PrecisionWave AG
Swiss RF Solutions

Product Brief

Digital Radio Access System (DRAS)

The Digital Radio Access System (DRAS) combines the functionality of a 12 ensembles DAB+, 32 channel FM voice break-in/repeater system with a TETRA, TETRAPOL and general-purpose radio repeater. Additionally, DRAS integrates the optical fiber distribution for dual tunnel tube master/remote systems in a single device.

Product Description

Our Digital Radio Access System (DRAS) helps you distributing all RF signals to any zone. Each of up to four RF receiving modules capture up to 70 MHz bandwidth, fed into the digital signal processing unit, with channel selective repeater and break-in functionality. Four RF outputs allow the feeding of power amplifiers per band and zone. Finally, up to 16 bidirectional optical CPRI interfaces connect all master and remote units in daisy-chain, star or redundant topologies.

System scalability is achieved through a licensing model unlocking the desired number of RX inputs, TX outputs, optical links, processor power and DSP features (e.g. Break-in for FM or DAB+, customer-specific IP cores).

You pay what you need, nothing more!

DRAS in the Master Unit

In the downlink direction, up to four individual radio resources are processed and routed with configurable service-specific sub-band filtering and automatic gain control.

For FM and DAB+ services, Voice Break-in modulator resources are available for multi-zone emergency messaging with two simultaneously useable audio groups.

Each digitized radio resource can be individually mapped to any remote DRAS TX.

In uplink direction, each same radio resources are combined to one stream that is then converted to analog RF outputs. Analog combiners are no longer necessary.

DRAS-MU is ready for directly interfacing any RAN equipment over CPRI instead of analog RF signals.

DRAS in the Remote Unit

Each DRAS in the remote unit is connected with an optical CPRI interface to a DRAS device in the master unit.

Downlink radio streams are digitally mapped to the desired TX channels and then converted to analog RF signals.

For redundant systems where link failures are to be prevented, a resource remapping to a still available radio resource of a second master unit is supported.

In the uplink direction, up to four individual analog RX signals are digitized and processed by a DSP. Each radio resource is then mapped to DRAS TX outputs in the master unit.

Each analog RF input may be used as a spectrum monitor and for distance to fault cable analysis instead of a radio uplink channel. This feature enables physical radio spectrum and cable monitoring.

GPIO, analog inputs and a transparent Ethernet interface to the master unit enables connectivity and low-level supervision of external third-party devices in the repeater.

Benefits & Highlights of our Solution

- Fully digital repeater solution with CPRI-based data link between master units and repeater units
- Up to four RF outputs and up to four RF inputs per device
- Up to 16 optical CPRI links per device
- 12 DAB+ and 32 FM Break-in modulators & repeater
- 16 Tetra/Tetrapol/Generic repeater
- Dynamically configurable multi-zone operations
- Sub-band filters, automatic gain control and voice break-in in one device
- Much better noise figure in comparison with any analog RF optical fiber link
- Plug-and-play capability
- Feature licensing model for best feature scaling
- Expandable architecture
- Targeting FM/DAB+, PMR, TETRA repeater systems for road tunnels and inhouse

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A Field Configurable Hardware Platform

DRAS is a hardware platform with a focus on system scalability and modular design. DRAS base unit includes slots for analog frontend (AFE) modules, a slot for the SoC/FPGA processor module providing the right computing power and slots for up to eight CPRI transceivers. Each DRAS can thus be scaled exactly to the needs of your project.

To guarantee high reliability, long-term operation, compact size and low power consumption, our system follows a simple yet powerful approach where the complete hardware is downsized to just a few, but of the highest quality components. We're not ready to make compromises when it comes to quality.

Analog Frontend

For each RF port, band-specific analog frontends are integrated to guarantee the best channel selectivity.

Software Licensing

Our flexible SW licensing model unlocks hardware and software options according to your needs. Thus, even simple systems can be implemented cost-effectively.

SoC/FPGA Processor Scaling

Repeater, voice break-in and radio resources mapping are completely hardware-based DSP IP-cores, running on an FPGA without the need for an embedded computer. Required computing power per DRAS node depends on the type and number of active DSP IP cores.

For best scalability, DRAS can be assembled with different FPGA modules enabling scalability in processing power for the best cost structure.

SFP+ Slots

Per DRAS, up to 16 units are connected via optical CPRI links. Unused CPRI slots remain empty. Higher repeater counts are supported by daisy-chaining multiple DRAS as CPRI slaves.

Various Audio Sources for Break-in Zones

During break-in, the audio payload in the FM and DAB+ stream is replaced by customer specific content from several audio sources triggered by a push on a button or fully digital over Ethernet (WebUI/SNMP). Each option can be unlocked by a software key:

Two analog differential audio inputs are dedicated to local audio sources as external microphones or any other analog audio source.

Audio files can be stored on the device and played-out for several emergency scenarios.

A SIP-Client for Voice-over-IP (VoIP) enables live break-in from mobile phones or operation centers.

Each audio source can be mapped to two playout groups, which in turn can be selected for play-out in the break-in zones.

Integrated System Supervision

One DRAS per system is configured as a site controller for supervision and configuration purposes. Each CPRI link contains a logical ethernet. There is no need for any other industrial computer or external network.

Web UI for Configuration and Supervision

A web UI, easily accessible with web browsers, is used for configuration and monitoring of the overall DRAS system.

The web UI shows an overview of the system, where the playout audio groups, the radio channel mappings and the associated zones can be configured. Additionally, the operational status of each radio channel is monitored and displayed in real-time. A log stores all events for maintainer analysis.

Features are unlocked by a software key via the WebUI.

Beneath the WebUI, machine-to-machine protocols (SNMP, etc.) are available for integrating the DRAS system into a given control system. Customer-specific requirements can be taken into account.

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DRAS Hardware

DRAS Master unit, RF ports depend on confguration / output per band or internal couplers

DRAS Remote unit, 19" 3U rack version, RF ports depend on confguration / output per band or internal couplers

DRAS Remote unit, stainless-steel wall-mount version and passive cooling with heatsink on the back

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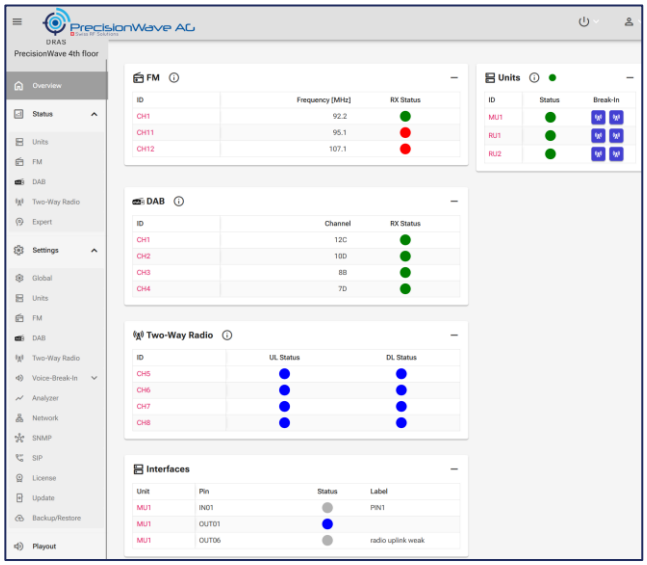
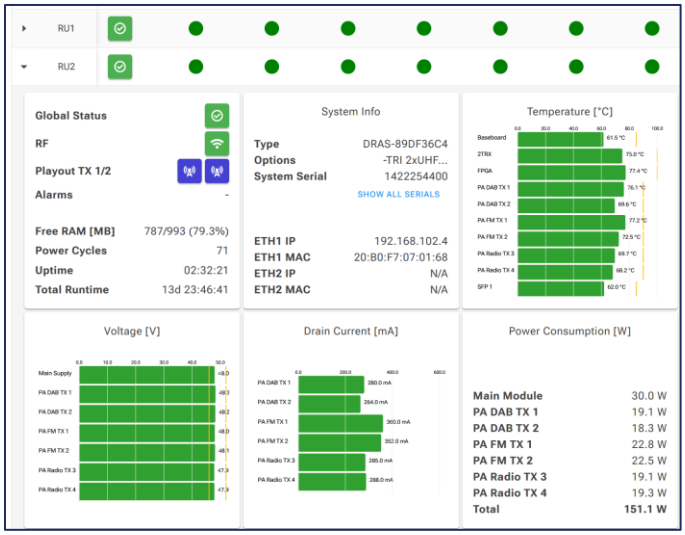
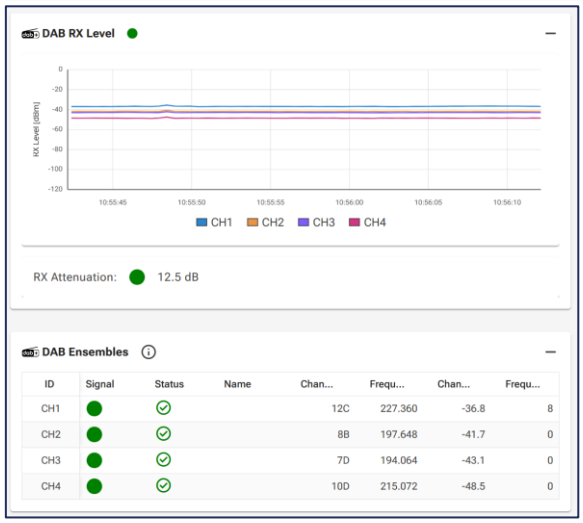
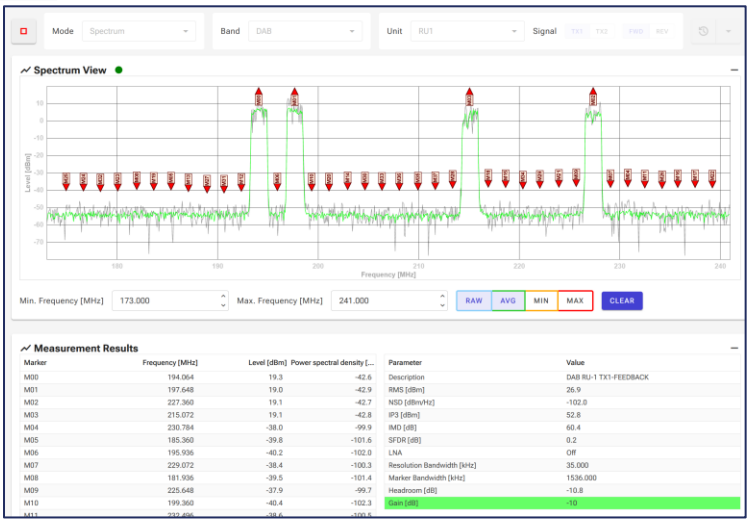
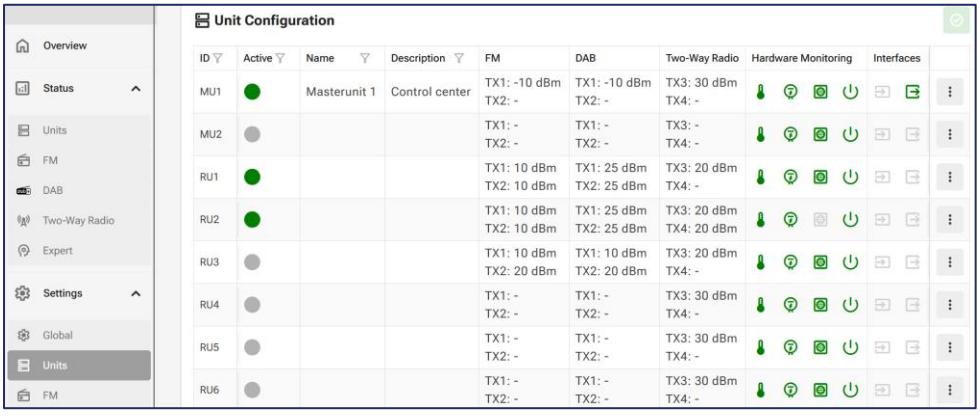
DRAS WebUI for Configuration and Supervision











A self-explaining and easy-to-access web UI simplifies the configuration and the maintainance of the system

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Logical Block Diagram Master Unit

Analog radio signals are preselected and amplified on the analog frontends before analog-to-digital conversion to a digital radio stream.

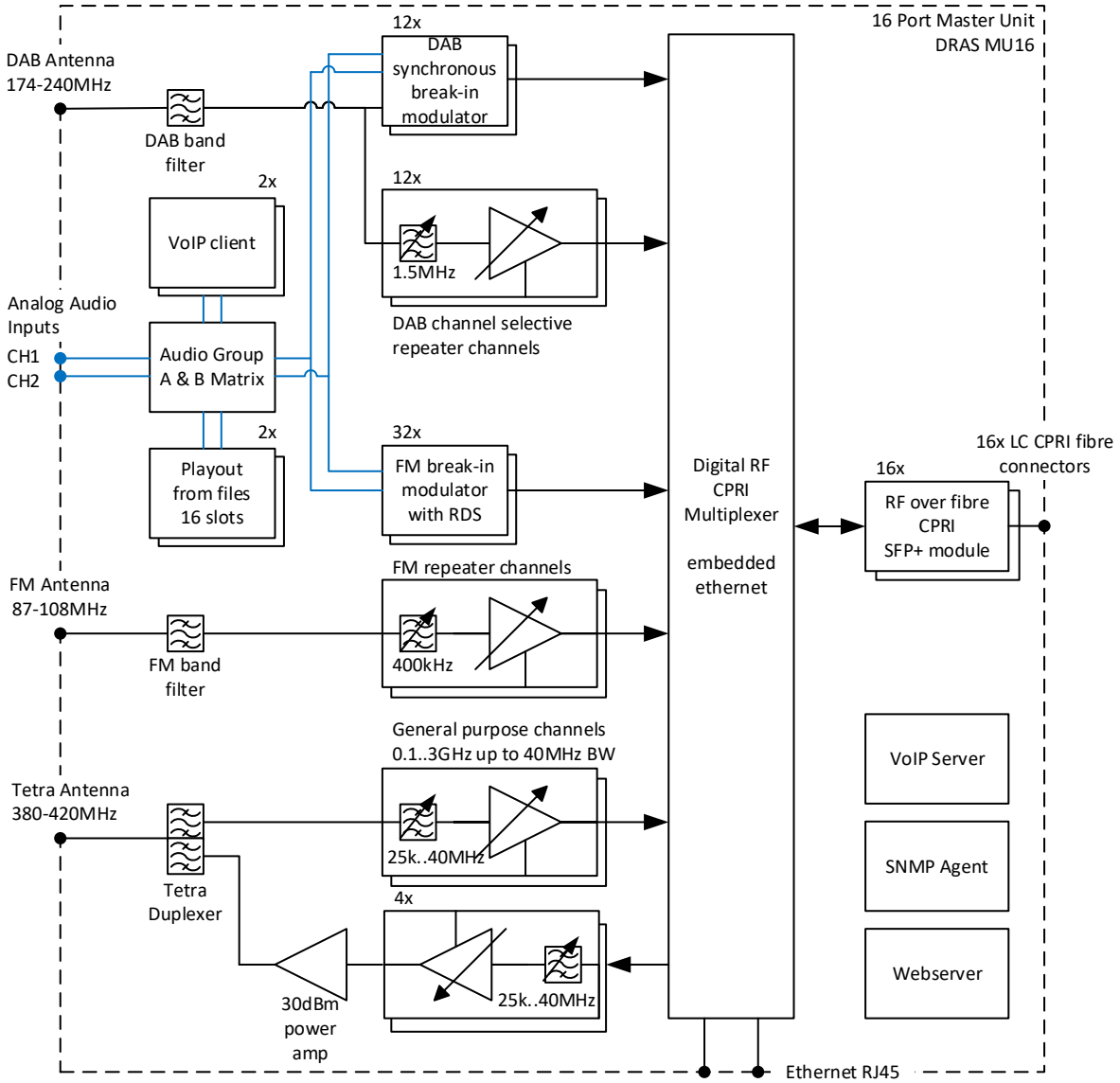
Each RX input can be switched to one of the three band-specific DSP channels.

After digital signal conditioning in the DSP, each radio stream is mapped to one of ten radio resources. In case of an emergency, the digitized radio streams are replaced by voice break-in streams from FM/DAB+ modulators. Therefore, the modulators are synchronized to the digitized radio streams.

Each radio stream is then mapped to one of ten radio resources, that is distributed over an optical CPRI interface to remote DRAS.

For each TX, one radio resource can be assigned. If a TX is enabled, the radio resource is upconverted, interpolated before the digital-to-analog signal conversion.

For bidirectional radio services, upstreaming radio resources received from up to eight remote DRAS are first digitally combined to one stream and then routed to the assigned TX. If necessary frequency translation can be set per channel. Analog coupling fields are a thing of the past!



DRAS master unit functional block diagram

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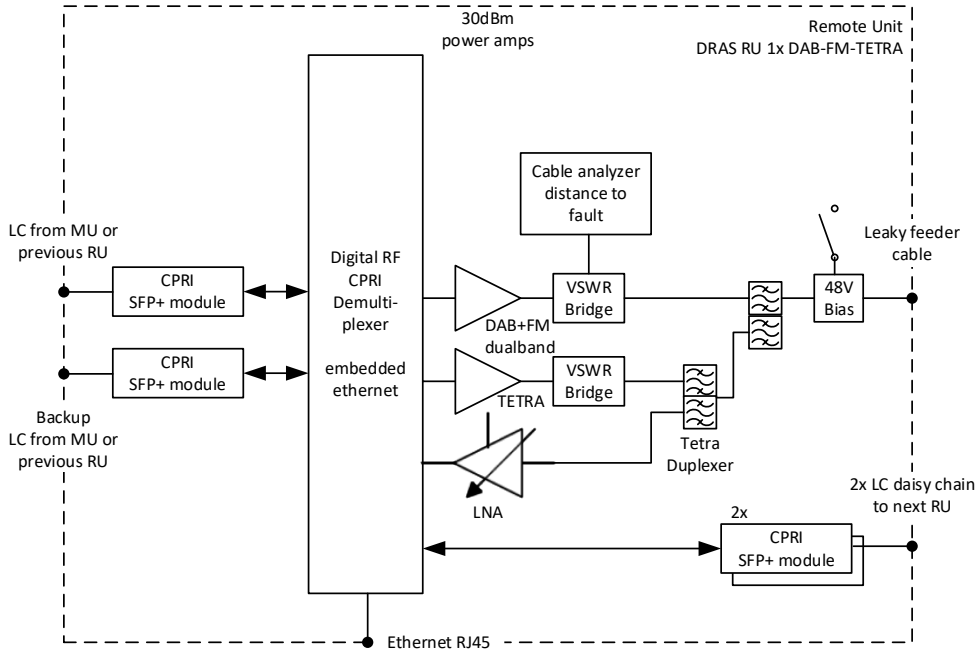
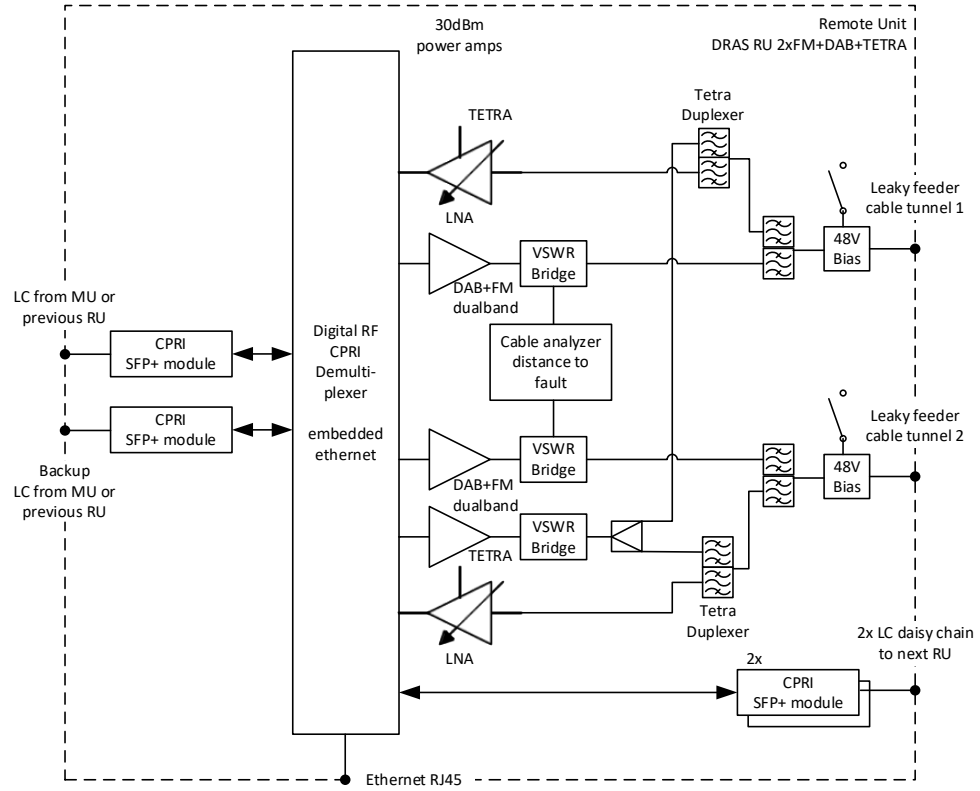
Logical Block Diagram Remote Unit Configurations



DRAS remote unit equipped for one tube with FM + DAB + TETRA



DRAS remote unit equipped for two tubes with FM + DAB + TETRA

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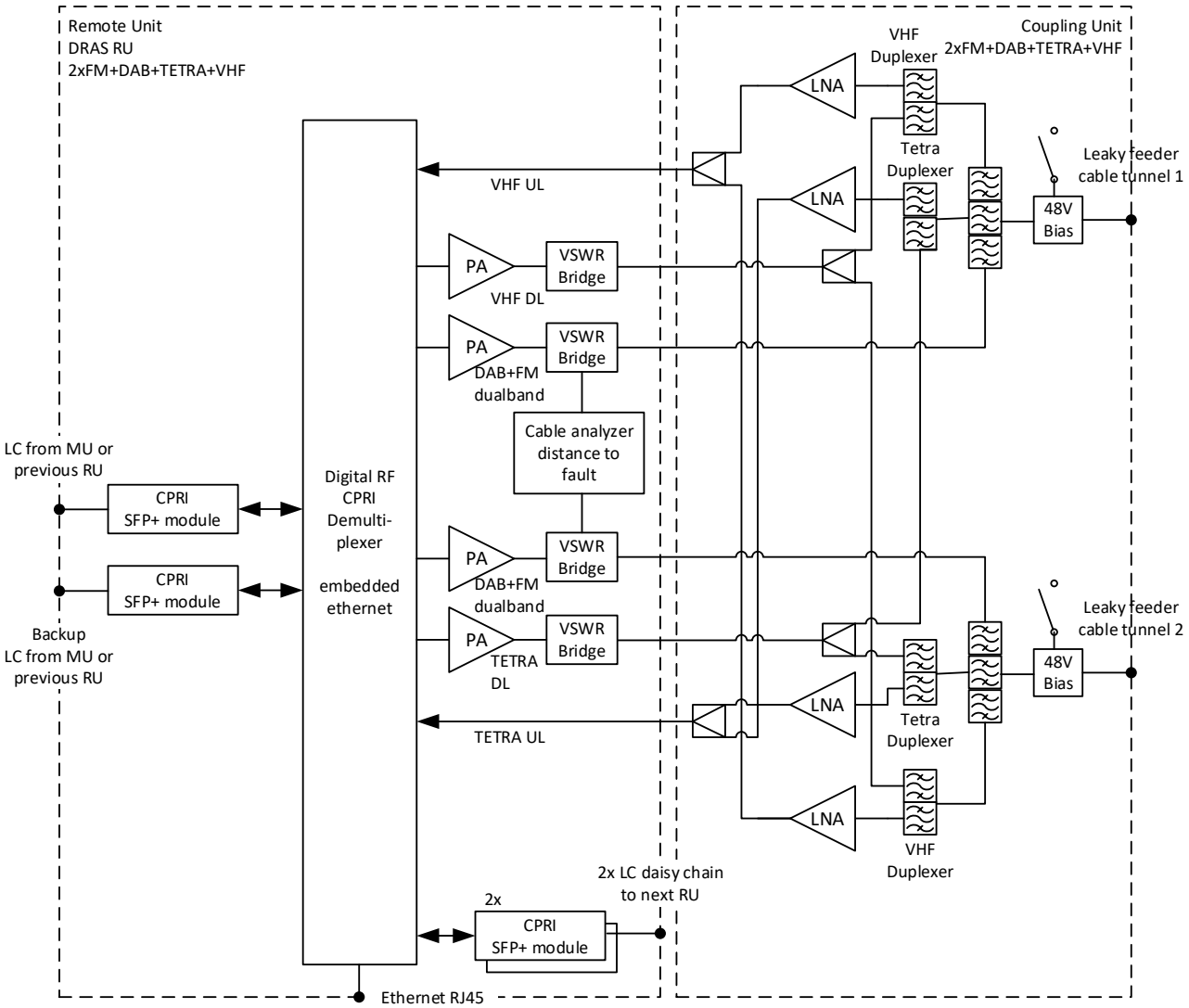
Logical Block Diagram Remote Unit Configurations



DRAS remote unit equipped for two tubes with FM + DAB + VHF + TETRA

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Use Case: TETRA and DAB+ Repeater with Emergency Break-in

In a typical road tunnel scenario, one or two broadcast signals in combination with emergency radio and private mobile radio are distributed into the tunnel. Many use-cases require that radio services are differently mapped within the tunnel.

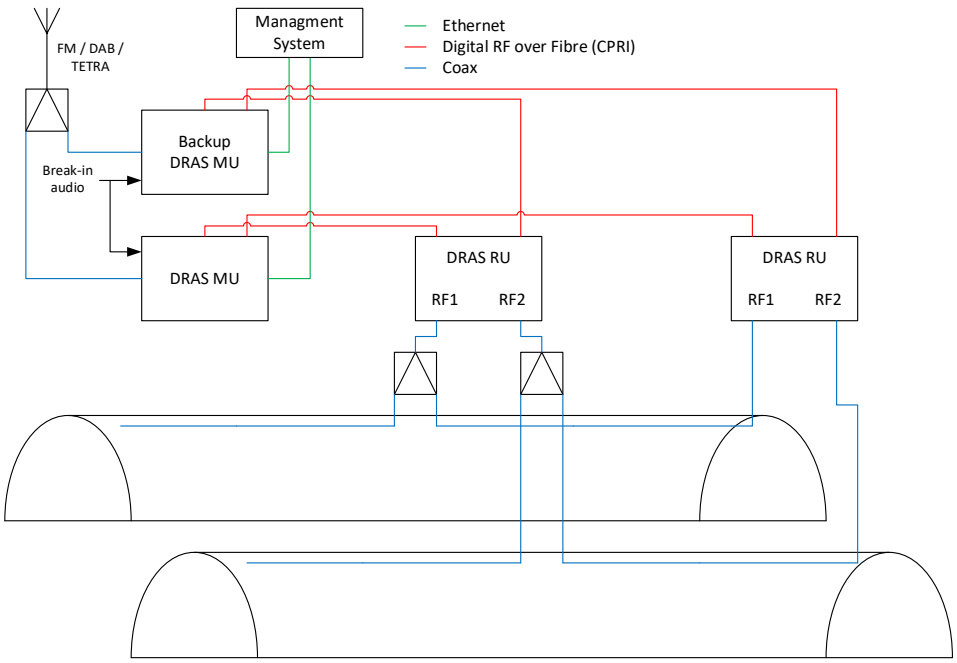
For example, for DAB+ break-in, two separate break-in zones are required for each of the two tunnel tubes so that emergency messages can be played-out in one single tube.

As another example, emergency radio is often transmitted via portal antennas and is not routed to each repeater.

With DRAS, each radio resource can be individually mapped to the desired repeater ports. Reconfiguration and scalability are given since the mapping is a software configuration.

This application example shows a tunnel configuration with two tunnel pipes, hence two separate break-in zones are necessary. TETRA is repeated and transmitted equally in both tubes.

Each RU is connected over an optical CPRI interface to the MU.



Typical tunnel application with two radio services for TETRA and DAB+, for two tunnel pipes and two independent emergency voice break-in zones.

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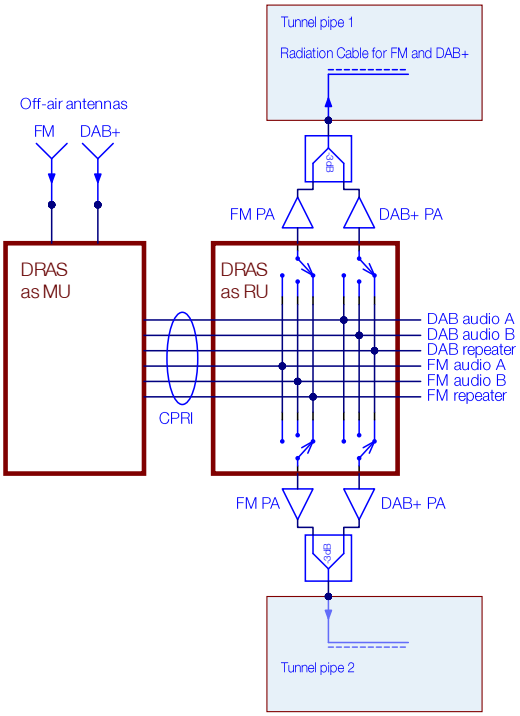
Typical Scenarios

Use-case: FM/DAB+ break-in and repeater

Tunnels are often built with two separate tubes. Emergency announcements should often only be broadcast in one of the two tubes. This requires two different voice break-in zones, which can have individual contents in case of emergency.

For each zone (equal to RF outputs), one of three FM/DAB+ resources can be selected by DRAS as RU.

For each zone, one RF output for DAB and one for FM can be assigned. The operator can choose between one of three sources: Break-in Audio A, Break-in Audio B, Repeater.



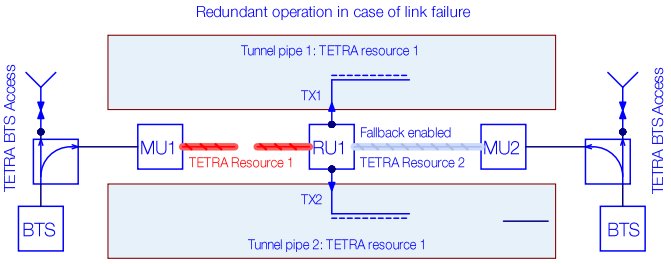
FM/DAB+ Resources switching (e.g. from repeater mode to break-in mode) is performed in the DRAS RU

Ready for redundant scenarios

In many cases, safety-relevant radio from two redundant head master units shall ensure that radio services continues to be available even if one of the two links fails. DRAS detects missing logical radio resources and can autonomously switch to a fallback radio resource. Almost any redundant scenario can be configured in the DRAS resources mapper.

Example:

RU1 is redundantly connected to MU1 and MU2. During normal operation, TETRA resource 1 is streamed to RU1-TX1 and RU1-TX2.
If now TETRA resource 1 is abruptly no longer available due to an error in the system or due to a component failure, RU1 radio resource mapper immediately switches to the still available radio resource 2.



Guaranteed availability in case of radio resource disruption thanks to redundant configuration capabilities.

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DRAS Platform RF Specification

DRAS General Hardware Specification	
RF input FM+DAB (2x)	87-108 or 174-240MHz 66MHz digitized bandwidth
RF input wideband (2x)	30-1000MHz 20MHz digitized bandwidth
RF outputs FM/DAB (2x)	87-240MHz 153MHz digitized bandwidth
RF output wideband (2x)	30-1000MHz 20MHz digitized bandwidth
RF Port Impedance	50 Ω
RF Port Connectors	SMA
RF Port Input Reflection (S11)	< -10 dB
Output intercept point (OIP3) DRAS	> 30 dBm
Composite RF output power DRAS module	-20...5 dBm
Composite RF output power power amplifier	5…36 dBm
Noise figure FM	4 dB
Noise figure DAB	4 dB
Noise figure VHF & UHF	3.2 dB
Maximum Gain FM & DAB with PA	100 dB
Maximum Gain VHF & UHF with PA	100 dB
Maximum Input Power FM + DAB LNA on	-10 dBm
Maximum Input Power FM + DAB LNA off	+10 dBm
Maximum Input Power VHF + UHF LNA on	-10 dBm
Maximum Input Power VHF + UHF LNA off	+10 dBm
Channel filter width FM	270 kHz
Channel filter width DAB	1536 kHz
Channel filter width VHF & UHF	34, 48, 79, 104, 125, 146, 171, 214 kHz
Band filter width VHF & UHF	1.68, 3.36, 5, 6.5 MHz
Total delay incl. 1m fiber, band filter active MU Rx > RU Tx or RU Rx > MU Tx	9.4, 8.8, 8.6, 8.5 us
Total delay incl. 1m fiber, channel filter active MU Rx > RU Tx or RU Rx > MU Tx	65.1, 45.8, 38.5, 35, 32.4, 31.6, 29.7, 28 us

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DRAS Platform Hardware Specification

DRAS General Hardware Specification	
Optical CPRI Interfaces	16x 6144MBit/s (MU) 4x 6144MBit/s (RU)
Break-in audio groups	2 Break-In and 1 Repeater
Peripheral Interfaces	2x 1000BASE-T Ethernet (MU) 1x 1000BASE-T Ethernet (RU)
Optional analog I/O extension board	16x galvanically isolated inputs 8x relay outputs 2x differential audio input (10 kΩ, 2Vpp max) 2x differential audio output (50 Ω, 2Vpp max)
ESD protection on any port	IEC 61000-4-2 (Level 4)
Mains input voltage	90-260VAC / 127-370VDC
Power supply efficiency 230V AC > 48V DC	92%
2nd supply input voltage	48VDC +-2V / 6A
Rack enclosure version	19" 3U 372mm, 15kg, IP22, 4 fans
Wall-mount enclosure version	500x400x280mm, 28kg, IP65, passive cooling
Temperature Range Rack Version	0..50°C
Temperature Range Wall-mount Version	0..35°C with 6 power amps, please ask us for other versions
Long-term availability	At least until 2035

Typical Power consumption @ 48VDC	
MU16 main module	33W
RU main module	21W
2TRX module	8W
IO module	2W
SFP+ fiber transceiver module	1.5W
Power amplifier single band @ Pout=30dBm	23W
Power amplifier dual band @ Pout=30dBm	23W per band
Power amplifier single band @ Pout=36dBm	28W
Power amplifier dual band @ Pout=36dBm	28W per band

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DRAS Platform Hardware Specification – MTBF

Module	MTBF RiAC-HDBK-217Plus (ground stationary) [h]
Master unit MU16	159'331
Master unit MU4	198'497
Remote unit RU	258'891
MU16 with dual wideband transceiver extension	139'641
MU4 with dual wideband transceiver extension	168'838
RU with dual wideband transceiver extension	210'632
DRAS-FM-PA	1'338'514
DRAS-DAB-PA	1'369'306
DRAS-DAB+FM-PA	851'046
DRAS-TETRA-UHF-PA	1'368'395
DRAS-2M-PA	1'369'306
DRAS-4M-PA	1'338'514
DRAS-IO	1'047'492
Powersupply	253'400

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IP-Core: DAB+ Voice Break-In DSP

Per default, all configured ensembles are repeated with low latency to enable best reception quality and no interference of the user experience. During Voice Break-In mode, all or a selectable number of ensembles are replaced by custom voice (via microphone input), pre-recorded messages or audio via IP. Also, radio display messages are replaced and fully customizable, by default showing “Police info”.

DAB+ Voice Break-In	
Supported bit rates	8, 16, …, 192 kBit/s (in multiples of 8 kBit/s)
Supported sampling rates	32 kHz, 48 kHz
ETSI Standard	ETSI EN 300 401 compliant
Time Synchronisation Error	< 10 µs
Frequency Synchronisation Error	< 5 Hz
Audio Encoder	DAB+, DAB
Simultaneous encoders (1 per bitrate needed)	15
Min. signal input level	-80 dBm
Group delay repeater mode	16 µs (22 µs including CPRI)
Linux on CPU onboard	
possible integration into virtual environment (3rd party)	

IP-Core: FM Voice Break-In DSP

Per default, all configured ensembles are repeated with low latency to enable best reception quality and no interference of the user experience. During Voice Break-In mode, all or a selectable number of ensembles are replaced by custom voice (via microphone input), pre-recorded messages or audio via IP. Also, radio display messages are replaced and fully customizable, by default showing “Police info”.

FM Voice Break-In	
Number of FM modulators	32
Max deviation	±75 kHz
Max modulation power MPX	3.0 dBr
Modulation type	Mono
RF Frequency Error	<100 Hz
Automatic audio gain control range	20 dB
Group delay	8.2 µs (repeater mode)

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Product Hardware Options

Product Code	Description
DRAS-MU16	**Base master unit** Support for up to 8x DAB ensembles with two audio sources (16 modulators) or 12x DAB ensembles with one audio source, 32 FM channels with two audio sources (64 modulators), 16 CPRI SFP+ slots, 1 DAB RF Input, 1 FM RF Input, 2 DAB+FM RF Outputs
DRAS-MU4 not available at the moment	**Base master unit** Support for up to 8x DAB ensembles with one audio source (8 modulators), 32x FM channels with one audio source (32 modulators), 4 CPRI SFP+ slots, 1 DAB RF Input, 1 FM RF Input, 2 DAB+FM RF Outputs Can be used as a replacement for the DAB-VBI
DRAS-RU	**Base remote unit** Support for up to 12x DAB ensembles, 32x FM channels, 4 CPRI SFP+ slots, 1 DAB RF Input, 1 FM RF Input, 2 DAB+FM RF Outputs
DRAS-2TRX	**Twin wideband RF transceiver extension** Analog 30-3000MHz direct conversion transceiver with band selective filter, input LNA and attenuators., 20MHz Bandwidth
DRAS-SFP-CPRI-MASTER	**Supports single-mode fibers** Other options on request
DRAS-SFP-CPRI-SLAVE	**Supports single-mode fibers** Other options on request
DRAS-RACK	**Enclosure 19inch 3U** With integrated 90-264VAC power supply can be equipped with 1 DRAS base unit + 2 singleband PAs + 2 duaband PAs + IO-Board + 2 ceramic duplexer OR 1 cavity duplexer
DRAS-FM-PA	**FM band power amplifier** Frequency range=87-108MHz, OIP3=54dBm, harmonic filter, forward, backward power & temperature measurement
DRAS-DAB-PA	**DAB band power amplifier** Frequency range=174-240MHz, OIP3=58dBm, harmonic filter, forward, backward power & temperature measurement

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Product Hardware Options

Product Code	Description
DRAS-DAB+FM-PA	Dualband FM+DAB power amplifier Frequency range1=87-108MHz, Frequency range2=174-240MHz, OIP3=58dBm DAB band, OIP3=54dBm FM band, harmonic filter, forward, backward power & temperature measurement, integrated triplexer for FM+DAB+TETRA
DRAS-TETRA-UHF-PA	TETRA band power amplifier Frequency range=380-470MHz, OIP3=58dBm, harmonic filter, forward, backward power & temperature measurement
DRAS-2M-PA	VHF band power amplifier Frequency range=140-174MHz, OIP3=58dBm, harmonic filter, forward, backward power & temperature measurement
DRAS-4M-PA	Power amplifier Frequency range=70-88MHz, OIP3=55dBm, harmonic filter, forward, backward power & temperature measurement
DRAS-IO	Additional frontpanel IO and power connectors Two channel audio transformator coupled line inputs and outputs, 16 isolated trigger inputs and 8 relays, two 48V DC power supply inputs with supervision
DRAS-MUX-FM-DAB-UHF	3-Port RF multiplexer FM 87-108MHz, DAB 174-240MHz, UHF 380-500MHz, 1dB IL, 35dB attenuation
DRAS-DUPLEXER-TETRA	RF ceramic resonator duplexer For Tetra UL 380-386.5MHz, DL 390-396.5MHz, 4.5dB IL, 60dB attenuation
DRAS-DUPLEXER-UHF	RF cavity duplexer For UHF UL 458-461MHz, DL 468-471MHz, 2dB IL, 65dB attenuation
DRAS-DUPLEXER-TETRA-5M-380	RF cavity duplexer For UHF UL 380-385MHz, DL 390-395MHz, 2dB IL, 65dB attenuation

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Product Hardware Options

Product Code	Description
DRAS-DUPLEXER-TETRA-6.5M-380	RF cavity duplexer For UHF UL 380-386.5MHz, DL 390-396.5MHz, 2dB IL, 65dB attenuation
DRAS-DUPLEXER-TETRA-5M-455	RF cavity duplexer For UHF UL 455-460MHz, DL 465-470MHz, 2dB IL, 65dB attenuation
DRAS-CABLE-SMA-SMA	RF Cable For internal connection between SDR, PA and Multiplexer
DRAS-CABLE-SMA-N	RF cable For internal SMA male to front panel N female
DRAS-DONGLE	USB Dongle For Portable License required on master unit only
DRAS-RACK-COUPLER	Coupling rack unit 19" 2U 340mm for additional Duplexers or Multiplexers
DRAS-CABLE-N-N	RF cable For external N male to N male

Product Software Options

Product Code	Description
DRAS-REP-GENERIC	Option repeater for generic bands (up to 4) Optimized for TETRA, Automatic Gain Control
DRAS-REP-FM	FM channel digital bandpass filters Automatic Gain Control
DRAS-REP-DAB	DAB+ ensemble digital bandbass filters Automatic Gain Control

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Product Software Options

Product Code	Description
DRAS-VBI-FM (per channel)	**FM modulator for one break-in channel** RDS encoder with individual program ID per channel DRAS-REP-FM required
DRAS-VBI-DAB (per ensemble)	**DAB modulator for synchronous break-in** To one ensemble DRAS-REP-DAB required
DRAS-SIP	**Option audio from SIP VoIP** Unlocks a dual VoIP client audio break-in source.
DRAS-Playout	**Break-in playout from audio files stored on the unit** Break-in messages can be uploaded over the web user interface and triggered there, by isolated inputs or by SNMP. Break-in audio signal can be picked up from analog audio output for external usage

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