TetraPack

HAMRADIO 2024

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BrandMeister

10 years anniversary

Established at 29 June 2014

TetraPack.online

Summary

- Introduced at HamRadio 2023 in Friedrichshafen
- “multiple vendor’s TETRA TMO in one PACKage”
- The same goals like BrandMeister Network has:
  - Support of different hardware
  - Widely-available talk-groups
  - Most of services and user-experience for TETRA TMO
  - In most cases - connect network controllers (SwMI) instead of base stations
- Closed integration to BrandMeister Network:
  - Seamless exchange of group calls, individual calls, SMS
  - Almost all services available in BrandMeister Network: APRS, SMS services, etc.

TetraPack.online

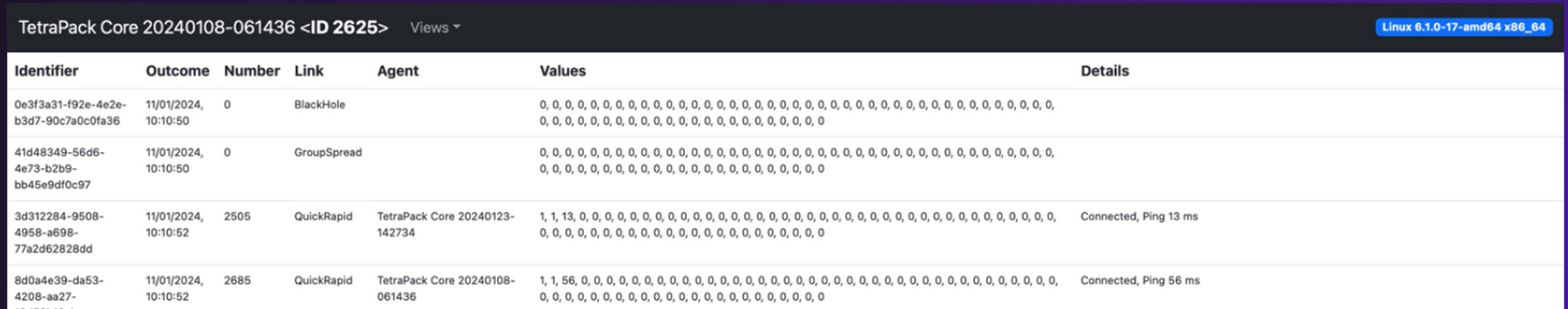
Features

- **Supported TETRA TMO features**
  - Group calls
  - Simplex and duplex individual calls
  - Phone calls
  - Short text messaging and geo-positioning
  - Packet data access
- **Bridging with BrandMeister**
  - Group calls (any talk-group > 90 available across both networks)
  - Bridging talk-groups with “classic” ham-radio technologies (D-STAR, System Fusion, etc.)
  - Simplex individual calls and SMS bridging
  - SMS services via APRS/MQTT/API
  - Geo-positioning to APRS/MQTT/API
- **Supported radio-access technologies**
  - Motorola CompactTETRA (CTS)
  - Motorola Dimetra (EBTS/MBTS/MTS)

Why not BrandMeister?

TETRA TMO:

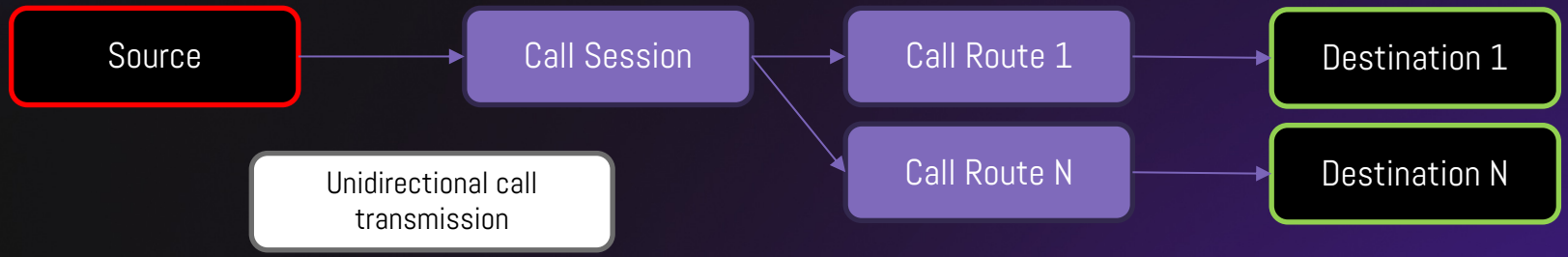
- Another user experience (trunking, duplex calls, OACSU)
- Another codec (ACELP vs. AMBE)
- Another signalling procedures (OACSU for individual calls)
- More powerful set of basic services
- Acts more like a mobile



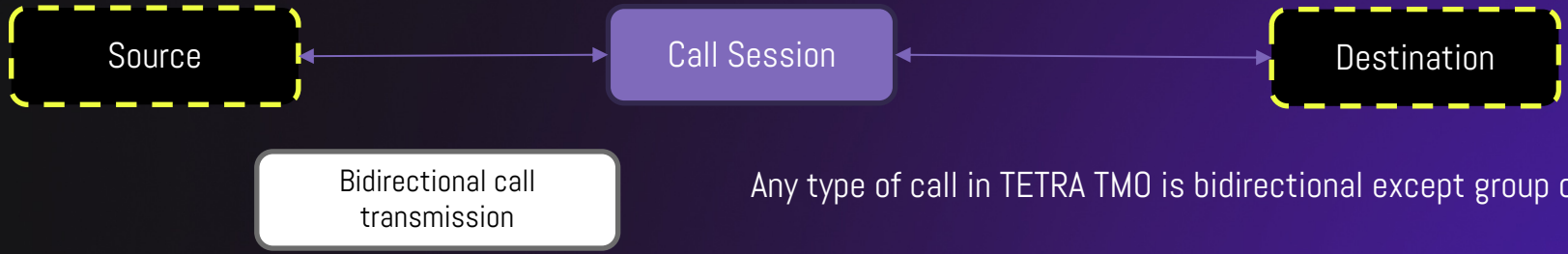
Differences in concept

Explained

BrandMeister



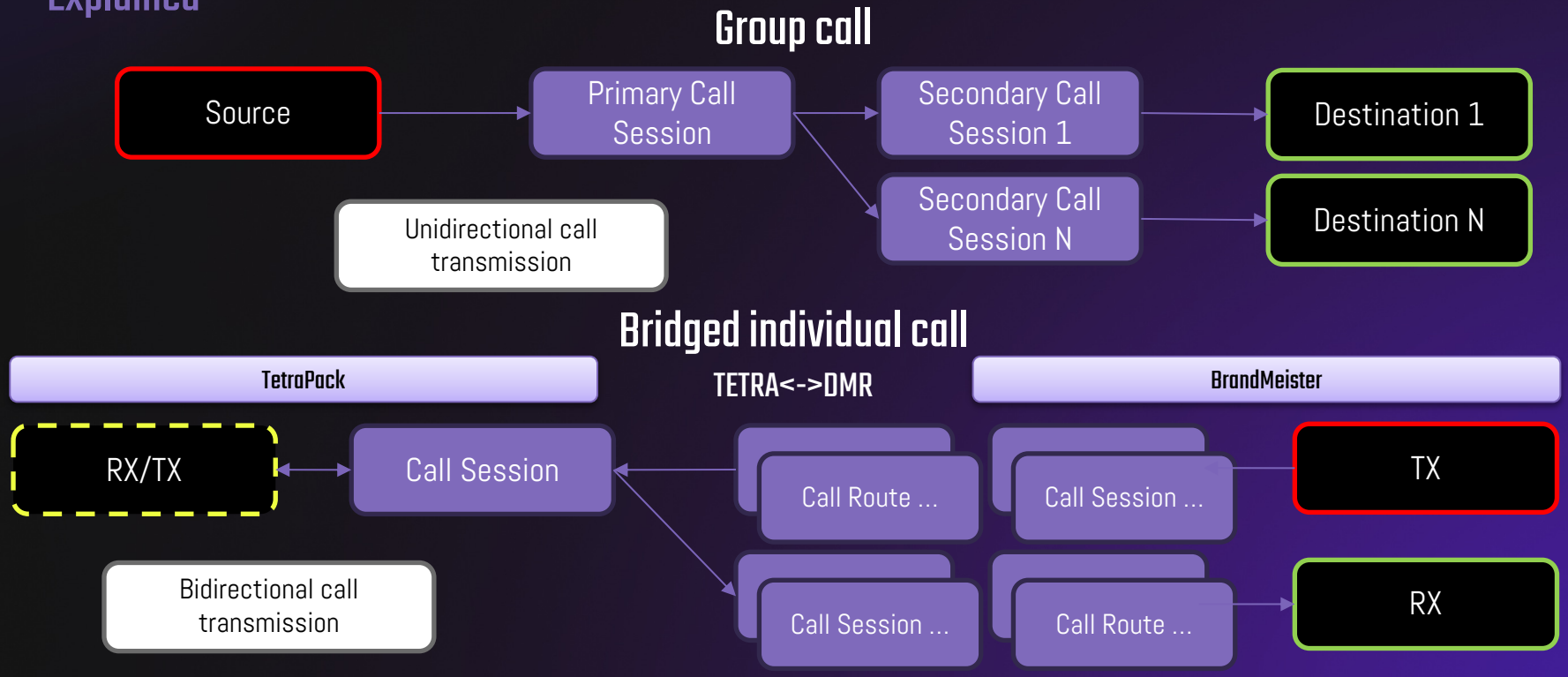
TetraPack



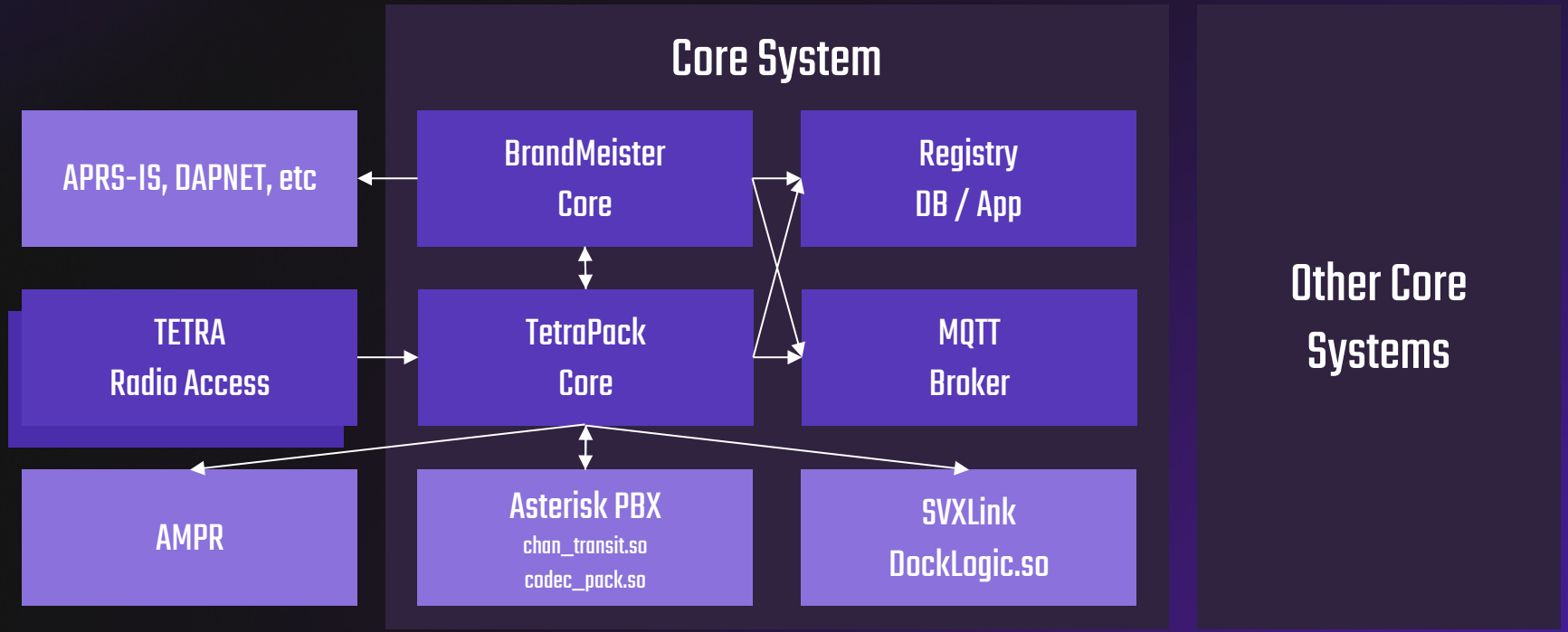
Any type of call in TETRA TMO is bidirectional except group call

TetraPack concept

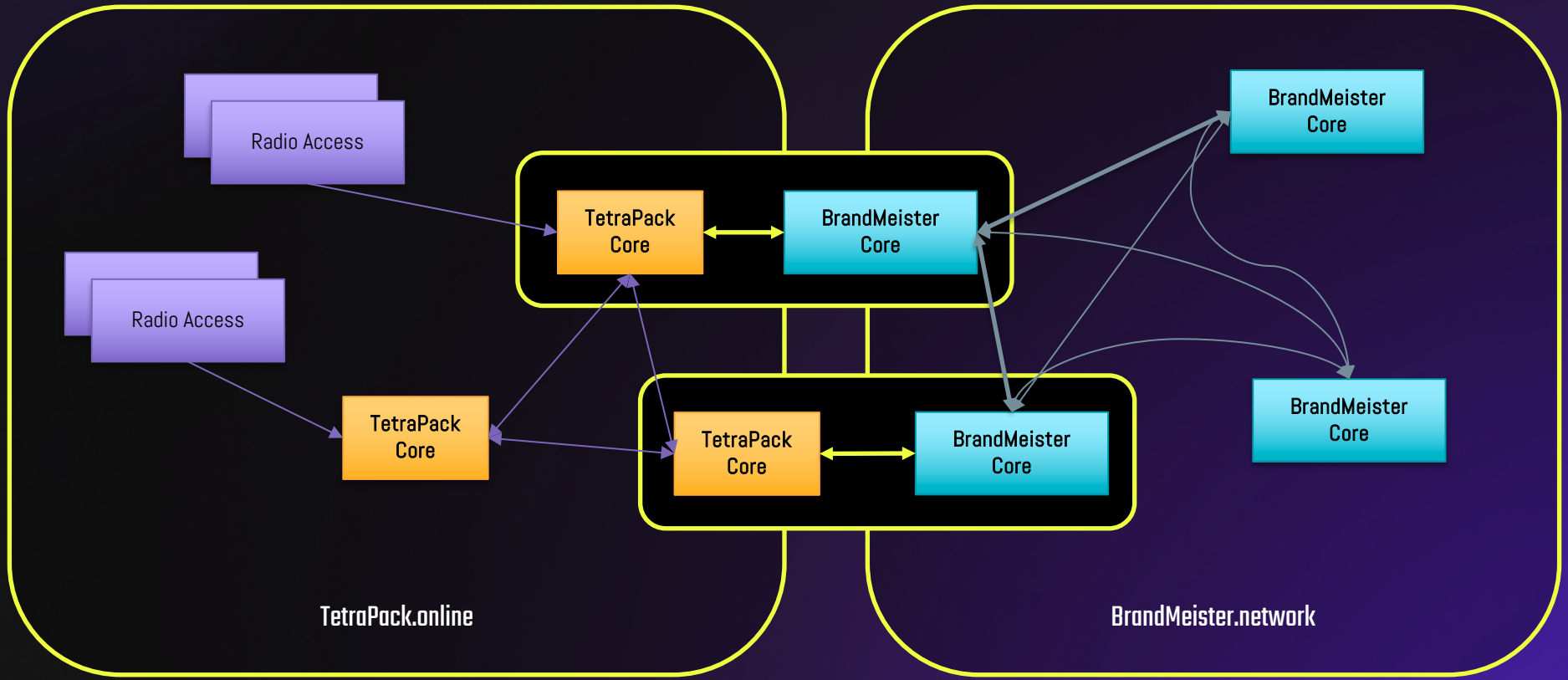
Explained



Core system architecture



Network topology



Roles of components

- **TetraPack Core**
  - User registration / TG affiliations
  - Calls and data switching
  - Radio access connectivity
  - Acts as a transit switching center
  - Acts as a packet data gateway
- **Registry**
  - HLR/VLR
  - Call routing
- **BrandMeister Core**
  - TETRA <--> DMR individual and group calls, SMS bridging
  - GPS and SMS apps handling (APRS, DAPNET, MQTT, HTTP API)
- **Asterisk PBX / chan_transit.so**
  - Individual and phone calls bridging, IVR apps
  - SMS apps and bridging
- **SVXLink / DockLogic.so**
  - TETRA-DMO group calls bridging (+ passing of ISSI)

SVXLink

DockLogic.so

- **DockLogic.so – our own SVXLink Logic module, implements TetraPack's Dock IPC protocol (should run on the same host as TetraPack Core)**
  - Works on top of pure DL1HRC's SVXLink / tetra-contrib
  - Requires nodes to use the same CALLSIGN in [ReflectorLogic] and [TetraLogic] to make our bridges pass talker's ISSI correctly
- **Patches applied to SVXReflector and ReflectorLogic at DL1HRC's GitHub.com**
  - Pass originating ISSI over SVXReflector to TetraLogic / DockLogic
  - Reflector to Reflector links does not pass originating ISSI
- **Not recommended to use:**
  - Too many transcoding (ACELP <--> analog <--> OPUS <--> ACELP)
  - Poor quality of analog audio on many SVXLink nodes

Asterisk PBX

chan_transit.so

- **chan_transit.so – our own Asterisk module, implements TetraPack's Transit IPC protocol (should run on the same host as TetraPack Core)**
- **codec_pack.so – our own port of TETRA codecs to Asterisk (ACELP, ...)**
- **Possibilities**
  - Individual simplex calls with PTT control (RADIO_KEY/RADIO_UNKEY)
  - Duplex individual, PSTN or PBX calls
  - TETRA codec selection / DTMF pass
  - TETRA call priority management
  - Short messaging (out-of-band messaging)
- **Use-cases**
  - Ham telephony
  - Direct call to emergency services
  - AllStarLink access (in theory)

Supported radio access technologies

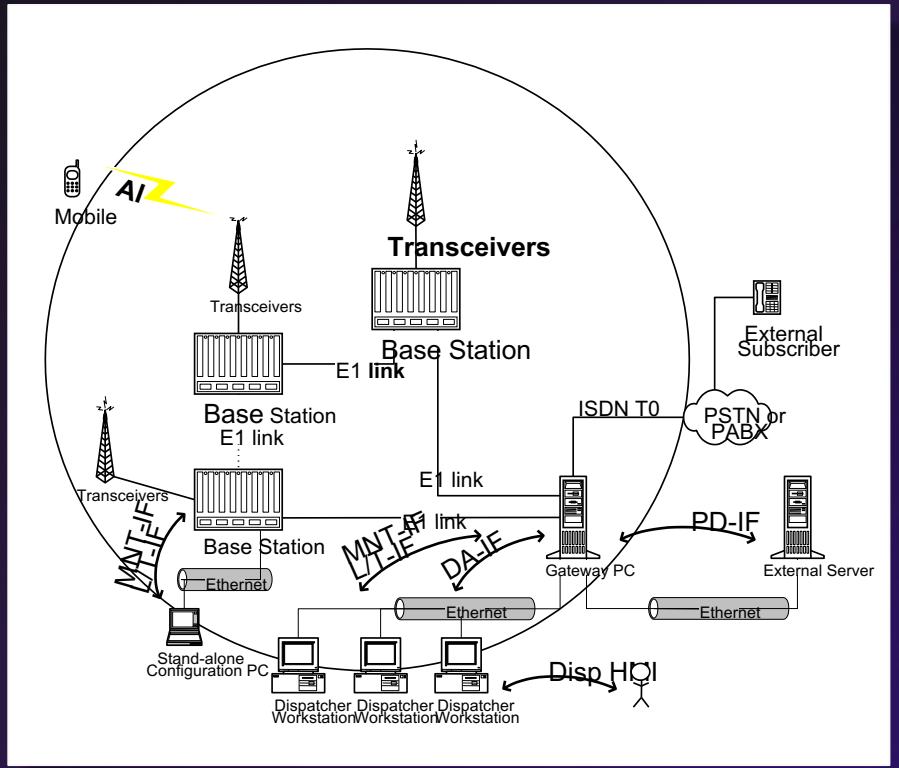
- **motorola compactTETRA (CTS)**
  - Designed by DAMM and Frequentis, labeled by Motorola
  - Built-in network controller (BSC)
  - **NOT compatible** with Motorola Dimetra
  - Supported since 2023 with the first release of TetraPack
- **motorola dimetra**
  - Designed and produced by Motorola
  - Support in TetraPack - new for this year
  - Development and testing based on Dimetra R5 and R9
  - **Uses dedicated Dimetra Core system**!


motorola compactTETRA

motorola compactTETRA

In details

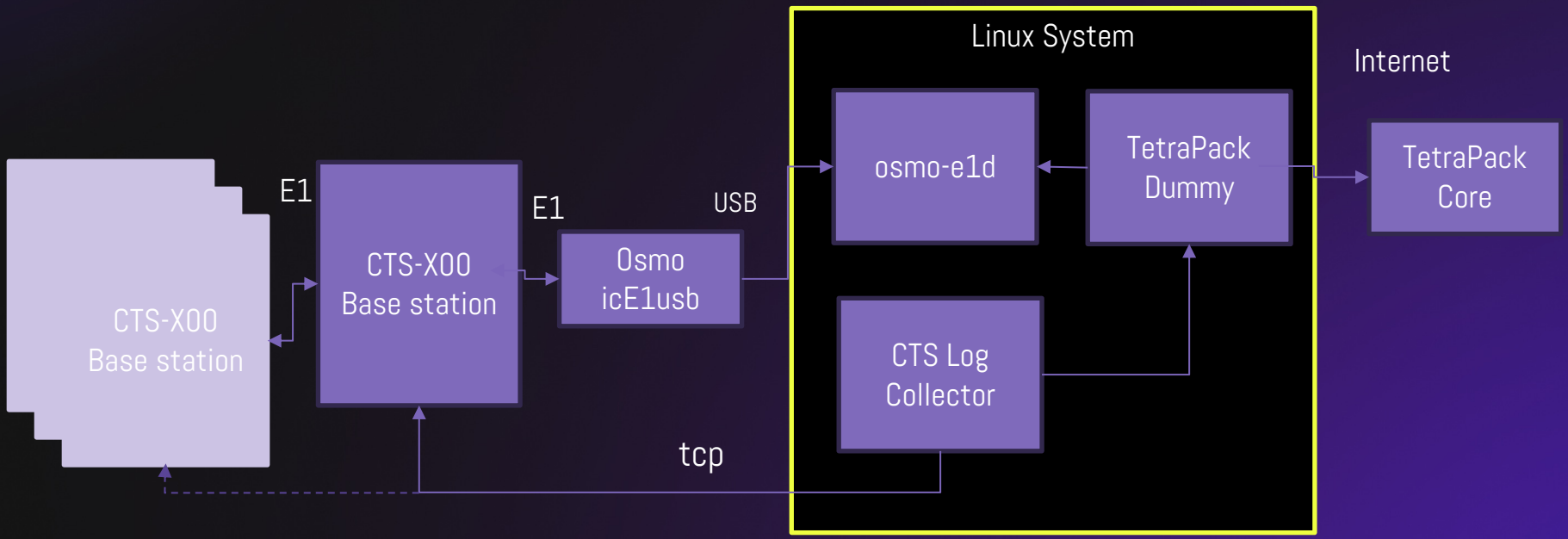
- Designed by DAMM and Frequentis, labeled by Motorola
- Uses E1 closed-ring topology
- Up to 8 base-stations
- No need for dedicated network core
- Voice and signaling only over E1
- Proprietary <Inter-site Connect>
- Not compatible to ISI/E1 (TETRA Interconnection standard)
- Base-station controller (BSC411) runs on Windows NT 4.0 Embedded



Dummy

- Client software to connect Motorola CompactTETRA (CTS-X00) zones
- Emulates Base Station and Gateway PC
- Up to 31 mobile and 32 “fixed” calls (maximum capacity of emulated nodes)
- Debian Linux 11+, x86-64 or arm64 (Raspberry Pi 4+)
- Osmocom icE1usb interface for E1
- Extra software – CTS log collector

Motorola CTS-X00 Site



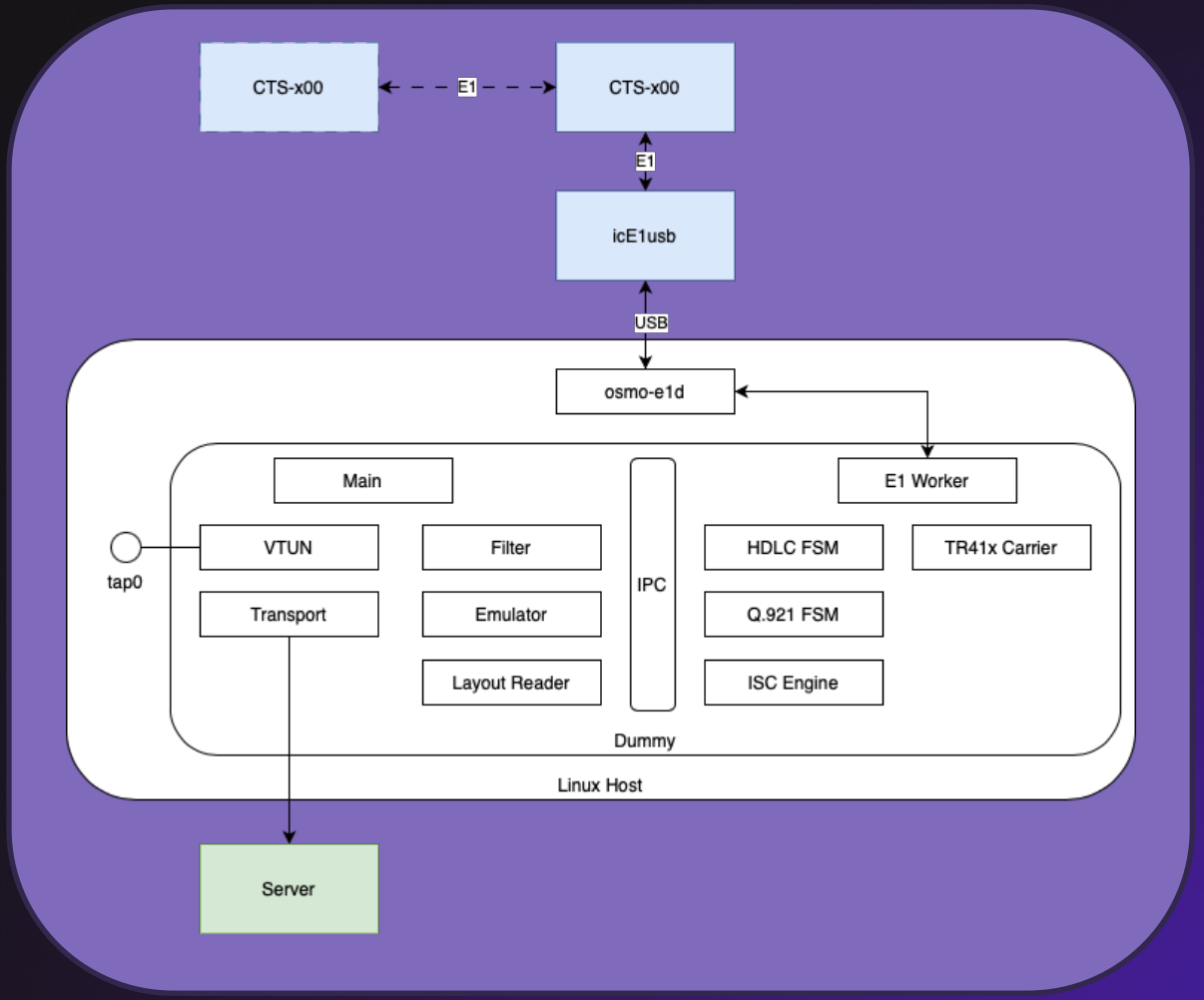
Dummy

In details

- Transmits application-level messages between CTS E1 and TetraPack Core server
- Decodes/encodes full signaling stack:
  - **E1 handler **
  - **HDLC FSM -- (normally done by IC on BSC411 board)**
  - **Q.921 FSM /**
- Inter-site Connect transport including priority management (normally done by ISCD2.EXE)
- Decodes/encodes E1 and pre-buffers carrier streams (normally done by BSC411/TR412 boards)
- Partially emulates BSS.EXE/GWS.EXE (presence / status updates)
- VTUN over E1 between CTS and host (does not forward to the server)
- Uses the same bssparams.txt configuration file as a base station
- Typical IP bandwith 4-100 Kbits/sec
  (that's nothing in comparison to TDMoIP – 2x 2 Mbits/Sec, 2x 8000 PPS constantly)

Dummy

In details



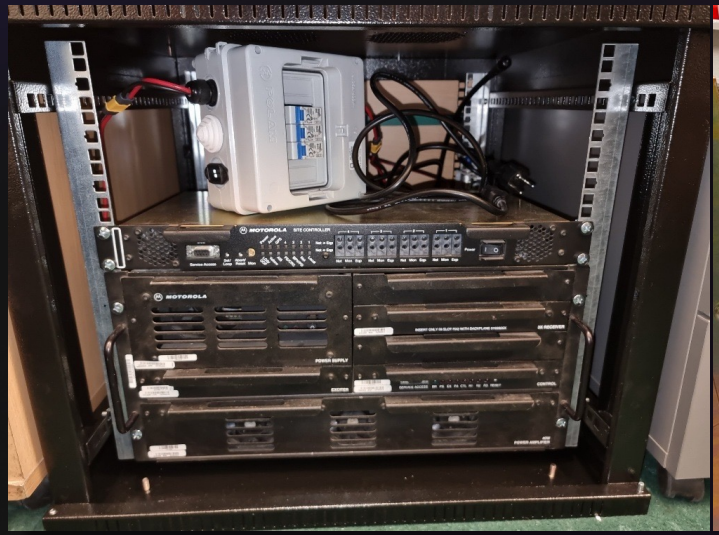
Osmocom icE1usb

- Available for ordering, not expensive
- USB to connect to PC
- Role (NE/NT) can be selected by jumpers, can be used with a regular network cable
- User-space Linux driver, no need to change kernel
- Supports required work mode (SUPERCHANNEL)


motorola dimetra

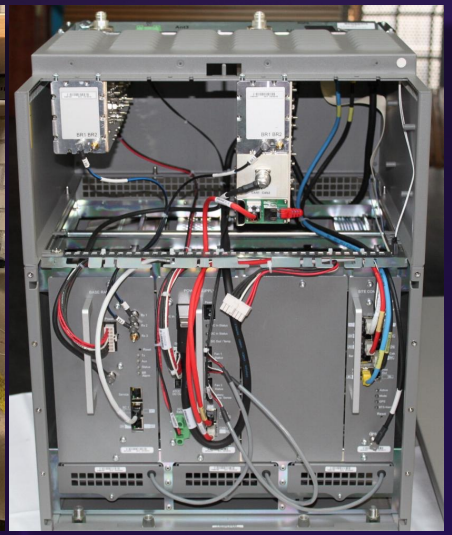
Dimetra hardware

Base stations



EBTS (gen1, gen2)

MBTS

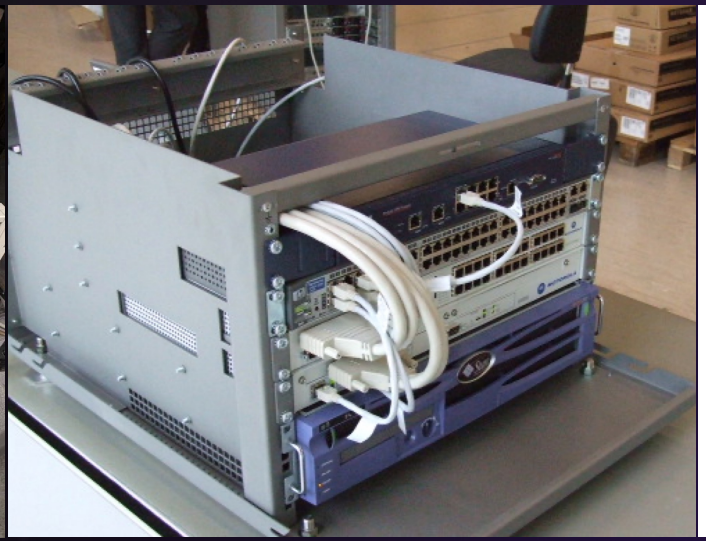


MTS2/4

Dimetra hardware

Core systems

CP1500 (gen1)



Sun Netra + IBM Power (gen2)

Core X (HP ProLiant)

Dimetra hardware

Core systems

- **Sun CP1500-based**
  - Can run Dimetra up to R6.2
  - Fully hardware
  - Motorola-proprietary cPCI boxes, ZNYX redundant ethernet blades
- **Sun Netra + IBM Power**
  - Standard 19" equipment
  - Solaris 9+ containers
  - Multiple support boxes based on PowerPC / x86 / Linux / Windows
  - Dimetra R6-R8 (?)
- **Core X**
  - HP Proliant DL-series
  - Linux / Linux KVM or VMware / Windows
  - Many virtual machines running on a single box

Dimetra concept

General information

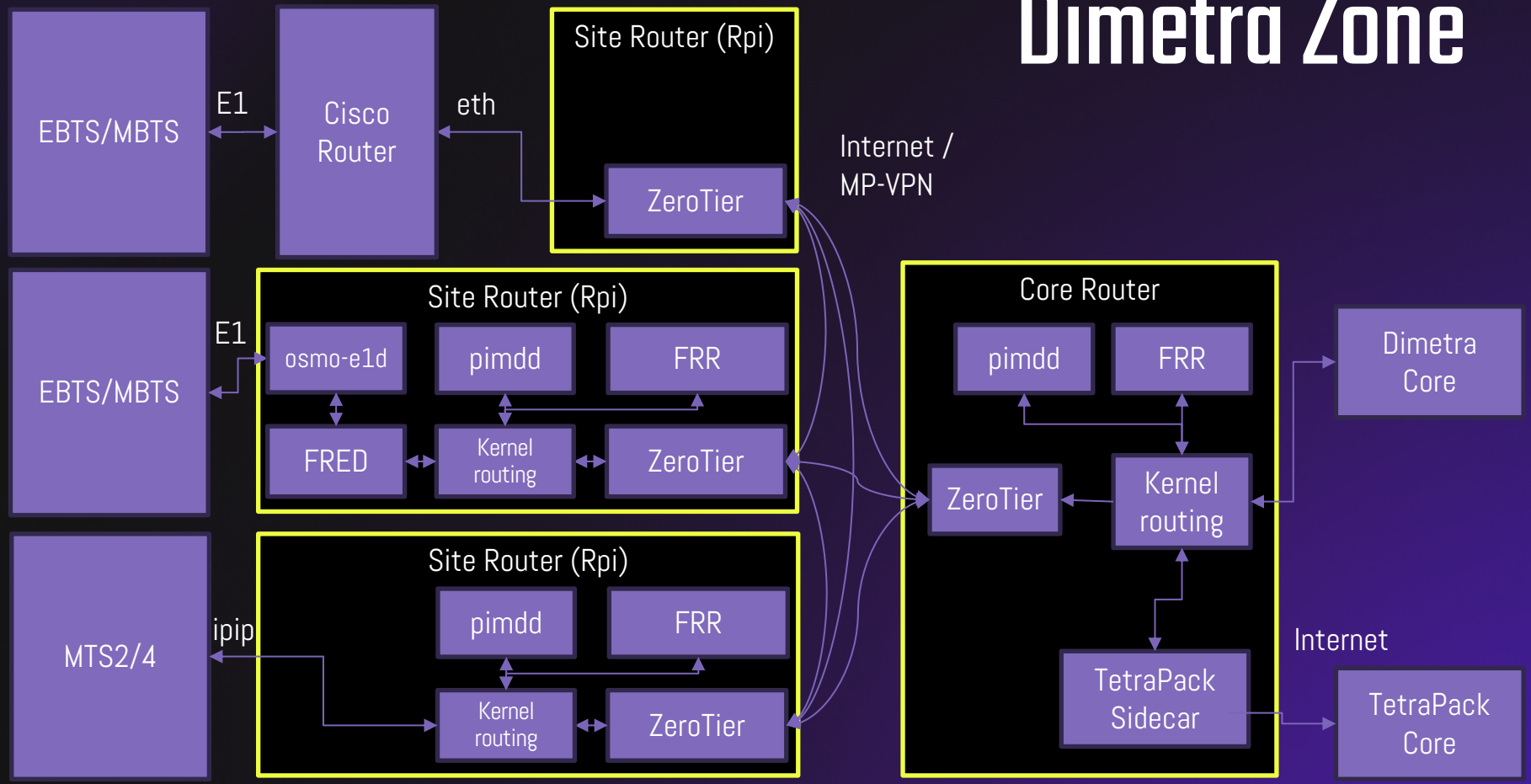
- Centralized switching and network management
- Redundant configuration of core components
- Shares many core components with SmartZone, Astro P25, MOTOTRBO Capacity Max
  - **Pure IPv4-based private (RFC1918) packet-switched transport**
  - **EBTS/MBTS base stations use IP over FrameRelay (E1 or X.25)**
  - **MTS2/4 base stations use IP over IP VPN**
- Predefined fixed IP plan
- Media and signaling use mostly IP multicast

Our Dimetra Core approach

Base concept

- ZeroTier MP-VPN to connect sites and core
- OSPF for unicast routing, PIM dense-mode for multicast routing
- Two options to connect EBTS/MBTS base stations
  - **Cisco router with E1 card + any box (Linux/OpenWRT/Mikrotik) for ZT**
  - **Osmocom icE1usb + any Linux box for osmo-e1d + fred + FRR + pimdd + ZT**
- One option to connect MTS2/4 base stations
  - **Any Linux box + FRR + pimdd + ZT**

Dimetra Zone



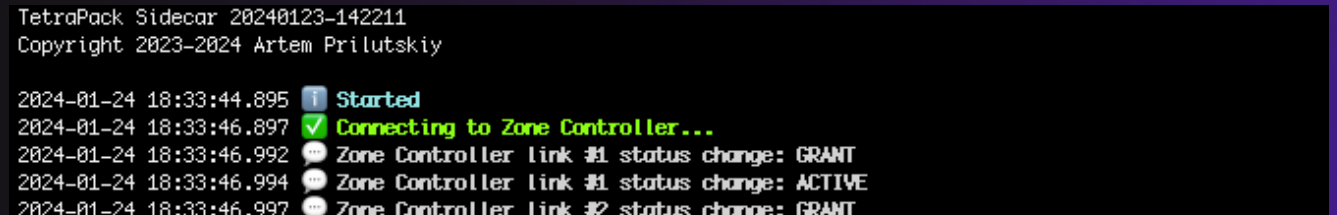
Option 2: FRED

FrameRelay-over-E1

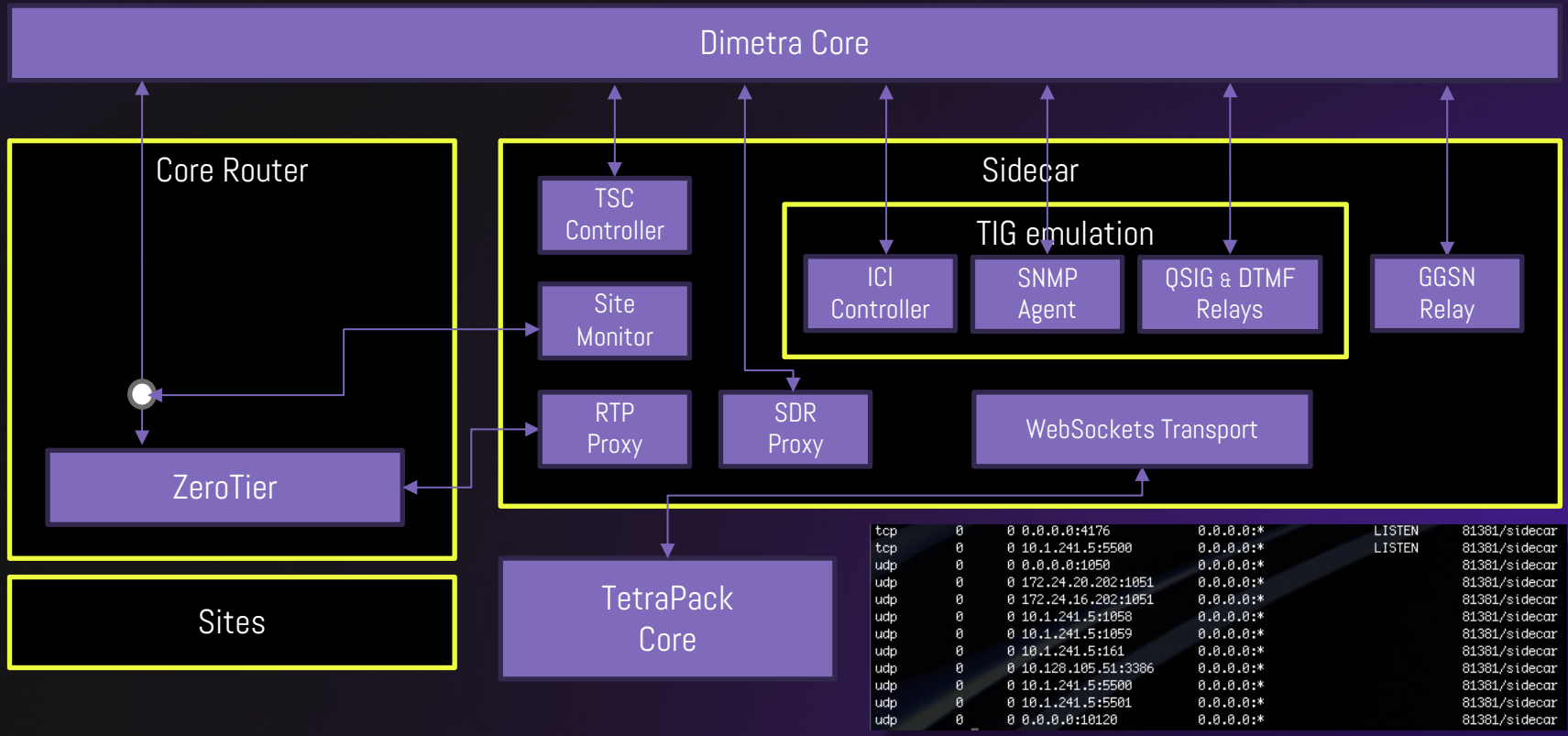
- Our own gateway software to run on on-site E1 connection
- Bridges IPv4/IPv6/Ethernet packets between Linux kernel and FrameRelay over E1 (RFC 2427, RFC 2590)
- Supports FRF.12 (inner and outer) fragmentation for incoming traffic
- Implements basic DCE-PVC LMI with support of ITU-T Q.933-A, ANSI T1.617-D, GOF (automatic detection)
- Acts via TUN/TAP network interfaces (one per DLCI) on Linux side
- Can share icE1usb interface with another FRED / dummy / etc
- Debian 12 arm64 or amd64, tested on Raspberry Pi CM4, Raspberry Pi 5

TetraPack Sidecar

- Agent software to connect Dimetra Core (on per-zone basis) with TetraPack Core (like TetraPack Dummy for CompactTETRA)
- Should run close to Dimetra Core in the same private network (better to have it on core router)
- Single TCP connection to TetraPack Core over Internet
- Emulates EBTS TSC to register users and to pass group and individual calls and SDS
- Emulates MTIG for phone calls interconnection with ISSI passthrough and without transcoding
- Emulates GGSN for packet data
- Watches for signaling between TSCs of real base stations and Zone Controller to grab registrations, group affiliations and group calls



TetraPack Sidecar




```
tcp        0      0 0.0.0.0:4176            0.0.0.0:*               LISTEN      81381/sidecar
tcp        0      0 10.1.241.5:5500         0.0.0.0:*               LISTEN      81381/sidecar
udp        0      0 0.0.0.0:1050            0.0.0.0:*                           81381/sidecar
udp        0      0 172.24.20.202:1051      0.0.0.0:*                           81381/sidecar
udp        0      0 172.24.16.202:1051      0.0.0.0:*                           81381/sidecar
udp        0      0 10.1.241.5:1058         0.0.0.0:*                           81381/sidecar
udp        0      0 10.1.241.5:1059         0.0.0.0:*                           81381/sidecar
udp        0      0 10.1.241.5:161          0.0.0.0:*                           81381/sidecar
udp        0      0 10.128.105.51:3386      0.0.0.0:*                           81381/sidecar
udp        0      0 10.1.241.5:5500         0.0.0.0:*                           81381/sidecar
udp        0      0 10.1.241.5:5501         0.0.0.0:*                           81381/sidecar
udp        0      0 0.0.0.0:10120           0.0.0.0:*                           81381/sidecar
```

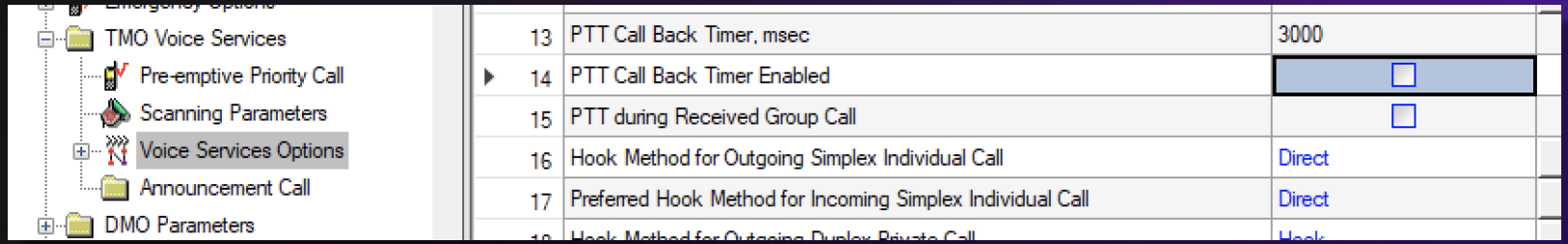
TETRAPACK

User Experience

DMR <-> TETRA

Individual calls

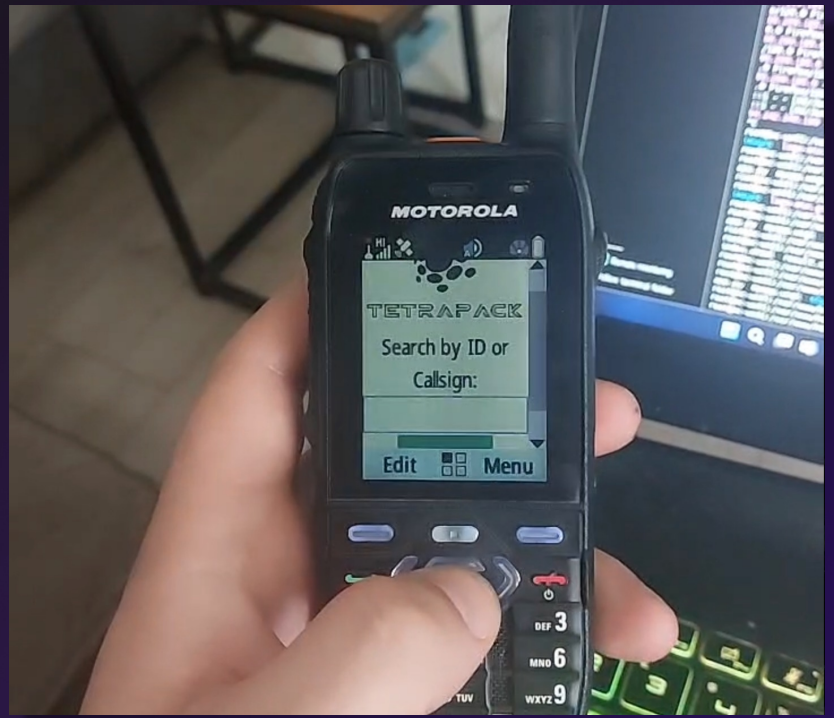
- TETRA -> DMR: DOUBLE PTT TO SETUP A CALL AND THEN TO TRANSMIT
- Recommended settings:
  - **PTT Call Back Timer – Disabled**
    (respond for initial delay on call DMR->TETRA)
  - **Hook Method for Outgoing Simplex Individual Call – Direct**
    (respond only for transmitted call capabilities, the bridge is tolerant to this setting)
  - **Preferred Hook Method for Incoming Simplex Individual Call – Direct**
    (allows TETRA radio to hook a call automatically - DMR side doesn't know about when the call hooked)



Mobile IP-data and WAP

Packet data access

- Static IP allocation for better compatibility
- WAP gateway based on Kannel (kannel.org)
- Single IP and settings for any access types
- Dimetra-based access:
  - Password authentication using CHAP
  - Password can be set in BrandMeister's dashboard (hotspot/repeater password)
  - Should be enabled per ISSI by administrators
- CTS-based access:
  - Should be enabled per ISSI for each cell by operator
  - Multi-slot Packet Data should be off for CTS



Mobile IP-data and WAP

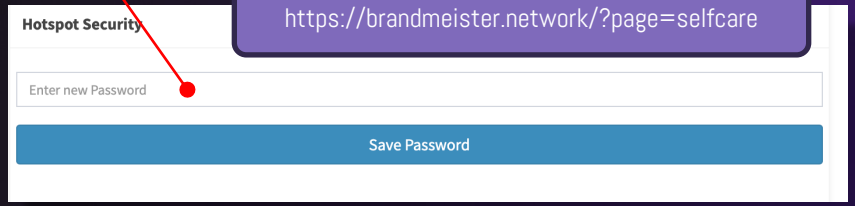
Radio settings

	Field Name	Field Value	Set Default
1	Proxy IP Address	10 .10 .10 .2	
2	Remote Port	9201	
3	Force SAR	☑	
4	SAR Group Size	3	
5	Bearer Index	0	

	Field Name	Field Value	Set Default
1	Protocol Type	CHAP	Set Default
2	User Name	2356266	
3	Password	BM-SelfCare-Pass	

	Field Name	Field Value	Set Default
1	User Authentication	☑	
2	Authenticator Name	DIMETRA_P	
3	Data Only	☑	
4	Voice&Data	☑	
5	Voice Only	☑	
6	Default Packet Data Mode	Voice&Data	Set Default
7	PD Page Period Updates, msec	1000	Set Default
8	IP Queue Timeout	☐	
9	IP Maximum Queuing Time, sec	5	
10	Request a Dynamic IP Address	☑	
11	Static IP Address	0 .0 .0 .0	

https://brandmeister.network/?page=selfcare



Phone calls

PSTN calls

- Available numbers:
  - 2 – Asterisk's IVR demonstration, DTMF test
  - 600 – Echo test

Next steps

TetraPack Core and supplementary components

- **TetraPack-specific LastHeard web page**
- **Packet data support**
  - Packet access management in the dashboard
  - AMPR access with static address binding to follow ITU-T rules and better radio-access capabilities
  - HamNet should be reachable via AMPR
- **Support for radio-access equipment of other vendors**
- **Ham and emergency telephony integration**
  - Dial plan development
  - Trunk agreements
  - SIP is available, but IAX2 is preferrable

Links

- https://tetrapack.online/
- https://t.me/TetraPackGeneralSupport