

Economic usage of communication systems in AVLC

Agile Hybrid

The availability and bandwidth of voice and data communication are central prerequisites for secure, economic operation of the AVLC. While operational radio systems – so-called PMR systems – safeguard exclusive quality of service, the public mobile network facilitates fast transfer of large data volumes. Agile Hybrid optimises cost-effective use of both radio systems.



For many transport operators, communication between the control centre and the vehicles currently takes place in hybrid mode – on the one hand using a PMR system such as TETRA digital radio, DMR or analogue radio, and on the other hand with public mobile radio. The system for voice and data communication always prioritises the PMR system, with the drawback that broadband public mobile radio is then only available when the vehicle has no connection via the PMR system.

Agile Hybrid

For integration of future data-intensive functions while making economic use of the PMR radio system, ebblo has modernised the AVLC voice and data communication

system, with Agile Hybrid as a further development. Agile Hybrid facilitates service-oriented prioritising or fixed allocation of voice and data radio actions between the control centre and the vehicles using the available radio systems, with clearly enhanced flexibility and availability of voice and data communication even under difficult reception conditions.

Agile Hybrid in practical use

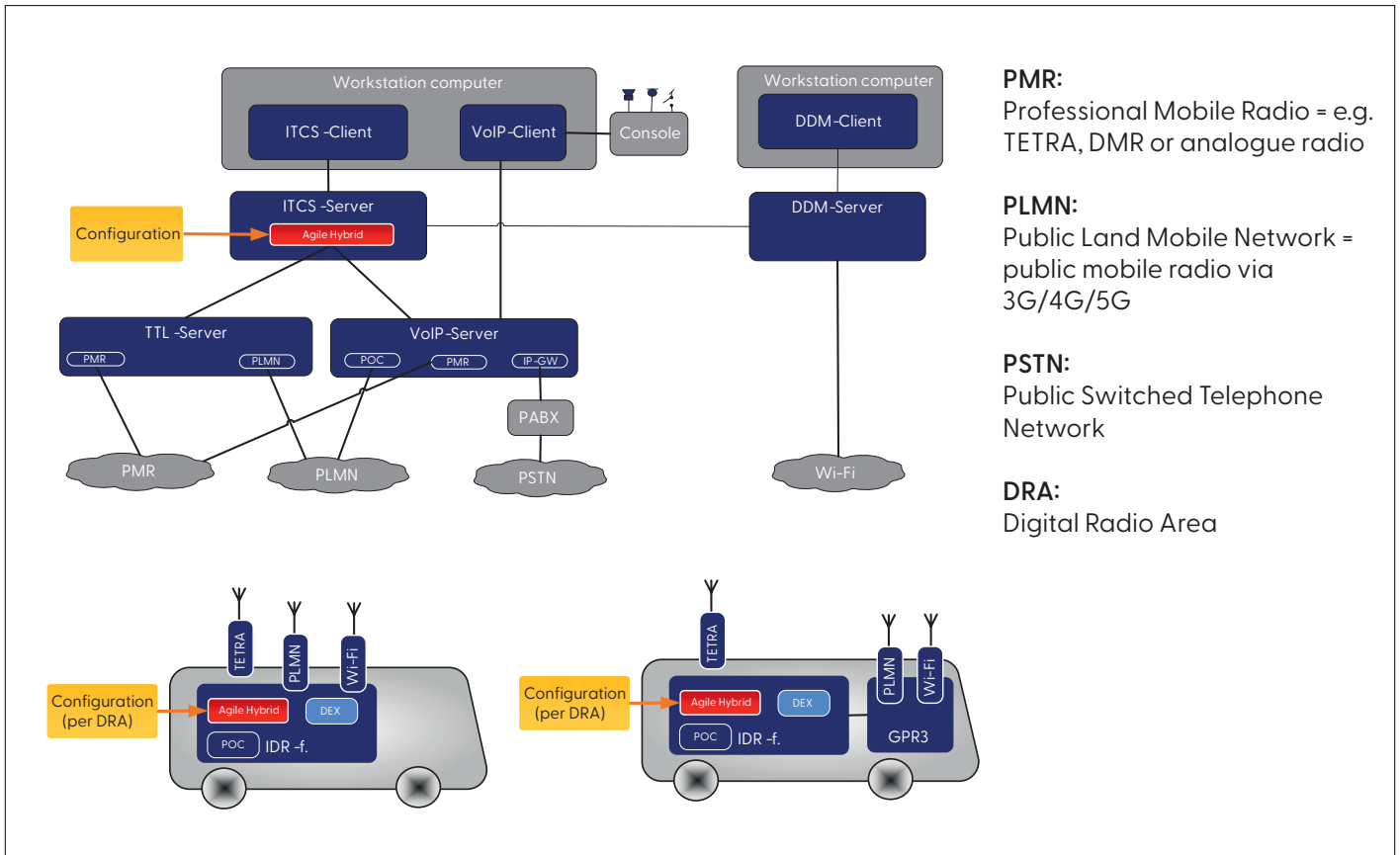
The following example illustrates the operational possibilities and advantages of Agile Hybrid. This diagram shows an AVLC system integrated in the vehicle fleet with a PMR system (TETRA digital radio or analogue radio) and public land mobile radio (PLMN). Voice communication by means of public mobile radio is possible using VoIP or also the provider's telephone network.

Agile Hybrid makes it possible to prioritise voice and data radio regardless of the radio system. For on-board computer actions directed to the control centre and control centre actions directed to the vehicle, respective prioritising of the transmission channels is configured separately in each case in the control computer (AVLC server) and in the vehicle on-board computer.

When operating trams, consideration also has to be given to the Regulation on the Construction and Operation of Tramways (BOStrab). The regulation specifies that priority must be given to transmitting particularly important messages to main operating centres. This can be safeguarded flexibly with Agile Hybrid.

Typical use cases:

- Depending on availability, **important operational data** are transmitted via public mobile radio or PMR, to use the system that offers better coverage in each case. Relevant actions in terms of **BOStrab** can thus be prioritised with the PMR system, while public mobile radio is used for other actions.



- **Actions demanding very high bandwidth** that cannot be transmitted via the PMR system or actions that are not critical to operations can be firmly allocated to public mobile radio. This relieves pressure on operational radio and allows for more economic dimensioning of the corresponding capacities.
- **Location data** are transmitted in parallel via public mobile radio and operational radio. Using PLMN means the data can be transmitted with far higher frequency, making vehicle location far more accurate and with more accurate arrival time predictions for passenger information.

Geographical allocation of the radio system

In combination with the Digital Radio Area function, it is also possible to control **geographic allocation of the radio system**.

The digital radio areas (DRA) in the data supply are used for this purpose, with individual allocation of specific configurations with the required prioritising.

Geographic allocation of the digital radio area is carried out at the stopping points and can also be changed, starting from a certain distance on the link. The radio system can thus be changed en route. For example, the radio system can be firmly allocated before entering a tunnel or in case of constantly changing radio reception, to avoid unwanted changeovers.

Uploading and downloading the operational data

The radio system can also be prioritised for exchanging operational data between the Depot Data Management (DDM) and the vehicle. This prioritising is done by the data export service (DEX) in the on-board computer, regardless of Agile Hybrid.

Example configuration

The following overview shows a typical configuration for control centre and vehicle actions in a transport operator with trams subject to BOStrab.

Control centre actions

Actions	PLMN	PMR
Voice calls	S	P
Multifunctional display MFD – Transfer monitor – Operational and incident messages	F	N
Dynamic passenger information DFI	F	N
Instructions to drivers	S	P
Dispatch Reassignment	S	P

Vehicle actions

Actions	PLMN	PMR
Request-to-talk	S	P
Priority call	S	P
Emergency call	S	P
Driver message	S	P
Device messages	F	N
Location	F (high rate) (e.g. 5s)	F (low rate) (20s)

P: Primary radio system

S: Secondary radio system

F: Firmly allocated to a radio system

N: Not available for the radio system

Most control centre actions are transmitted primarily via the PMR system, with PLMN as the secondary system. One exception comprises information for the multifunctional displays (MFD) in the vehicles and data communication of the dynamic passenger information (DPI) to the stop DPI signs: these are transmitted via PLMN only, to relieve the capacity of the PMR system.

Most vehicle actions directed to the control centre are transmitted primarily via the PMR system, with PLMN as the secondary system. Only device messages are transmitted solely via PLMN, as such messages can be highly data-intensive and would need too much bandwidth of the PMR system.

Locating is transmitted via PLMN and PMR in parallel, with different frequencies. Location updating is transmitted in a 5s cycle via PLMN and 20s cycle via PMR. This ensures high location precision even during a call on PMR.

Migration to Agile Hybrid

The on-board computer software and the control centre software need to be extended in order to use Agile Hybrid. The procedure consists of three individual steps:

- Firstly the control centre software is activated with Agile Hybrid. Communication to vehicles that have not been migrated yet remains unchanged. If necessary, specifically prioritised digital radio areas are set up.
- Agile Hybrid can then be gradually added to the vehicles. From this point onwards, the vehicles follow the configured priority.
- The control centre recognises vehicles with active Agile Hybrid and changes communication for these vehicles over to the defined behaviour. The previous behaviour is retained for vehicles that have not been migrated yet.



Operational advantages of Agile Hybrid

Agile Hybrid has two central advantages: enhanced availability of data and voice communication, and the possibility of extending the operational area to include areas outside the coverage of the company's own radio system. The new solution also brings many other advantages for transport operators, as illustrated by the following examples.

Data communication also during voice communication with PMR

While data communication is primarily transmitted using public mobile radio, voice communication primarily uses the PMR system. The advantage of this is that data communication is available via PLMN while TETRA is available for a voice call.

Economic use of the radio systems

The possibility of always using PLMN for transmitting data-intensive, non-security relevant information reduces the burden on the PMR radio system, or allows for it to be streamlined. This opens up capacities in the PMR system for additional vehicles or functions.

More precise locating and better predictions

The location data are transmitted via mobile radio and TETRA at the same time. This makes predictions more precise.

Voice communication with PLMN

Voice calls via mobile radio can be made available as VoIP (PoC) using the data service of the mobile radio provider or via the telephone network. It is thus possible to configure how the connection should be put implemented for individual calls, announcements and emergency calls.

Simple migration of the existing system

Migrated and not migrated vehicles are supported simultaneously, thus allowing gradual migration to Agile Hybrid.

Technical prerequisites

- On-board computer from generation IDR-f or IDR-f2. Vehicles with IBISplus only support the old procedure, but mixed operation with Agile Hybrid is also possible.
- Data communication via PLMN 2G, 3G, 4G or 5G
- Data radio via internal modem in IDR-fx or GPR3
- Third-party modems on request
- The Digital Radio Area function is necessary for geographical allocation of the radio system via the data supply.

Availability

- Already available for TETRA/TETRAPOL
- For analogue radio from 2025

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