1 The Vision of MAR-MOR

The Web Log

„Area 1.0 – the 10th State of Austria" (https://areasharpa.blog/about)

had developed a vision of a "Mixed/Augmented Reality Model Railroad – MARMOR", some time ago. This vision was depicted as follows:

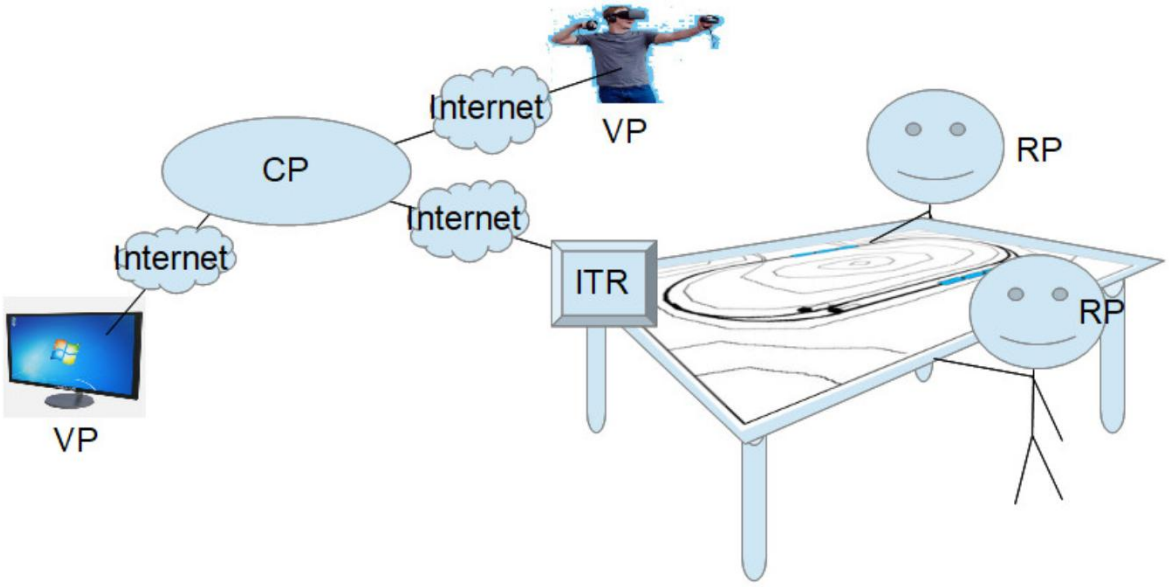

Figure 1: A Vision of a "Mixed/Augmented Reality Model Railroad" – MARMOR

The vision can be phrased as follows.

> Several friends meet at a semi-virtual meeting with the goal to play a real model railroad.
>
> Some of them meet at the real place of the model railroad and attain the roles of "Real Players" (RP).
>
> Others cannot afford to come to the meeting place.
>
> Be it, they live too far away or be it the room of the model railroad does not provide enough space for so many players, so they attain the roles of "Virtual Players" (VP).
>
> Some computer systems and the Internet enable their connection to the model railroad.
>
> Another – more advanced – role could be the role of an "MR/AR Player" (MRARP), who joins the small crowd of real players, but he/she uses some AR equipment to enjoy additional virtual features, which augment the direct perception of the real model railroad (be it walking pedestrians or flying airplanes or whatever).

Well, this vision is heavily involved with the application of real time 3D computer graphics – what we currently call the Metaverse -, but this paper shall focus on people, who are not so much involved with 3D graphics.

Hence, **the paper will deal with the same use case**, **but we will strip off the 3D graphics**. Therefore, we will deal with the general use case of a "Remotely Controlled Model Railroad" – RC-MOR.

2 The RC Model Railroad in a Coach (RC-MOR)

This chapter deals with the idea of a remotely controlled model railroad (RC-MOR), but to make the example even more intriguing for railway people, we will think about an RC-MOR that is installed in a vehicle, namely in a railway coach, which can be easily moved from city to city and the RC-MOR can be exhibited with a minimum staff that needs to be on site.

The experts, which are responsible for the operational aspects of the RC-MOR, can gather in a remote room, which we call the

MOR-DOR – Model Railroad Dominion Room

Needless to say, the MOR-DOR could be a "virtual" room, where the staff could work from Home Office (hybrid or completely remote).

So, if we assume a big country that can afford to have more than one RC-MOR, then we will still need (logically) one MOR-DOR only.

The MOR-DOR and the RC-MOR need to be connected by a "Connectivity Platform" (CP), which provides following services.

- Some "IP Connectivity", to transport "Some IoT Protocol" and some "Application Layer Protocol" (this is described in more detail in chapter 2.1).
- The possibility to do VOICE calls between MOR-DOR and RC-MOR – to talk to the on-site staff
- The possibility to transmit live VIDEO from RC-MOR to MOR-DOR – to help the staff at the MOR-DOR in doing operational decisions
- The possibility to do DATA calls, in case a staff of MOR-DOR wants to directly control some element ("Thing") of the RC-MOR (e.g. a locomotive for shunting actions)

2.1 Protocol Stack for the Control of More Than One RC-MOR

The basic setup of our vision was described in the introduction of chapter 2.

Now, it is the time for a closer look to the needed protocols.

First, we realize there is a difference between the general collaboration of the MOR-DOR staff and the detailed command and control of all the elements ("Things") within the IoT.

We assume two protocols: "Some Application Layer Protocol" (ALP) for the collaboration of the MOR-DOR staff – probably needing a lot of bandwidth – and "Some IoT Protocol" to control all of the many elements ("Things") of the RC-MORs. Each single element will not need much bandwidth, though.

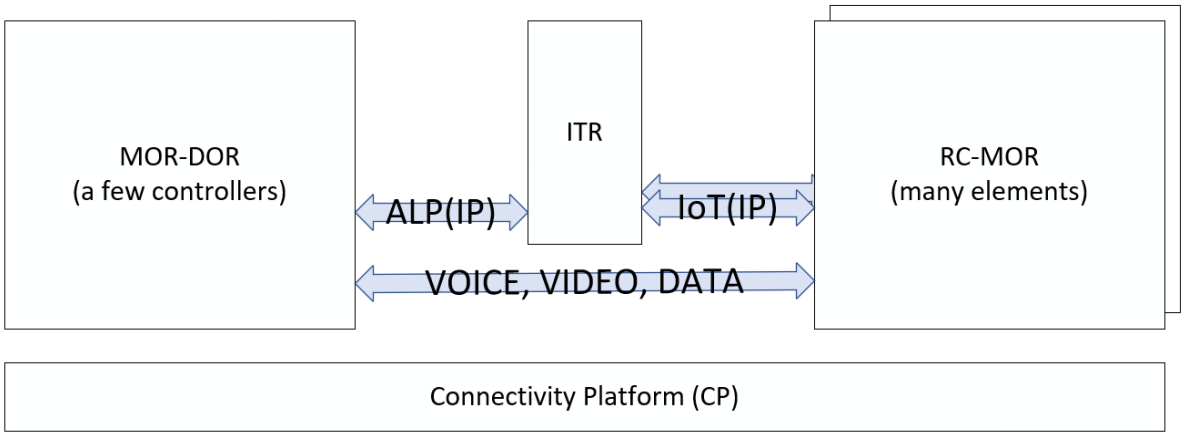

Figure 2: Protocol stack for the control of more than one RC-MOR

Due to this difference between the IoT protocol and the collaboration protocol (ALP), we assume a mediation element, an “Interface to Reality”, which mediates between the command and control at the IoT and the collaboration of the MOR-DOR staff.

2.2 Our Assumptions about the Connectivity Platform (CP)

Our example is about an RC-MOR that is installed in a real railway coach.

- Hence we assume the “Connectivity Platform” (CP) will be a communication platform that is actually available at railway stations with sufficient bandwidth and “Quality of Service”.
- Also, we assume the two protocols “ALP” and “IoT” (“Some Application Layer Protocol” and “Some IoT Protocol”) will not be supported by the “Connectivity Platform” inherently.
- Hence the “Connectivity Platform” will provide some generic “IP Connectivity”, which can be used to create a meshed IP network between all MOR-DOR staff and the ITR(s), as well as a meshed IP network between the ITR(s) and all RC-MOR sites.
- The “Connectivity Platform” will provide some kind of “dynamic addressing” (chapter 2.3). This is necessary, so the RC-MOR can “announce” elements by their functional address. Hence the MOR-DOR staff can use this “activated functional address” to call single elements of the RC-MOR selectively for VOICE, VIDEO and/or DATA transmission in a standardized, efficient way.

2.3 Addressing

2.3.1 ID and Service ID

The “Connectivity Platform” will not be available for unauthorized users. Hence each RC-MOR needs at least one user name and password.

It makes no sense to require passwords from all the elements of the RC-MOR (from each signal, point, locomotive, ……), so from the point of view of the “Connectivity Platform”, **each RC-MOR is a single user with one ID and one password**, e.g.

- ID = model-railway-317@my-railway.at
- Password = KennIchNicht

We assume, the “Connectivity Platform” provides the possibility to have a different Service ID for each service (VOICE, VIDEO, ……), but for our use case we assume the same Service ID for all services

- Service ID = sip:model-railway-317@mcx.my-railway.at (DATA, VIDEO, VOICE, IP Connectivity)

2.3.2 Generic Functional Alias

This Service ID (see chapter 2.3.1) could already be used to basically call the RC-MOR, but it does not reveal any information about the function that is provided by this RC-MOR.

Hence, we assume, our “Connectivity Platform” provides the possibility to address any equipment on a vehicle by the following “generic functional alias”:

- Generic Functional Alias: sip:<vehicle-id>.Equip.<function-label>@mcx.my-railway.at

Where <function-label> is one of the pre-defined labels VEF01, VEF02, ….., VEF25 (vehicle equipment function 1 to 25).

That is, the “Connectivity Platform” provides a standardized way to address up to 25 different equipment functions on each vehicle.

Hence, if our RC-MOR is installed in the coach with the vehicle-id 1234567, and if the operator of the coach 1234567 has decided to use the function label VEF13 for this RC-MOR, then the generic

functional alias that can be used to connect to our RC-MOR would read:
sip:1234567.Equip.VEF13@mcx.my-railway.at

From some central vehicle register, we can know that VEF13 of vehicle 1234567 is an RC-MOR, and hence the ITR can address the RC-MOR for IoT connectivity (generic “IP Connectivity” with “Some IoT Protocol” on the top).

2.3.3 Dynamic Functional Alias

As soon, as the “IP Connectivity” between the ITR and the RC-MOR has been established for “Some IoT Protocol”, the ITR can “command and control” all the elements on the RC-MOR. Possibly, the ITR will need some support from the MOR-DOR staff, to accomplish this task.

Let’s assume, the “Some IoT Protocol” has some “external addressing scheme”, that is unknown to the “Connectivity Platform”, e.g. as follows:

- The RC-MOR features one locomotive that has got a camera for “engineer’s view”
- The RC-MOR consists of two “modules”, let’s call them “City” and “Hills”.
- The module “City” contains two points, “point1” and “point2”
- The module “Hills” contains one signal, “signalA”
- The RC-MOR has got two video surveillance cams, “cam_x” and “cam_y” and one telephone “phone”. These elements are not assigned to any module.

Hence, the ITR could address following elements (“Things”) over “Some IoT Protocol”:

- Trains-loco001
- City-point1
- City-point2
- Hills-signalA
- Frame-cam_x
- Frame-cam_y
- Frame-phone

Now, we want to establish a direct call to one of the elements, using VOICE, VIDEO or DATA direct via the “Connectivity Platform” (bypassing the ITR).

Hence the RC-MOR publishes the “Dynamic Functional Alias” for all the elements (“Things”) that can be directly called by the MOR-DOR staff.

- Dynamic Functional Aliases
  - sip:1234567.Trains-loco001.VEF13@mcx.my-railway.at (VIDEO)
  - sip:1234567.Trains-loco001.VEF13@mcx.my-railway.at (DATA)
  - sip:1234567.Frame-phone.VEF13@mcx.my-railway.at (VOICE)
  - sip:1234567.Frame-cam_x.VEF13@mcx.my-railway.at (VIDEO)
  - sip:1234567.Frame-cam_y.VEF13@mcx.my-railway.at (VIDEO)
- Are published via IoT and ALP
- Are activated at the “Connectivity Platform”

3 Conclusion

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