

# Yards, A Challenge Through Growth and Changed Landscape

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## SUMMARY

*This paper addresses the challenges for yards when due to growth the demand for remote controlled points is rising. A description is given of a small yard with its applicable systems and the demand to automate the planned operation resulting in the need for an interlocking solution, then the reader is taken in the challenge when the yard is combined with its surrounding where the applicable systems grow in size and quantity, which open the opportunity to divide the area in multiple interlocking areas. The latter is future proof and makes the approach of yards adoptable to urban areas. From a logistic operational perspective, the service process is described in this paper and the signalling manner is described, keywords in this description are ease of operation. Finally signalling and service process are combined in access control and addressed in this paper.*

## 1 INTRODUCTION

Dutch infrastructure manager ProRail is facing growing demands with the increase of Railway operators on the network and the growth of the Dutch Railways (NS) on top of the need of NS to replace older trains by many more modern trains allowing more seating capacity. Recently the forecast of ProRail related to passenger services for 2030 has been published, handling a 40% growth requires an upgrade to stations, yards and increase of service.

As indicated in figure 1 different colours indicate different traffic streams, that all come together in main transfer stations. To optimize a transfer station, direct access to a yard is needed. This paper is focused on the kind of systems to be used on a yard to optimize its function in a logistical manner. Each kind of system is detailed in its architectural composition. Furthermore, the paper addresses the logistical processes and the need to interact with the system in a controlled behaviour.

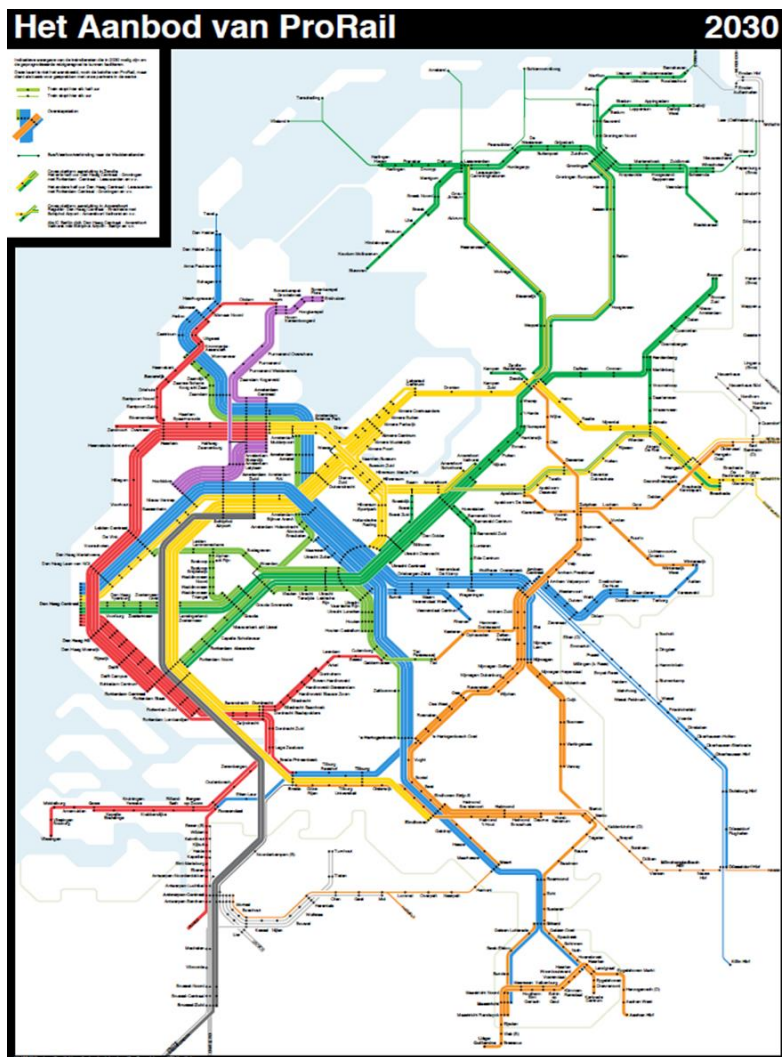


Figure 1. Forecast network drawing

Consider the colourful network drawing in figure 1. In case of a disrupted transfer station, the yard can be used to handle trains on the streams to the transfer station. In case of a disrupted stream, the non-disrupted streams can still be continued at the transfer station, whilst the disrupted stream can use the yard to handle trains. In case of normal traffic behaviour, the yard fulfils a role in regular service (cleaning trains, refuelling non electric traction trains, (small) maintenance, etc.).

In the remainder of this paper two current examples are discussed, in which the second example addresses the need to combine the transfer station with yard functionality. As a result of the increased scope, multiple interlocking areas will be addressed. On a yard it is all about service processes, which are discussed in relation to daily operation. In order to ease the operation, the signalling aspects on yards are discussed and finally specific service installations on yards demand access control to ease a safe operation.

## 2 COMMON PRACTICE

In the Netherlands the vast majority of the network is controlled by a dispatcher. The network itself is an interconnection of interlocking systems. Up to the 21<sup>st</sup> Century a minority of the network, especially on yards and shunting areas worked differently. There is no interlocking system to support the dispatcher. Control by dispatcher is based on procedural verbal communication between dispatcher and driver, the driver sets the points in the granted route and reports back to the dispatcher when the route is finalized. This is a labor intensive process. The Dutch abbreviation for this minority of the network is NCBG (non-centrally controlled area).

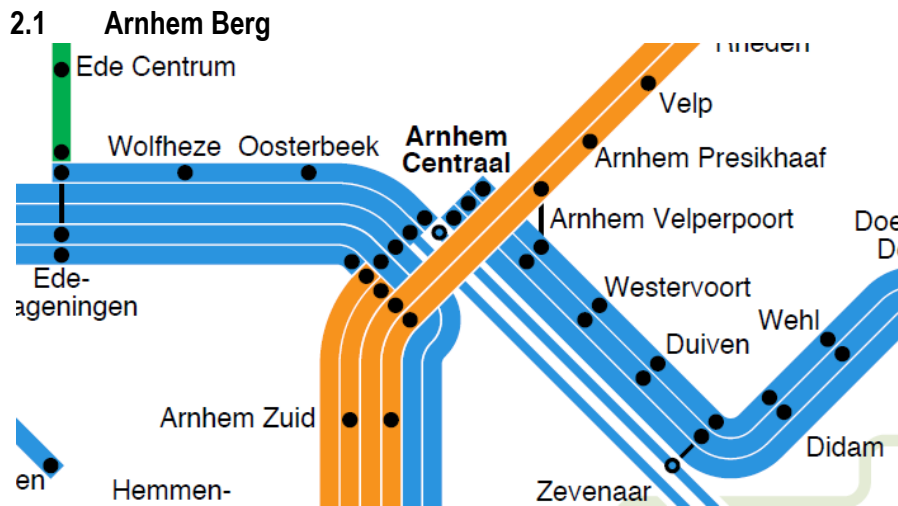


Figure 2. Transfer station with stabling yard in the network

Consider the transfer station Arnhem in figure 2. The stabling yard Arnhem Berg has been upgraded in 2017 to NCBG LWA; LWA is a Dutch abbreviation and stands for point remotely controllable by dispatcher.

LWA enables the dispatcher to set the routes in advance eliminating the need for the driver to stop at every point in order to control the point manually. Routes over the yard could easily count up to six individual points where the driver has to stop, leave the train, manually push the control button (points were equipped with hydraulic levers to reduce the manual labour), verify the correctness of the new point direction, enter the train, drive and repeat this process for any next point in the route.

As with the introduction of the LWA system the labour of work has been significantly decreased and therefore the driver operation has been improved and the capacity of the yard has significantly been increased. On peak hours up to 12 routes/hour can be handled. Nowadays the yard Arnhem Berg is used by multiple train operators (regional railway operators and NS) servicing a number of corridors.



Figure 3. Yard Arnhem Berg

The picture in figure 3 illustrates the yard Arnhem Berg. Routes through the service installation are only possible when the warden of the service installation sets the installation to accept trains.

## 2.2 Combining station and yard

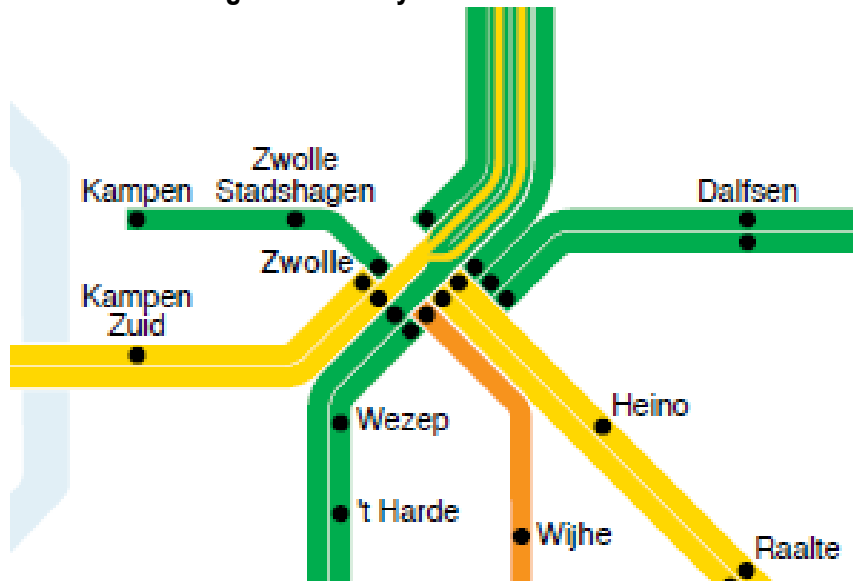


Figure 4. Multiple corridor transfer station with stabling facilities in the network

Consider the transfer station Zwolle in figure 4. It serves multiple corridors. Some of the corridors are nowadays dependent on each other. Goal is to unbundle the corridors. Also the relay based interlocking is replaced by an electronic interlocking. When combining station and yard the recommended approach is an integral approach, therefore adding remote control to the points for the dispatcher is simply not enough. A complete integration with the interlocking on the main line and integration of the yard service processes similar to main line is proposed, thus demanding a CBG<sup>1</sup> (centrally controlled area) solution for yards: controlled yards.

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<sup>1</sup> CBG is the logistical opposite of the Dutch abbreviation NCBG.

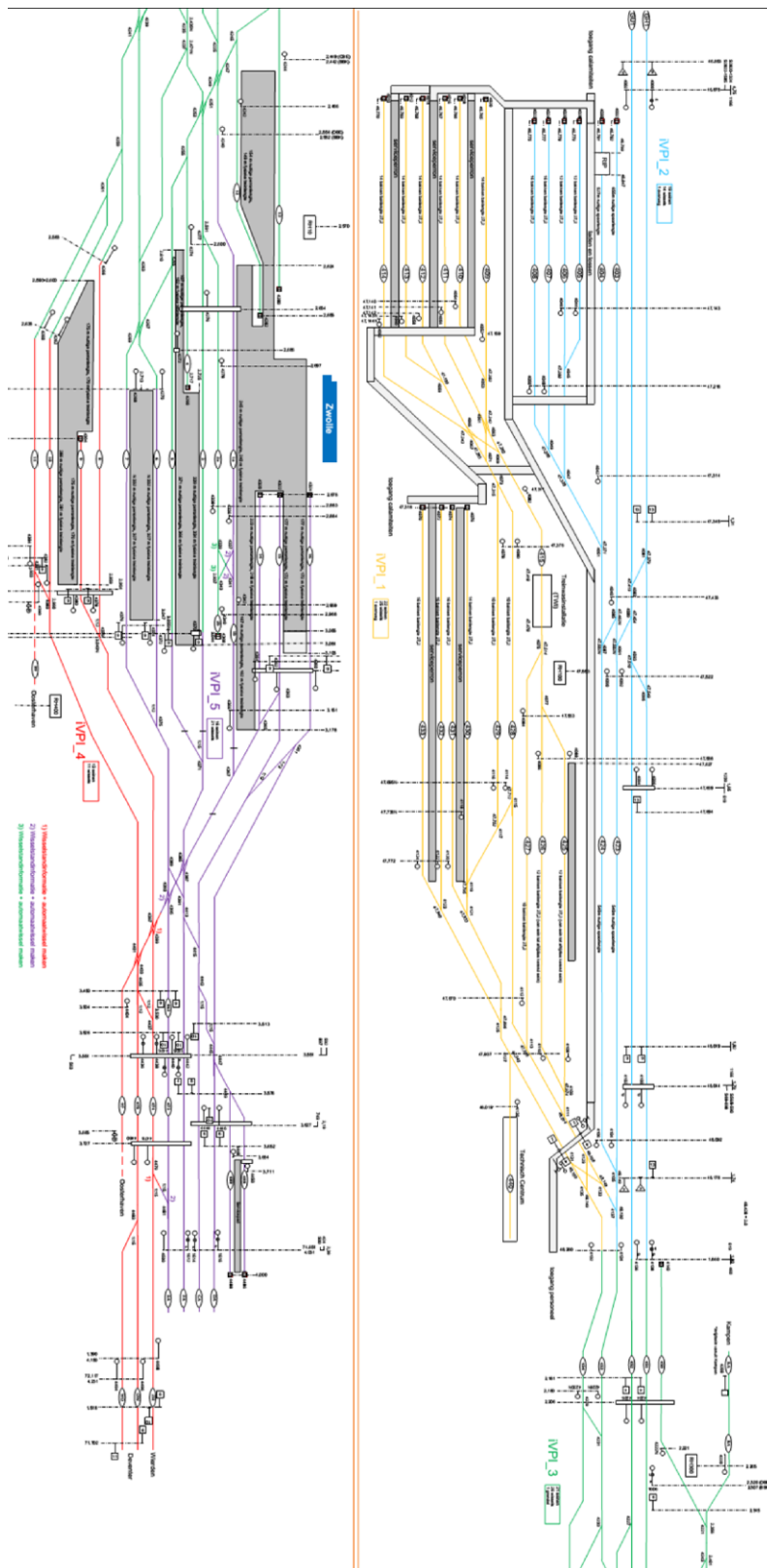


Figure 5. Work drawing previous figure decomposed in multiple interlocking areas

The detailed picture (figure 5) indicates different colours. Each colour represents an electronic interlocking area, this will be detailed in the paragraph “Multiple interlocking areas”.

Traditionally the structure was centrally oriented. The interlocking was located in a relay house and all of the equipment (points, signals) was directly coupled by copper wires to the relay house. Additional equipment for track vacancy proving is also centrally placed.

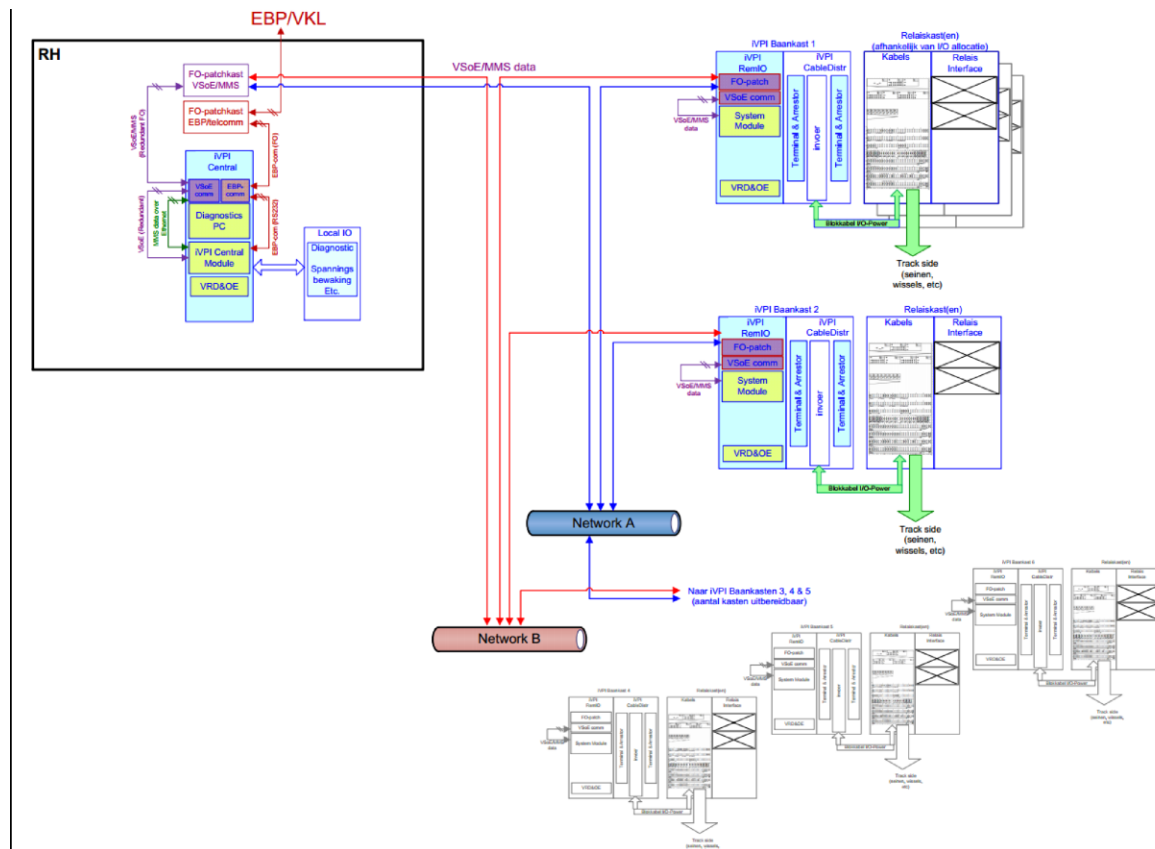


Figure 6. Decentralized interlocking architecture

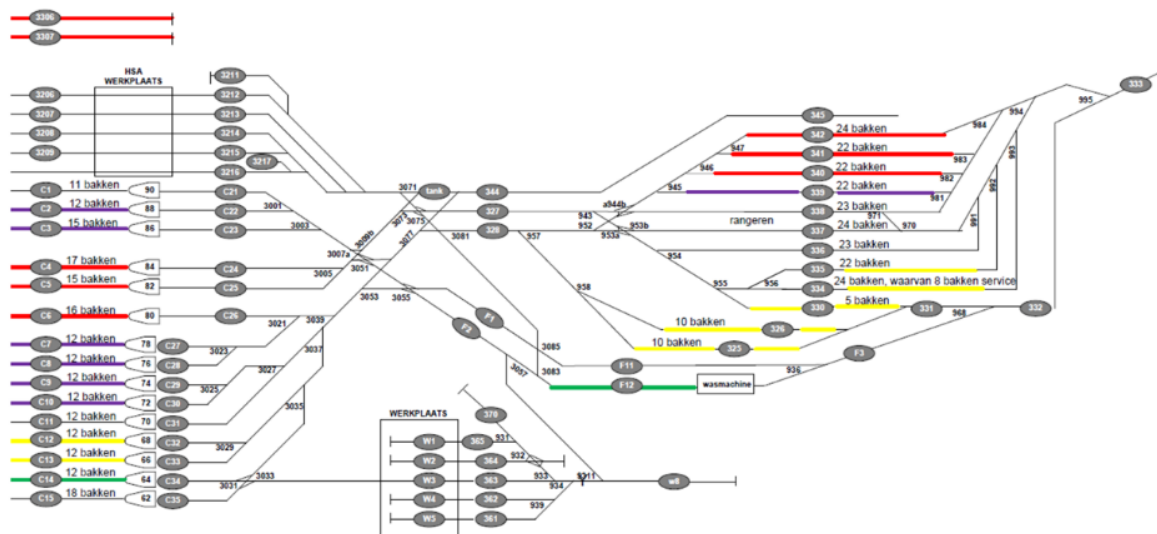
The decentralized architecture above enables the control of the interlocking by a central interlocking (in the rectangle box in the picture) which is connected by redundant optical links to a number of decentralized interlockings. Each decentralized interlocking can be located in a (smaller) relay house or cabinet combined with the local equipment (points, signals). This reduces the costs of copper wiring. The redundant optical links give the ability to improve the robustness. The central interlocking can be duplicated in a data centre, giving the ability to control the infrastructure from different places.

For operation there shall be no difference between routes between decentralized interlockings and within a decentralized interlocking. For controlled yards the same signals shall be used, preferably common colour based signals indicated in the Dutch signal system, although the signal follow up can be easily simplified, more on that later in this article. For LWA Yards there is a dedicated signal (white signal aspect) with a slightly different operational behaviour; furthermore on LWA yards the point direction is also indicated with a white arrow sign. Both the signal and the point indicator are visible in figure 3.

### 3 MULTIPLE INTERLOCKING AREAS

From a logistical perspective there must be no difference between routes within a decentralized interlocking area and for routes crossing multiple decentralized interlocking areas. The route crossing multiple decentralized interlocking areas often becomes the logistical bottleneck. For logistic reasons it is best practice to run these trains as fast as possible, offering the best permissive signals. When the infrastructure of the yard is redesigned and build these routes can benefit from speed optimizations. For legacy situations the speed is often limited and the distance of a route from the station to the yard and vice versa is often long, therefore these routes easily become a bottleneck. To minimize the bottleneck the entry of the yard is often a non-stopping area. To allow the

trains to run in non-stopping mode to the yard a prerequisite for route setting to the yard is the knowledge in advance that the yard is capable of receiving the train. For controlled yards equipped with an interlocking this is managed by the interlocking itself. For Yards equipped with LWA an optimized handshake protocol between the (neighbouring) interlocking and the LWA system is established.



Suppose the puzzle is solved it is very likely that the installation is in operation 24 hours a day, 7 days a week. In the rare cases that the installation is not in operation for its intended use it can be part of a resilience design that the tracks in the service installation can also be designed for normal train traffic (i.e. non-stop passing through the installation).

Another aspect of the logistic puzzle is to design and provide sufficient parking space that allows to buffer the trains when entering a service process or to buffer the trains when leaving a service process.

## 5 SIGNALLING ON YARDS

Braking distances on yards shall comply with mean deceleration levels for a regular service brake as defined in the TSI Rolling Stock Locomotives and Passenger Trains. Mostly yards do not have steep gradients. Due to the lack of steep gradients on yards and the fact that the mean deceleration level is much better than worst case trains the braking performance is better and thus permitting shorter distances between signals. Often yards are located in urban areas where available space is limited. Often between tracks a point is placed requiring a division of the tracks with signals. When using standardized points the total length of the point (for example point 1:9 approximately 40 meters) is larger than the braking performance of a modern passenger train travelling at yard speeds. Therefore it is possible to design a simple signal follow up, i.e. PROCEED, APPROACH, STOP without designing the long braking distances required for worst case trains. The simple signal sequence aids in simplifying driver and use processes of yards.

## 6 ACCESS CONTROL OF A SERVICE INSTALLATION

On top of the normal operation on yards, there can be certain service installations that demand the warden of the service installation to block access to the service installation. Commonly when the service installation is idle access to the service installation is blocked. The most preferred situation is a point that is excluded from regular route setting and turned into a direction leading away from the service installation, unless the warden of the service installation grants the proper rights to perform the route setting. In the past a number of different approaches (as illustrated in the Figure 8 on the left) have been implemented on yards, all with benefits and drawbacks. The preferred situation (Figure 8 on the right) has been developed in the yard Arnhem Berg and has proven a major step forward in simplifying access control to service installations.



Figure 8. Left: manual operated point with mechanical lock, Right: electronic key box for remote controlled point

Of course, the simplified access control is secured in the user procedures for the service installation.

## **7 CONCLUSION**

Yards fulfil an important function from a logistical perspective in the network. The demand for service locations, logistical improvements and growth in the network demand a remote controlled solution for points and routes on the yard. For drivers the routes are signalled with a simple signalling system. Interlocking systems fulfil that demand offering the opportunity to integrate the yard control in the main infrastructure network and therefore the yard system will benefit from common achievements, such as ease of use (control layer is equal to the rest of the network) and security (interlocking network secured).