





9th Workshop Digital Broadcasting FhG IIS Erlangen 


 **Leaving the dead-end street:
New ways to digitise the
VHF-FM sound broadcasting with DRM+**

Part II: *First results on compatibility planning
of DRM+ and HD Radio™ in the VHF band*

 **Dipl.-Ing. Joachim Lehnert**
(Landeszentrale für Medien und Kommunikation Rheinland-Pfalz)

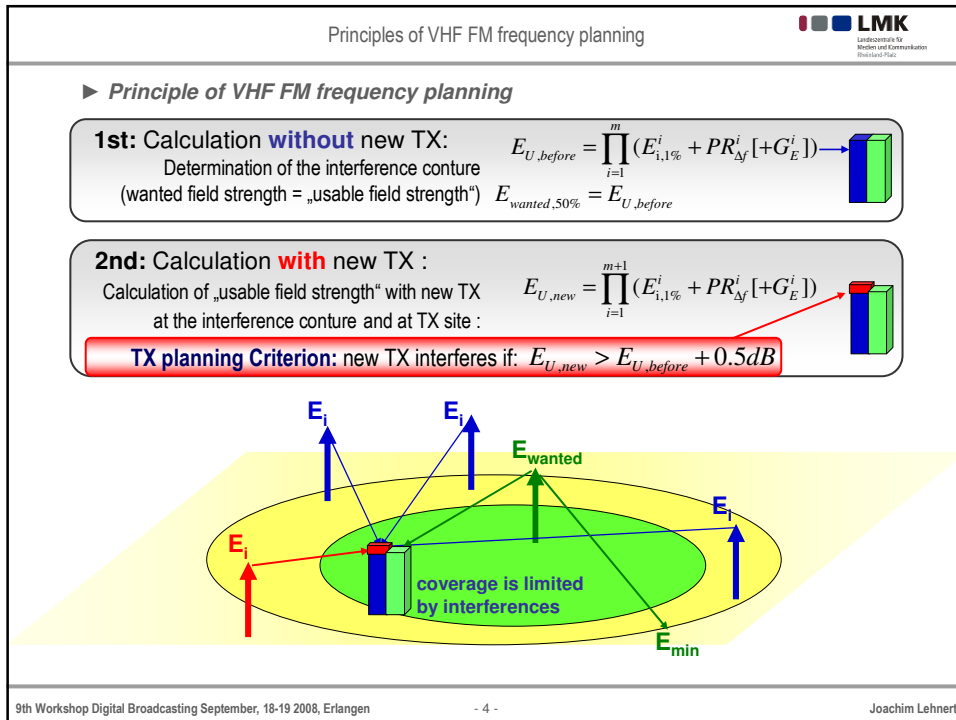
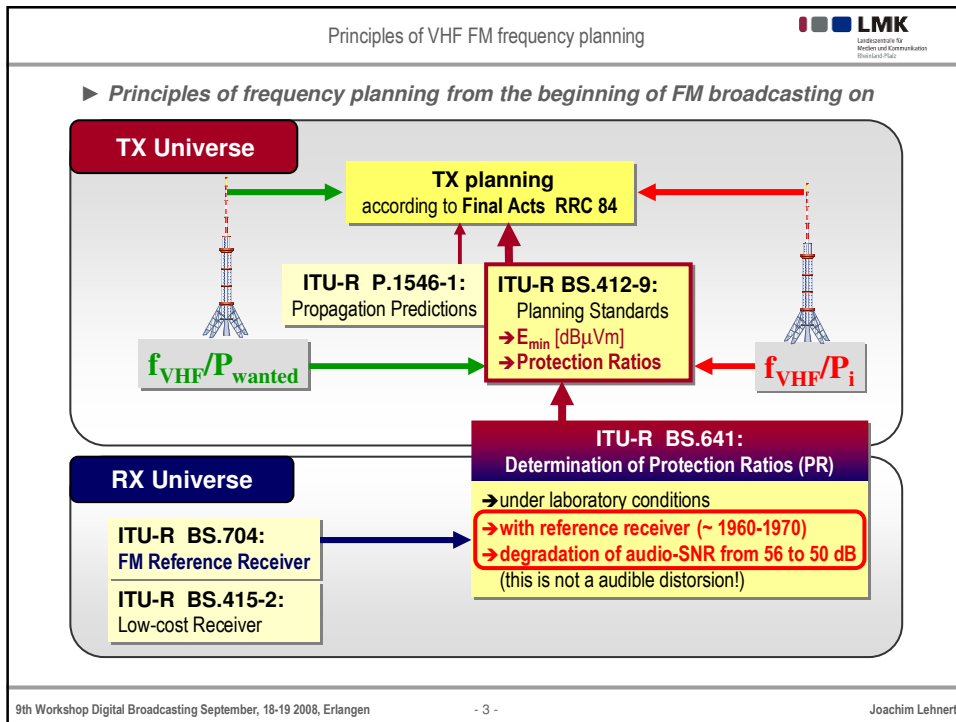
First results on compatibility planning of DRM+ and HD Radio™ 

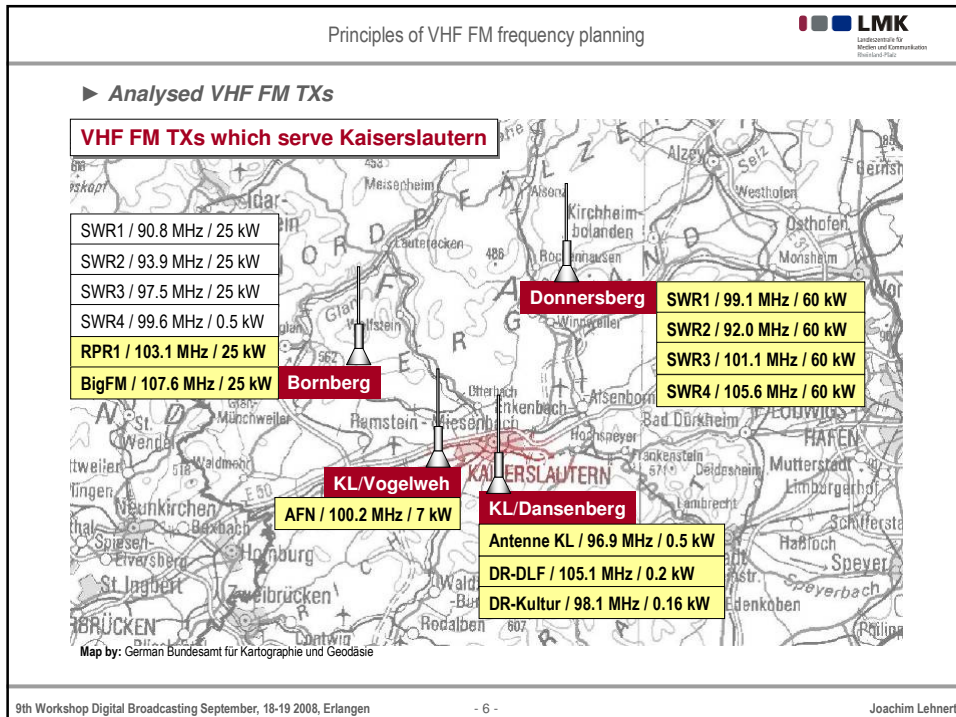
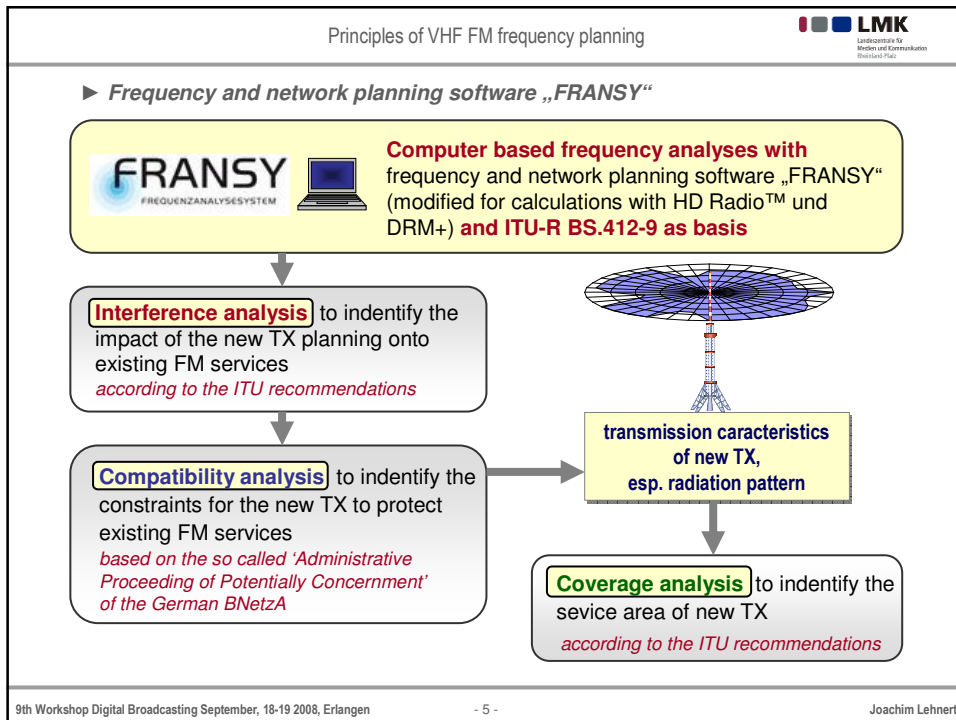
► **Outline**

 **First results on compatibility planning
of DRM+ and HD Radio™ in the VHF band**

- Principles of frequency planning in VHF FM Band**
- Frequency planning with DRM+
- Frequency planning with HD Radio™
- Leaving the dead-end street with *DRM+ Hybrid Mode?*
- Summary: problems and approach to solutions

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First results on compatibility planning of DRM+ and HD Radio™

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First results on compatibility planning of DRM+ and HD Radio™ in the VHF band

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- 2 **Frequency planning with DRM+**
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Frequency planning with DRM+

► **Protection ratios for the analyses with DRM+**

FM

Protection ratio for FM interfered with by DRM+
based on the results of the laboratory measurements and the field trial in 2007/08 and on ITU-R BS.412-9 and ITU-R BS.641-2

DRM+

Protection ratio for DRM+ interfered with by FM
based on latest studies in 2008

FRANSY FREQUENZANALYSESYSTEM

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Frequency planning with DRM+

► **First results of compatibility analyses for DRM+**

	Kaiserslautern				Bornberg		Donnersberg			
f [MHz]	98.1	105.1	96.9	100.2	103.1	107.6	99.1	92.0	101.1	105.6
P _{FM} [kW]	0.16	0.2	0.5	7	25	25	60	60	60	60
P _{DRM+ - FM} [dB]	-4.3	-2.5	-2.6	-3.9	-4.7	-4.7	-4.7	-4.7	-4.6	-4.6

FM - 5 dB = DRM+

These results suggest that
 → in general, a **existing FM TX can be replaced by a DRM+ TX by lowering the ERP by 5 dB** to protect existing FM services

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Frequency planning with DRM+

► **Example of coverage analysis for converting a TX from FM to DRM+**

with **FM - 5 dB = DRM+**

Coverage area of the TX 'Kaiserslautern Dansenberg' 96.9 MHz (Antenne KL)	
FM / 0.5 kW	E _{minFM} = 54 dBµV/m
DRM+ 16QAM / 0.16 kW	E _{minDRM+} = 25 dBµV/m
DRM+ 4QAM / 0.16 kW	E _{minDRM+} = 15 dBµV/m


Coverage according to ITUR BS.412-9 (aerial G=6 dB, 10m) considering the 20 strongest interferers
 Map by: German Bundesamt für Kartographie und Geodäsie


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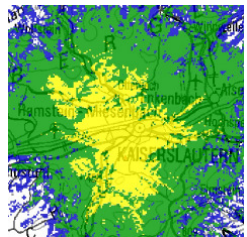
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Frequency planning with DRM+

► *First results of coverage analyses for DRM+*

with **FM - 5 dB** = 





Coverage_{FM} < Coverage_{DRM+}

This output and the other coverage analysis results suggest that

- the **coverage of a DRM+ TX is better** than before with the FM TX, **in spite of the power reduction of 5 dB** (This effect stems from the low protection ratio for FM into DRM+, yielding a low value of the usable field strength, and, therefore, a low interference impact),
- **coverage reserve of a DRM+ TX within the service area is higher** than those of the former FM TX,
- **DRM+ coverage area using 4QAM is larger** than using 16QAM.


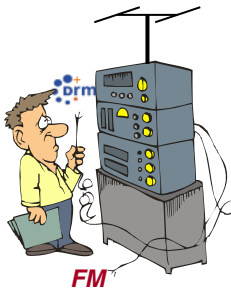
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Frequency planning with DRM+

► *Problem to switch over a FM TX to DRM+*





No FM broadcaster will turn off his FM TX to realize a DRM+ transmission for the simple reason that he would lose all his FM listeners, esp. in the early stage of digitisation.

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First results on compatibility planning of DRM+ and HD Radio™ 

► **Outline**

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- 1 Principles of frequency planning in VHF FM Band
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- 3 **Frequency planning with HD Radio™**
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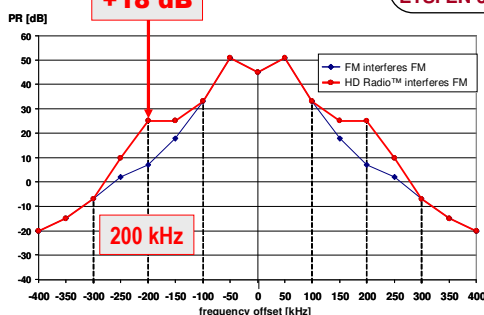
Frequency planning with HD Radio™ 

► **Protection ratios for the analyses with HD Radio™**

FM

Protection ratio for FM interfered with by HD Radio™
based on the results of the laboratory measurements and the field trial in 2007/08 and on ITU-R BS.412-9 and ITU-R BS.641-2

+18 dB




200 kHz

ETSI EN 302 018

HD Radio™


violates the European FM spectrum mask!

The protection ratio for HD Radio™ interfered with by FM is still not determined, so no coverage analyses could be made



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Frequency planning with HD Radio™

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► **First results of compatibility analyses for HD Radio™ Hybrid Mode**

f [MHz]	Kaiserslautern				Bornberg		Donnersberg			
	98.1	105.1	96.9	100.2	103.1	107.6	99.1	92.0	101.1	105.6
P _{FM} [kW]	0.16	0.2	0.5	7	25	25	60	60	60	60
P _{HD Radio™ - FM} [dB]	0.0	0.0	-16.6	-7.7	-16.5	X	-16.7	-16.6	-16.8	-17.2

FM - {0...17} dB = HD Radio


 

These results suggest that the use of HD Radio™ Hybrid Mode


- with a low power TX (less than 1 kW) is **sporadically possible** without any power reduction, but **in all other cases** only possible with power reductions up to 17 dB and thus **with loss of existing FM coverage**,
- with a mid power and high power TX is **only possible with power reductions** up to 17 dB due to the high interference in the 200 kHz adjacent channel and thus **with loss of existing FM coverage**,
- is **not possible** above 107.5 MHz due to increasing interference into aeronautical radio navigation services located on the frequency range above 108 MHz.

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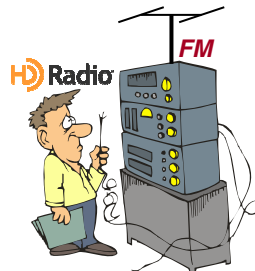
Frequency planning with HD Radio™

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► **Problem to use HD Radio™ Hybrid Mode**




Problem!




No FM broadcaster will broadcast simulcast FM and HD Radio™ when he has to reduce his TX power for the simple reason that he would loose most of his FM listeners.

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First results on compatibility planning of DRM+ and HD Radio™ 

► **Outline**

 **First results on compatibility planning of DRM+ and HD Radio™ in the VHF band**

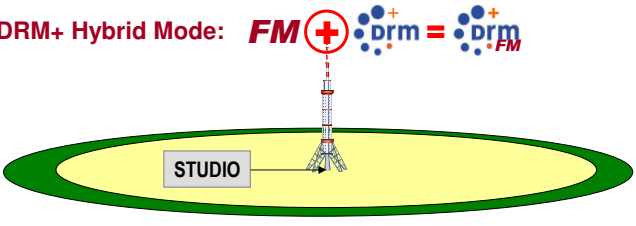
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Leaving the dead-end street with DRM+ Hybrid Mode? 

► **Proposal for conditions of DRM+ Hybrid Mode**

DRM+ Hybrid Mode: $FM + DRM = DRM+FM$



DRM+-Hybrid-Mode = Simulcast of FM and DRM+ with following conditions:

- broadcasting both signals over the same TX and antenna
- FM power remains unchanged and so the service area remains the same
- receiving both signals in the same service area
- the well known broadcasting frequency will be used furthermore
- receivable with a „one frontend VHF FM/DRM+ combined receiver“ with an automatic analogue/digital switchover
- important due to economical considerations particular at the beginning of VHF FM digitisation

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Leaving the dead-end street with DRM+ Hybrid Mode?

► **Proposal for parameters of DRM+ Hybrid Mode**

FM	TX power remains unchanged
$\Delta f_{(FM - DRM+)}$	flexible frequency offset: $\pm [200 \text{ kHz} - 400 \text{ kHz}]$, $\Delta f = 50 \text{ kHz}$ planning DRM+ in that channel with the lowest interference impact
DRM+	4QAM modulation flexible TX power as high as compatible to existing FM services

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Leaving the dead-end street with DRM+ Hybrid Mode?

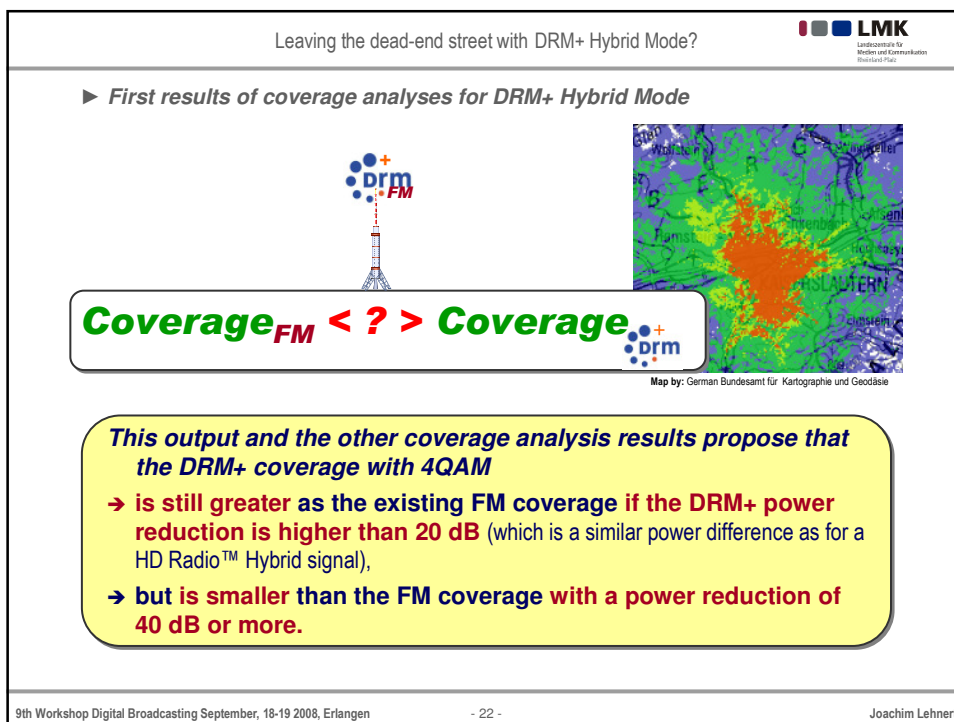
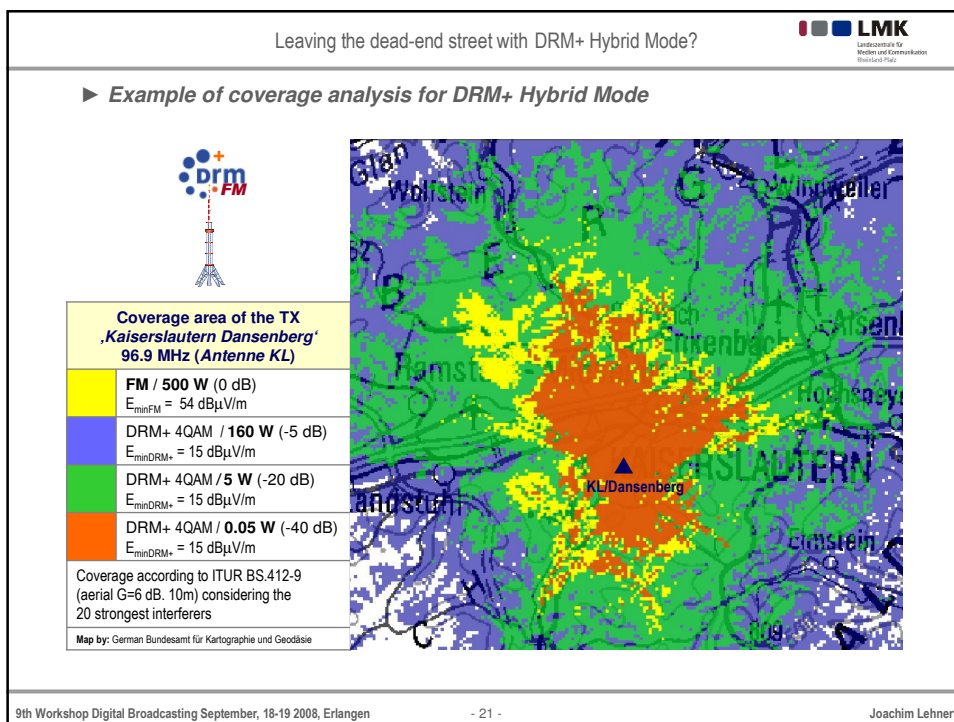
► **First results of compatibility analyses for DRM+ Hybrid Mode**

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P_{FM} [kW]	0.16	0.2	0.5	7	25	25	60	60	60	60
$\Delta f_{DRM+ - FM}$ [MHz]	200	250	-350	250	-250	-250	-250	-300	250	350
$P_{DRM+ - FM}$ [dB]	-15.9	-3.2	-12.3	-12.8	-34.7	-36.2	-40.3	-43.4	-40.1	-45.1
P_{DRM} [W]	4	96	29	375	8	6	6	3	6	2

The results propose that

- the determined **TX power reductions** of the DRM+ Hybrid signal **are in the lower watt range** (similar to the digital part of a HD Radio™ Hybrid signal),
- in some cases, **a quite high DRM+ signal power can be reached**,
- the required **power reduction** is obviously **not as high for low power TXs** as for high power TXs


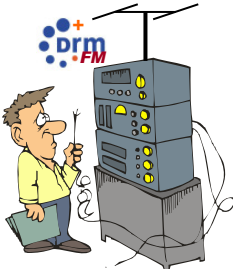
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Leaving the dead-end street with DRM+ Hybrid Mode?

► *Problem to deploy DRM+ Hybrid Mode*

The DRM+ Hybrid Mode
gives a chance for local or regional coverage areas
 but is currently not more than just a good idea.
 Investigations are pending*
 Concepts for TX and RX have still to be developed.


*) first compatible tests had been conducted by University of Hannover in August 2008

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First results on compatibility planning of DRM+ and HD Radio™


► *Outline*




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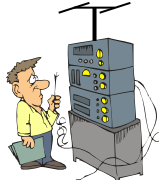
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Summary: problems and approach to solutions 

► *ITU planning recommendations as barriers*



ITU-R BS.412-9
ITU-R BS.641






no turnaround!


On the basis of the ITU planning recommendations for FM VHF systems the introduction of a new OFDM TX into the existing VHF FM environment involves high or even insurmountable barriers – this is a dead-end street!

- **HD Radio™** can generally only be planned with loss of existing FM coverage
- **DRM+** can only be planned with high coverage if the existing FM TX is replaced with DRM+
- **DRM+ Hybrid Mode** gives a chance for local or regional coverage areas, but this mode has still to be developed

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Summary: problems and approach to solutions 

► *Gap between interferences in TX planning and RX reality*

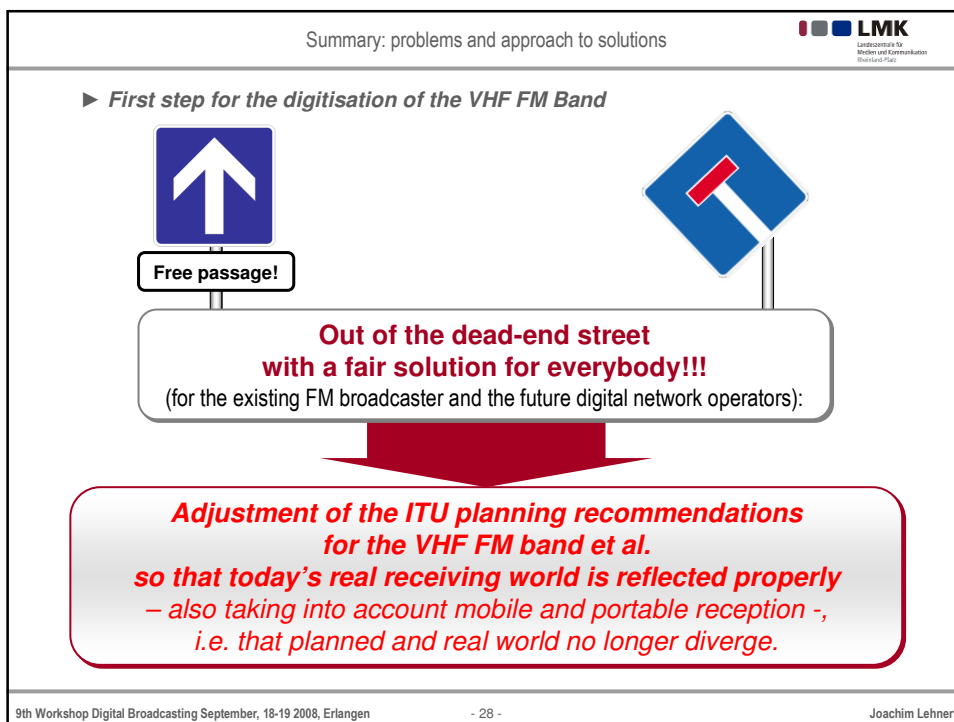
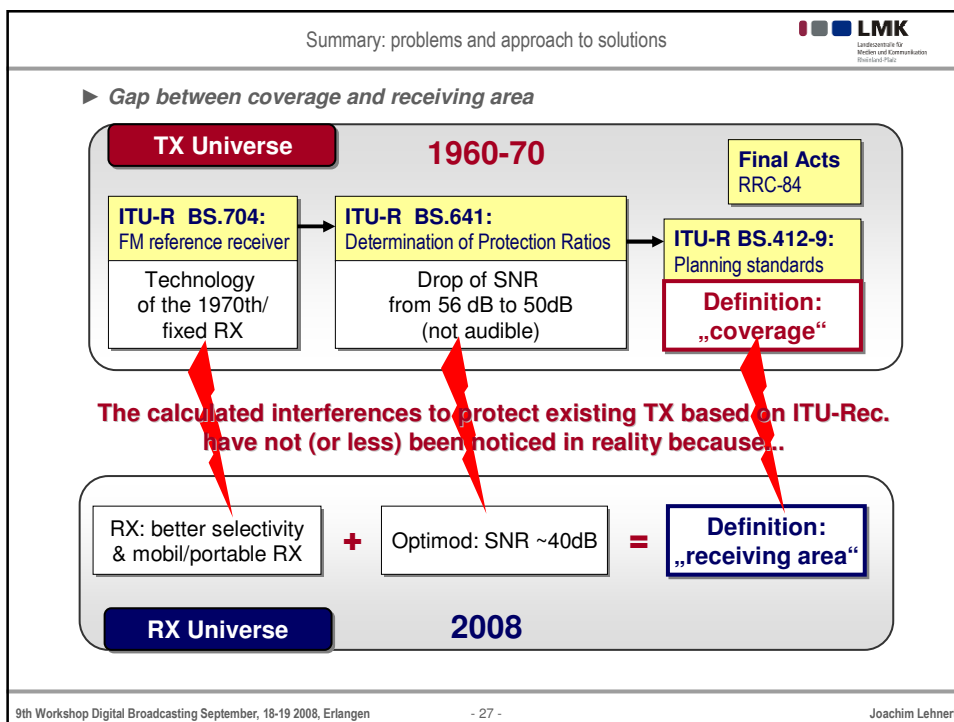



turn?

BUT: Experiences from the field trails with HD Radio™ and DRM+ and from daily FM receiving say:
The determined interferences based on the ITU Recs. have not (or less) been noticed in reality!

Why is there this difference ...?

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Summary: problems and approach to solutions 

► **Adjustment of ITU recommendations**

ITU-R BS.704: FM reference receiver...

- Adjustment of the reference receiver parameters to the today state of the art
- Amplification to specify the different receiving scenarios
- Supplement of digital reference receivers



ITU-R BS.641: Determination of Protection Ratios...

- Supplement to identify interferences from and onto digital broadcasting systems
- Modification of the measurement method from SNR to a criterion which refers to perceptible audible distortion: i.e. SINAD

ITU-R BS.412-9: Planning standards...

- Revised protection ratios based on a new measurement method (SINAD) with new reference receivers (modified ITU-R BS.641).
- Supplement of protection criterions between analogue and digital TX and digital-digital


ITU-R BS.1114-5: Systems for ... digital sound broadcasting in ... 30 - 3000 MHz

- Supplement of DRM with the Mode E (DRM+)

ITU-R SM.1140: Test Procedures for ... Aeronautical Receiver ... in ...108-118 MHz


- Supplement of compatibility criterions for digital VHF systems

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Summary: problems and approach to solutions 

► **On the way to the digitisation of VHF FM band**

There are a lot of construction sites on the roadmap to digitise the VHF FM band in Europe (with DRM+ as favorite)









Engineering first and at once!

Regulations directly after!

Market directly in connection with!

in 2020 et seq.?

FM45(08)055 – 03.07.08:
Initial Draft for an ECC Report
"Future Possibilities for the Digitalisation of Band II"

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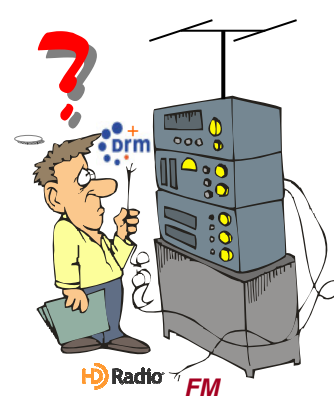
First results on compatibility planning of DRM+ and HD Radio™

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... a bundle of questions ...

Thank you for your attention ...

... further information on
www.DRM-Radio-KL.eu



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