ebblo

SOLUTION BROCHURE

From conventional traffic light preemption to V2X-based signal phase assistant

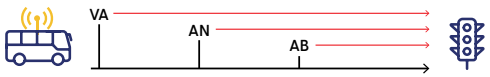
V2X – Vehicle-to-Everything Communication

We facilitate the use of V2X

Vehicle-to-everything technology (V2X) is a key subject for the urban public transport sector. Many transport companies are wondering what V2X can do for them and which functions it can perform in future. ebblo has been looking at the advantages and possibilities of V2X for some time now. In the AVLC setting, highest priority is being given to using V2X (C-ITS Service TSP, "Traffic Signal Priority Request") for traffic light preemption.

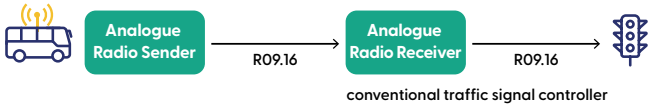
Current situation

Conventional traffic light preemption with analogue or digital radio based on the VDV Recommendations 420 and 426 works with presupplied reporting point chains. When a vehicle passes a reporting point, it sends an R09.16 message which the junction radio receiver forwards to the traffic light controller.



These messages consist of either advance registration (VA), registration (AN) or deregistration (AB). Using the information contained in the message, including timetable deviation and route, the traffic light controller defines which priority is given to the vehicle and which lane is to be enabled.

Conventional traffic light preemption with analogue radio



Supplying the reporting point chains is complex and comes with the drawback of preventing flexible path dispatch in the control centre at the same time as prioritising the vehicles. This is because the reporting point chains always enable the planned lane, even if another lane would be the right one due to a path dispatch. The lack of feedback leaves the driver uncertain as to whether preemption has worked.

Restructuring analogue radio frequencies

As of the end of 2028, in Germany the analogue radio frequencies used for traffic light preemption will be restructured. Channel spacing will be reduced from 20 kHz to 12.5 kHz, and in some cases the allocated frequencies will be shifted to other frequency bands.

As a result, analogue radio devices (transmitters in the vehicles, receivers at the junctions) will have to be reprogrammed or even replaced. Various local authorities have decided not to make any more investment in the technology dating back to the 1980s. Instead, they are planning to change over to modern "vehicle-to-everything" technology (V2X).

V2X is not just for the public transport sector and emergency vehicles. On the contrary, it is already being installed in private vehicles as well, for communication with other vehicles and with the infrastructure. The digitalisation of traffic light preemption is thus a springboard for further applications facilitated by V2X technology.

Changing from analogue radio to V2X

This quantum leap in technology offers many changes, but needs careful planning. Parallel operation of both old and new technology will be necessary for several years.

In its recommendation entitled "Using C2X-based public transport preemption at traffic light junctions (chapter 3.3)", the Federal Highway Research Institute (BASt) recommends taking a two-step approach to the changeover:

- **Step 1:** preemption with "R09.16 packed in CAM"
- **Step 2:** preemption with SRM/SSM (= "pure V2X")

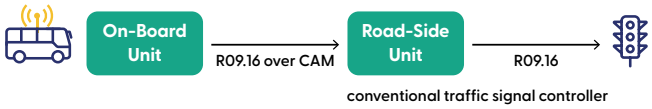
Step 1 is an interim solution which can be rolled out quickly thanks to the V2X transmission path (OBU in the vehicle, RSU at the junction) without having to upgrade the junction controllers. The roll-out can be implemented before restructuring the analogue radio frequencies comes into effect.

Step 2 is the desired status. The junction controllers have been upgraded and made fit for V2X, thus exploiting the full potential. It is now possible to implement the signal phase assistant and other smart functions.

Step 1A: Interim solution

As recommended by the BASt, the interim solution replaces the radio path with the OBU ↔ RSU tandem.

Traffic light preemption with V2X (interim solution)

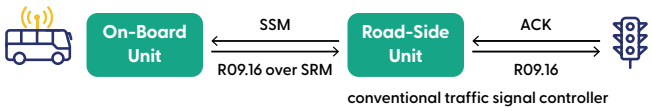


Reporting point chains still have to be supplied, and the driver still receives no preemption feedback.

Step 1B: Interim solution "plus"

As part of the C-ROADS projects in Germany, embedding the R09.16 messages in an SRM was tested as an alternative to CAM. The advantage: The SSM functions as reply. Above all, however, SRM and SSM can be passed on from subscriber to subscriber, resulting in a greater range.

Traffic light preemption with V2X (interim solution "plus")

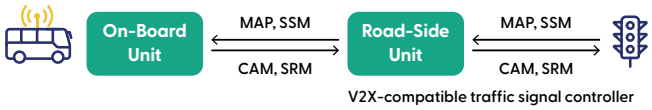


This solution of adding feedback to step 1 is also based on the R09.16 message, so that the supplied reporting point chains are still needed.

Step 2A: Traffic light preemption with V2X

As with step 1B, in step 2A the request is made by SRM but without needing an R09.16 message. This is possible thanks to a V2X-capable phase controller that sends the MAP (= layout of the junction and its lanes). The SRM refers to these lanes so that reporting points are no longer needed.

Traffic light preemption with V2X



In chapter 3.3 of its recommendation, the BASt writes: "With the changeover from the well-known reporting point principle to quasi-continuous tracking of a PUT vehicle with V2X and sending an SREM to a TLP node on approaching and departing, traffic engineers are called to have a rethink in order to extend existing control procedures or develop new ones."

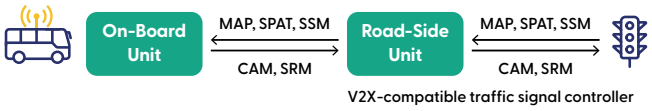
Transport companies can now avoid the complex, tedious work involved in supplying the reporting point chains and will welcome the increased flexibility in their dispatching processes as the paths are now no longer stored statically in the junction controller.

For the traffic engineers, permanent tracking of the vehicles means that valuable green phases will no longer be wasted.

Step 2B: Signal phase assistant with V2X

Besides the SRM, the SPAT is also based on the MAP. The on-board computer is now informed when the signal changes from red to green respectively how long the green phase lasts.

Traffic light preemption and signal phase assistant with V2X

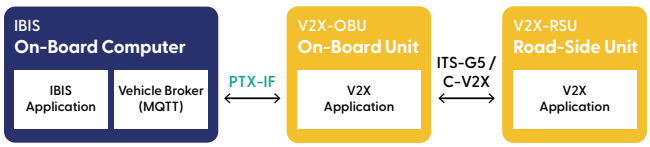


The OBU forwards this information to the on-board computer which uses it to derive trip recommendations for the driver (GLOSA, Green Light Optimal Speed Advisory) which are shown on the driver terminal. This results in the following advantages for the transport company:

1. Energy-optimised approach to the junction
2. Time-optimised departure from the stop

Open interface

The open interface PTX (Public Transport to Everything) between the ebblo on-board computer and the V2X-OBU gives the transport company freedom of choice with regard to which devices are used.



At the moment, current projects are using OBUs by Yunex and Herman.

Conclusion

V2X necessitates cooperation between the local authority that is responsible for upgrading the traffic light systems, and the transport company that has to take care of upgrading the vehicles. This shared workload is worthwhile because of the many additional interesting applications that can be implemented with V2X technology.

Glossary

BASt **Federal Highway Research Institute in Germany** (ASTRA is the equivalent in Switzerland)

CAM **Cooperative Awareness Message:** V2X message about vehicle type, location, travelling direction and speed with which the vehicle announces its presence and intention (can carry an R09.16 message as interim solution)

C-V2X **Cellular V2X:** 3GPP standard for V2X communication based on cellular technology

GLOSA **Green Light Optimal Speed Advisory:** C-ITS service for predicting traffic light phases and providing the relevant information to drivers – including trip recommendations based on this information (traffic light phase assistant)

ITS-G5 **Intelligent Transport Systems G5:** ETSI standard for V2X communication based on IEEE 802.11p, therefore also known as "WIFI-p"

MAP **Map Message:** V2X message that informs approaching vehicles about the layout of the junction with its lanes, connections and signal groups

OBU **On-Board Unit:** V2X device in the vehicle that communicates with the RSU at the roadside and is connected with the on-board computer

PTX **Public Transport to Everything:** MQTT-based, open interface between on-board computer and V2X-OBU

R09.16 **Record 09 (16 byte version):** Message originally defined in VDV Recommendation 420 (with many variants), used for conventional traffic light preemption with analogue or digital radio

RSU **Road-Side Unit:** V2X device at the junction that communicates with the OBU in the vehicle and is connected with the junction controller (but is not generally limited to junction controllers)

SPAT **Signal Phase and Timing Message:** V2X message (refers to MAP) which informs approaching vehicles about the current phase and predictions for the next phases for every signal group of a junction

SRM **Signal Request Message:** V2X message (refers to MAP) with which the vehicle requests preemption (can carry an R09.16 message as interim solution)

SSM **Signal Status Message:** V2X message (refers to SRM) with which the traffic computer informs the vehicle about its preemption status

TSP **Traffic Signal Priority Request:** C-ITS service for requesting priority at traffic light systems

V2X Vehicle-to-Everything Communication: new kind of digital communication based on either "C-V2X" or "ITS-G5"

ABOUT US

ebblo helps public transport providers move confidently into the future. Our advanced Intelligent Transport Control Systems (ITCS) adapt as mobility evolves – powered by future-proof technologies and decades of expertise. We deliver robust, best-in-class solutions, scalable platforms and next generation architectures – ensuring flexibility, control, and security. Our solutions streamline operations, improve accuracy, and enable cleaner, faster, and more accessible and barrier-free networks – making public transport the natural choice for everyone. With proven reliability and transformative innovation, ebblo is your trusted partner for what's next.

ebblo is part of Modaxo, the global collective of people transportation technology companies within Constellation Software Inc. (TSX: CSU).

Ready for what's next?

Transform your public transport operations with innovation engineered for change.

Contact us.

info@ebblo.com

Switzerland +41 58 911 11 11
Germany +49 30 34 06 02 70
UK +44 808 281 1039
Poland +48 71 715 83 00

ebblo.com