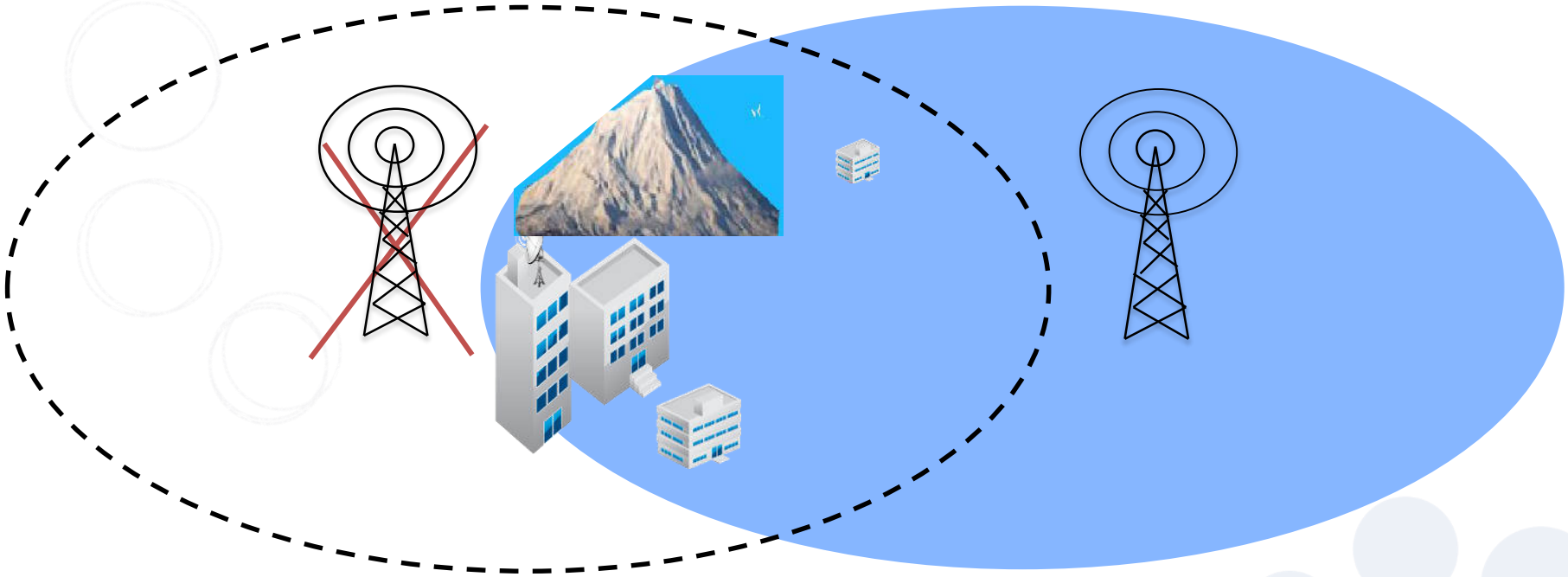
White spots - Areas with bad or no reception

Single Frequency Networks with DRM+



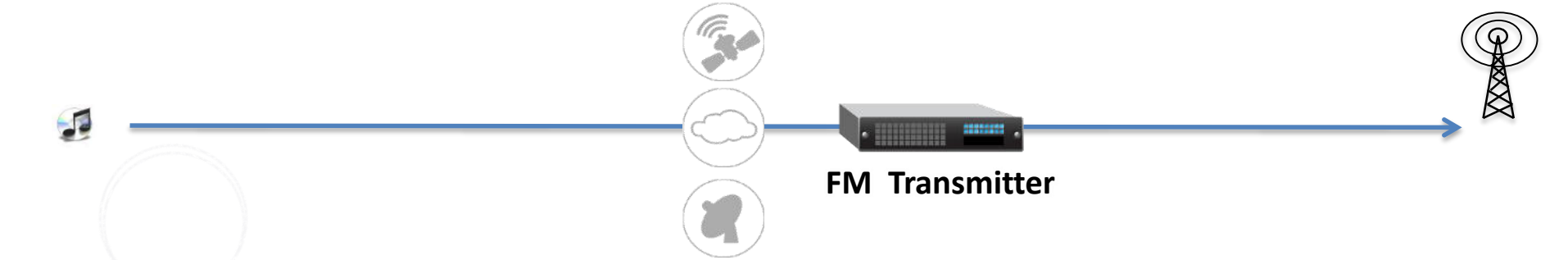
SFN Network Gain

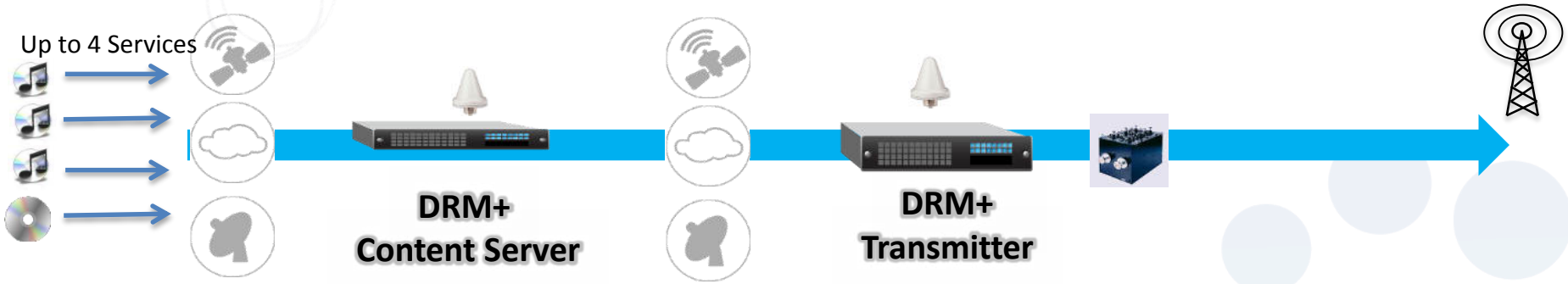
- SFN Network gain secures coverage in case of transmitter loss



Implementation of DRM+

DRM+ End-to-End System





Examples of DRM Content Servers

Fraunhofer

DIGIDIA

- Audio and Data delivery via IP
- Audio Encoder software based and integrated in the Multiplexer
- Multiplexer (so called Content Server) hardware based on standard Server

Transmitter Conversion from FM to DRM+

Requirements for a DRM+ ready FM-transmitter:

Exciter/ Modulator

- Resources for OFDM modulation
- MDI Input interface (IP)
- Real-Time-Automatic-Correction of non-linearity of power Amplifier
- GPS synchronization for SFN

Power Amplifier

- Multimode Amplifier on-the-fly switching between FM and DRM+

DRM+ Upgrade of FM Transmitter

Example of an DRM+ ready FM Transmitter

High Power Transmitter

10 kW FM

4 kW DRM+

Flexiva FAX10k

Low Power Transmitter

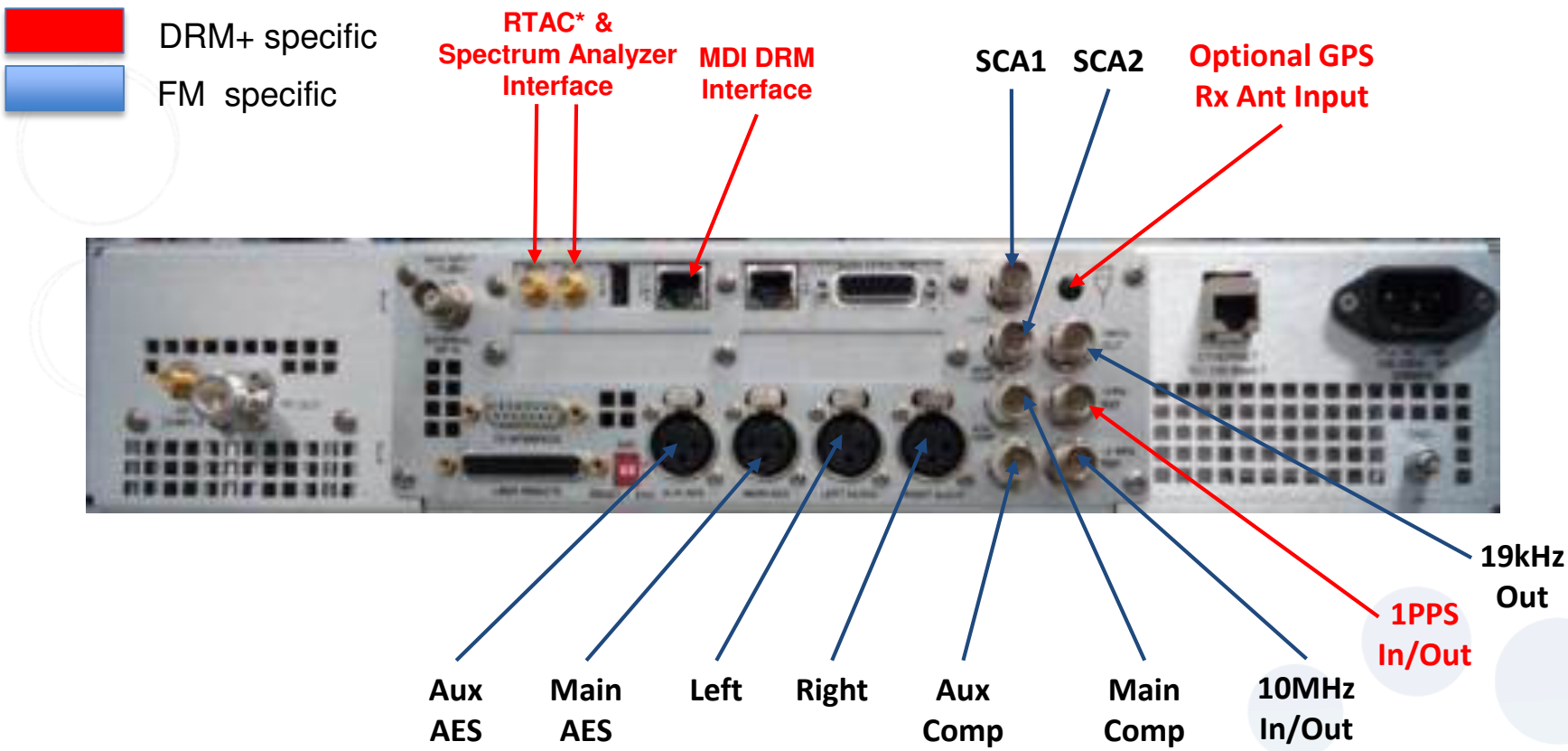
1 kW FM

400 W DRM+

Flexiva FAX1k

DRM+ Transmitter Interfaces

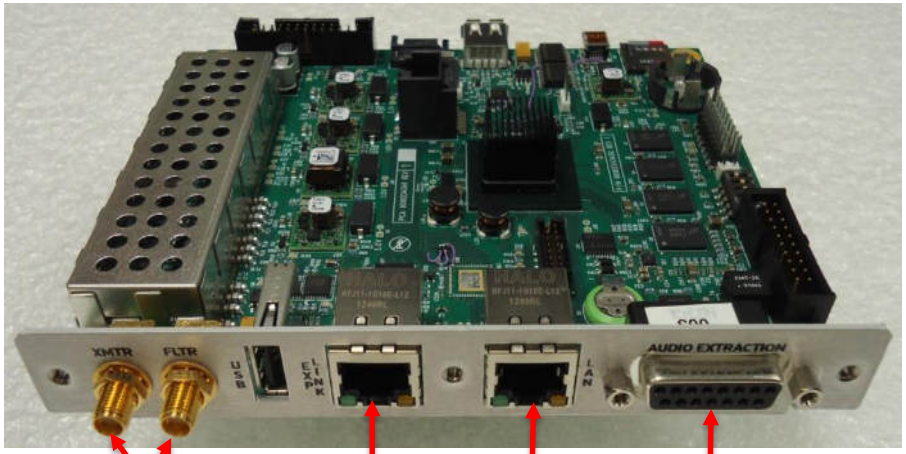
FM and DRM+ Specific Transmitter Interfaces



* RTAC – Real Time Automatic Correction for non-linear and linear distortions

DRM+ Upgrade of FM Tranasmitter

Gastesair Flexiva G4 Exgine Modulator Card



RTAC & Spectrum Analyzer Interface

MDI DRM Interface

LAN Interface

Remote Interface

Migration Costs FM to DRM+

Migration Costs FM to DRM+

Equipment

Capital Expenses (CAPEX)

- Signal Distribution
- Energy
- Cooling
- Floor space
- Service & maintenance

Operational Expenses (OPEX)

(5x CAPEX over the life time !)

Typical Generic Cost Scenario – Low Power

Scenario: network with 10 tx sites	FM replacement	DRM+ on existing FM site	DRM+ upgrade
Power level (TX)	**1 kW**	**10 W**	
Transmitter	$10.000	$15.000	$10.000
Mask Filter	$0	$500	$500
Cooling System	$0	$0	$0
Antenna & RF Line, Installation	Exists	Exists	Exists
TX Installation	$2.000	$2.000	$1.000
Total site costs (per site)	$12.000	$17.500	$11.500
Head-End (1x for network)	$0	$20.000	$20.000
No. of programmes	1	3	3
Cost per programme & site	**$ 12.000**	**$ 6.500**	**$ 4.500**

Typical Generic Cost Scenario – High Power

Scenario: network with 10 tx sites	FM replacement	DRM+ on existing FM site	DRM+ upgrade
Power level (TX)	**10 kW**	**100 W**	
Transmitter	$40.000	$20.000	$10.000
Mask Filter	$0	$1.000	$1.000
Cooling System	$5.000	$2.000	$0
Antenna & RF Line, Installation	Exists	Exists	Exists
TX Installation	$5.000	$2.000	$2.000
Total site cost (per site)	$50.000	$25.000	$13.000
Head-End (1x for network)	$0	$20.000	$20.000
No. of programmes	1	3	3
Cost per programme & site	**$ 50.000**	**$ 27.000**	**$ 15.000**

Energy Costs – Low Power

- Energy is stated as largest position of Operational Costs for Broadcaster
- **DRM+ with significant energy costs savings !**

Transmitter	FM	DRM+
Power	1 kW	10 W
Efficiency	70 %	40 %
Energy consumption per Transmitter	1.429 W	25 W
Annual Energy Bill per Transmitter	**1.877 USD**	**33 USD**
Programmes per Transmitter	1	3
Annual Energy Bill per Programme	**1.877 USD**	**11 USD**

Assumes 0,15 USD per kWh

Energy Costs – High Power

- Energy is stated as largest position of Operational Costs for Broadcaster
- **DRM+ with significant energy costs savings !**

Transmitter	FM	DRM+
Power	10 kW	100 W
Efficiency	72 %	50 %
Energy consumption per Transmitter	13.89 kW	0.2 kW
Annual Energy Bill per Transmitter	18.250 USD	264 USD
Programmes per Transmitter	1	3
Annual Energy Bill per Programme	**18.250 USD**	**88 USD**

Assumes 0,15 USD per kWh

International Tests DRM+

- **Germany, Kaiserslautern** (2008-2010) band II, III
- **Germany, Hannover** (2008-2011) band II, III
- **France, Paris** (2009) band I
- **Italy, Turin** (2011) bands I and II
- **UK, Edinburgh** (2011) band II
- **Vatican, Rome** (end of 2011) band II
- **Brazil, Sao Paulo** (2010/11) band II
- **Sri Lanka, Colombo** (2010) band II
- **India, New Delhi** band II
- **France, Nice (2013)** band I
- **Norway, Trondheim (2013)** band II
- **Sweden, Stockholm (2014)** band II

After successful trials, Radio Slovakia and bit eXpress (Germany) carry DRM+ transmissions regularly

Summary benefits of DRM+

DRM+ Benefits for the Broadcaster

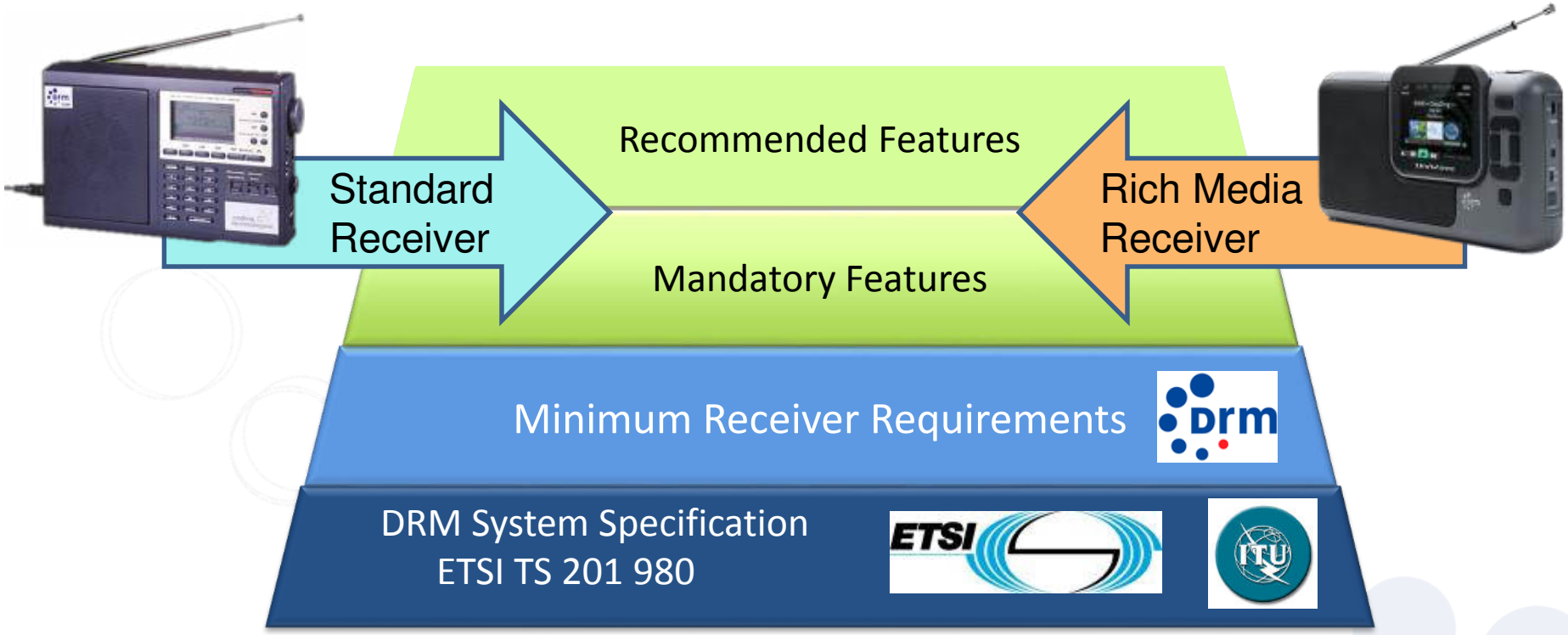
- Up to 4 Service per frequency channel
- Use of existing transmission system & equipment, no need for large multiplexes
- Wide use of spectrum in VHF Band I, II and III (30MHz to 230MHz)
- Significant lower total cost of ownership (TCO), especially in equipment, energy, service & operation
- Better coverage using Single Frequency Network design
- Opportunities for value-add services with data, text and other services
- Increased audience interest results in increased advertising interest and source of revenues for broadcasters

DRM – The Digital Standard for All Frequency Bands

Radu Obreja

Marketing Director
DRM Consortium

Global DRM Receiver Profiles



DRM Receivers on 3 Platforms

Desktop Radios

Mobile phone Radios

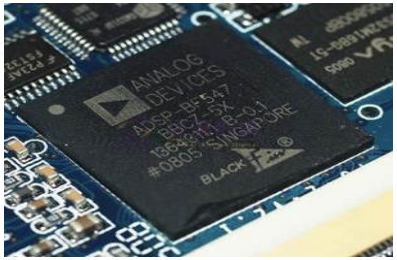
Car Radios

→ **A huge opportunity for the industry!**

→ But core requirement for radio manufacturers is the **availability of receiver chipsets.**

DRM Chipsets

ANALOG DEVICES



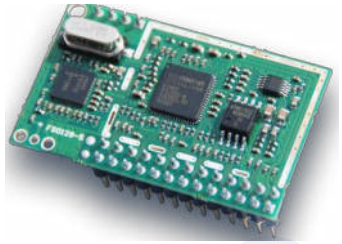
KeyStone Semiconductor

siano

MIRICS

Parrot

Octopus



All Major Chipsets Manufacturers have Multi-Standard Chipsets ready or announced with DRM!

Dec 2014: Parrot launches ready-to-use multi-standard Radio modules for Automotive
Based on SDR Octopus chip supporting **DRM30/DRM+,** DAB/DAB+, DVB-T2Lite, ISDB-Tsb, AM/FM
http://www.parrotoem.com/en-gb/news/2014/12/03/parrot-unveils-modules-best-class-dvb-t2-car-tv-reception/

Feb 2014: **Siano** launches Advanced Multi-Standard Digital Radio Receiver Chip
Supporting **DRM+,** T-DMB/DAB/DAB+, and Legacy FM Radio –
Targeting automotive and portable/mobile devices
http://www.siano-ms.com/index.php/news/press-releases/261-siano-launches-advanced-multi-standard-digital-radio-receiver-chip-supporting-t-dmb-dab-dab-drm-and-legacy-fm-radio

March 2013 : NXP launches Multi-standard and multi-tuner digital radio baseband processors for **DRM** radio, HD, DAB, DAB+, T-DMB
http://www.nxp.com/news/press-releases/2013/03/nxp-successfully-test-drives-digital-radio-mondiale-in-india.html

Current Receiver Developments

DR212

Full DRM feature set

Available in 2015

NEWSTAR ELECTRONICS 纽斯达电子

Latest DRM Receiver Prototype

AV DR1401

Full DRM feature set

Available in 2014

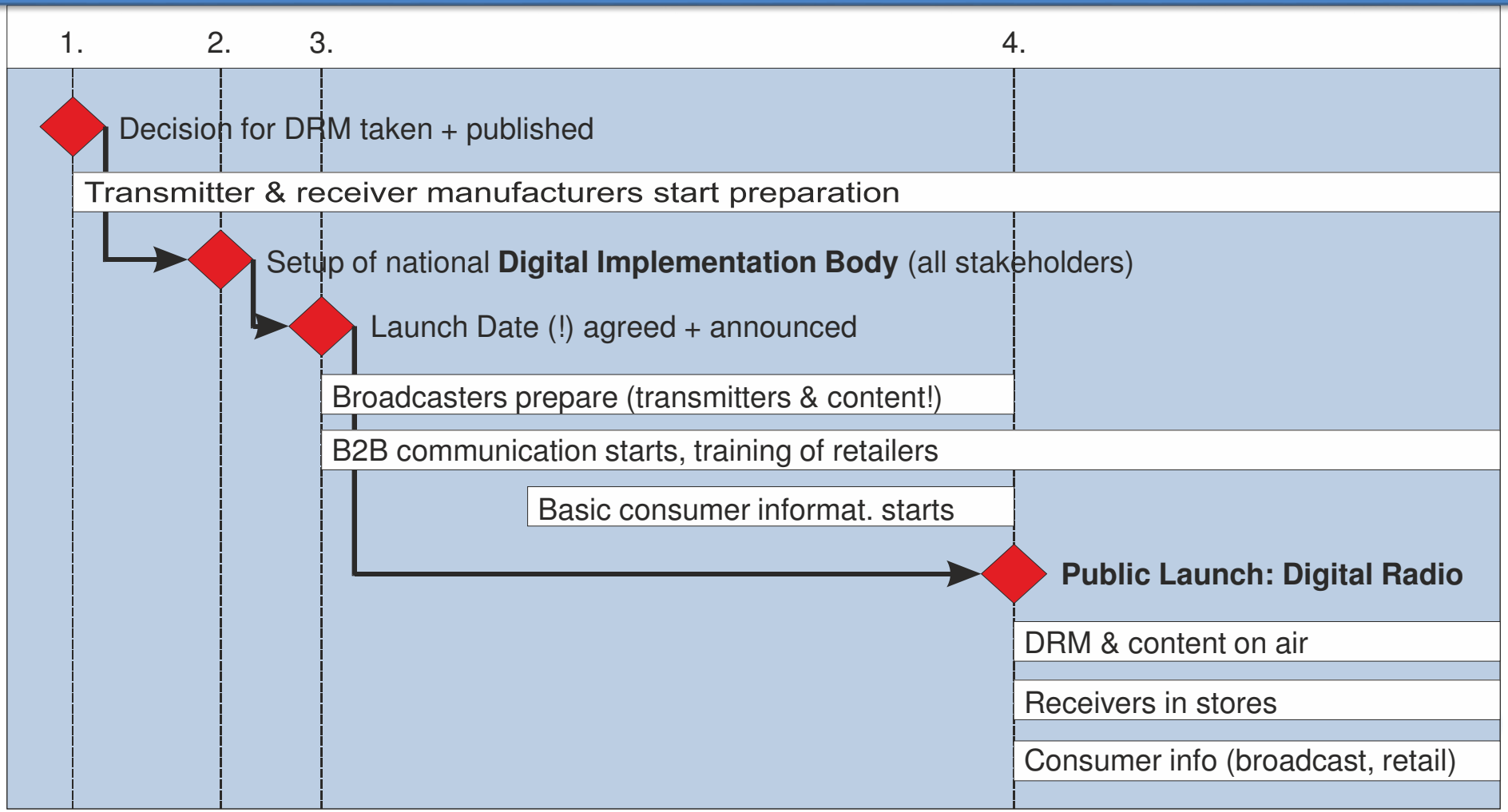
Just announced at IBC at the end of last week!

Domestic DRM Receiver Availability

How to start the local receiver market:

1. **Communication!**
   - → Decide upon a fixed **launch date**
   - → Communicate launch date in advance to receiver manufacturers
   - → Educate + excite public & listeners
2. **Political support!**
   - → Decide & announce analog sunset date
   - → Make DRM Disaster Alert feature mandatory for all new radio sets
3. **Content!**
   - → Create exclusive audio + data offers

DRM – SUGGESTIONS FOR ROLL OUT PLAN



DRM Benefits

LISTENERS

- Excellent quality sound in stereo DRM30, CD quality in DRM+
- Data such as text, pictures and Journaline
- Easy tuning on station name

MANUFACTURERS

- Replace receivers with new digital receivers
- Increase the market potential
- Increase possibilities for new areas of interest and content

BROADCASTERS

- Multilingual programme are possible plus extra information
- Reduced power consumption of up to 40-50%
- Increased opportunity for revenue generation streams
- Full coverage in DRM maintained

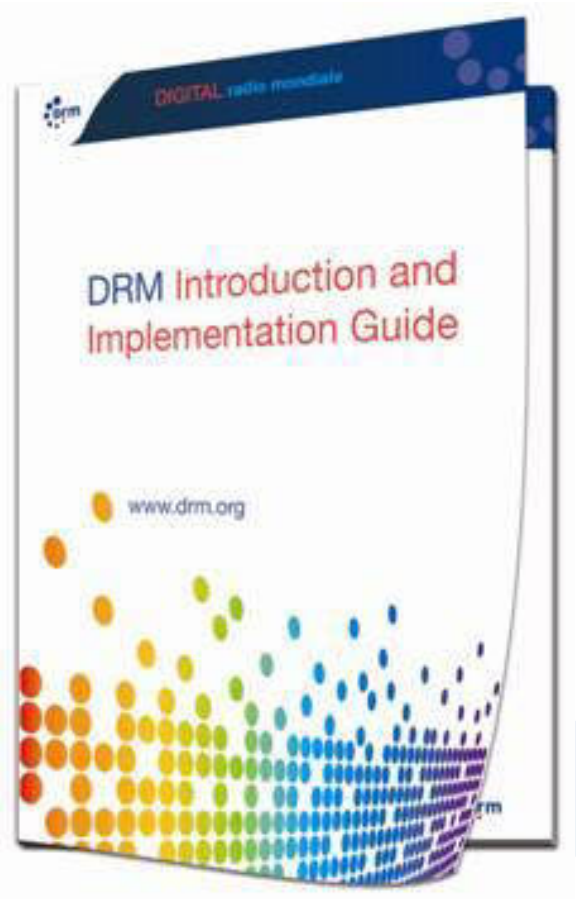
REGULATORS

- Uses less spectrum and release spectrum for other use
- An international standard
- Lower power costs – green broadcasting
- Emergency warning alert

All you need to know on DRM – Free

DRM Introduction and Implementation Guide

Updated – Version 2



More Information on DRM

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http://www.drm.org/?page_id=2494

For any inquiries or comments, please write to:
projectoffice@drm.org