1. Classification of nodal objects on lines
2. Expedition points
3. Operational points
4. Stations of various types

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Two kinds of service are required to safely transport goods and passengers:
- traffic control and manoeuvring – this work is done by traffic control points,
- receiving, sorting and delivering of goods and an attempt to the service for passengers – that’s job of expedition points.
Main duties of the expedition points are:
1) **loading and trade operations**: receiving of cargo (preparing documents, fares, sanitary customs etc.), loading, unloading, giving the goods to the addressee;
2) **passenger service**: getting on, getting off, fares, luggage receiving and giving, loading and unloading the luggage and mail;
3) **technical duties**:  
   - reception, sending and letting the trains to pass through,
   - shunting and combining trains, technical and trade inspection of carriages,
   - locomotive and crews exchange, placing and taking off the carriages from and to the loading points,
   - weighing, controlling of loading gauge and clearance of carriages,
   - other duties related to trains traffic or manoeuvring.
Passenger stop is an expedition point dedicated to service the passenger traffic. Its equipment are platforms, shelters, sometimes a building with waiting-room and ticket office.

On single track lines usually 1 platform is built (a), and on double track line 2 platforms are built on outer sides of the tracks (b) (especially on busy lines) or one 2-sided platform on the widened space between tracks (c). Access to the platforms, depending on the intensity of traffic, is designed as a grade crossing, in form of an underpass (e) or a footbridge. In case of the grade crossing the best location is at the end of the platform – it is possible to cross the track when occupied by the train (b).

Passenger stops are located together with diverging posts, block posts, siding posts and shield posts. In case the passenger stop is located at a grade crossing for road traffic it is recommended to design platforms on both sides of the road to avoid stopping across the grade crossing (d).
Loading point is a place designed for receiving and sending of cargo packed into freight carriages. It is equipped with a loading track linked to a regular line on one or on two sides. In case of more busy loading point a communication track, a subsidiary track or an additional loading track is designed linking the point with a warehouse and a stack yard. On a double track line the loading point is linked with the main line, what enables service from both sides but requires a diverging post at the main line.

The function of the loading point can be played by a siding operated by its owner. It is a system of commercial tracks, rooted in side station tracks or (seldom) from a main line. The siding should be equipped with a trap points securing the main line from the carriages freely rolling down from the siding.
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Traffic control points control the train traffic, ensuring safety and capacity of the line. There are following categories of the posts:

- **order control posts** – play the main role in setting the order of trains on the adjoining section or block obeying the rules of block signalling. They are equipped with semaphores.
- **auxiliary posts** – control entering and leaving of a siding.
- **shield posts** – serve for traffic securing in dangerous points: in a grade crossing of two lines, in a crossing of a railway line with a tram line, in change point of double track into single track line, in a section of gauntlet track etc.
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Operational posts

Traffic control posts
- Order control posts
- Announcing posts
- Block posts
- Siding posts

Auxiliary posts

Shield posts

Passenger stop

Loading point

Siding

Expedition posts

Stations

Diverging posts
**Order control posts**

**Block post** divides a route on blocks. On every block can be another train what increases the capacity of the line. This post is equipped with semaphores dependent on the Automatic Block Signalling system (one semaphore for each direction and each track). Decisions are taken by announcing posts, the block posts and the siding posts execute only the orders.

**Siding post** is designed at the divergence of the siding track from the main line when controlling the traffic in this spot by an announcing post is difficult due to the distance. Basically, like the block post, it doesn’t take part in deciding but when serving for trains coming from the siding it plays the role of announcing post.
Two kinds of service are required to safely transport goods and passengers:
- traffic control and manoeuvring – this work is done by **traffic control points**,
- receiving, sorting and delivering of goods and an attempt to the service for passengers – that’s job of **expedition points**.
Announcing post enables additionally controlling of the trains order.

Diverging post is designed in a place of joining of two lines or diverging one line from the main line as well as where the main tracks of a line merge. Sometimes also can serve siding branch tracks.

Station is an announcing post with at least one subsidiary track beside the main track. It enables trains crossing (when coming from opposite directions), overtaking as well as starting and finishing of the travel.
In fact station plays joint functions of an expedition point and an order control post. The main elements of station are:

• track layouts,
• posts: control tower (master) and signal boxes (slave),
• technic equipment (objects and devices for freight and passenger service),
• auxiliary objects (locomotive shed, car workstates etc.)
Criterion – location on line:
• terminus – existing on the beginning or on the end of railway line; such stations have reversal track layout,
• junction – in crossing of at least 3 lines; such stations can have a fork-like, cross-like and mixed track layout,
• through – existing between main junctions (nodal stations); such stations have a passing-through track layout.
Railway station as a junction

In the vast majority of cases, merging and diverging of lines takes place at stations. Large cities use a number of cooperating stations which have a different purpose.

This large station on the previous slide (Newcastle upon Tyne) merges more than four primary directions of railway lines, two of them (to the left in front of and behind the station) in most difficult spatial conditions due to river crossing. Lack of space resulted in one level junction as the only solution possible.
The last example of a terminus station in Wroclaw is the Świebodzki train station, formerly Freiburger Bahnhof. Due to the track arrangement the reception hall is as close to the Old Town as possible.
A photograph taken some 90 years ago shows this station from northern east. The middle part of the building is a later addition to the side wings, as a different concept of train traffic was introduced.
The termini of Moscow are still present in the landscape of the city, even though they are now all joined with a circumference tracks.
A scheme showing the interchanges between stations.
No more views like this are possible. All the connecting tracks running through city streets were removed due to urban traffic increase and moved to the outskirts.
Oversized junctions disintegrate urban surroundings

Frankfurt am Main Central Station
Large termini like in Leipzig or Frankfurt am Main occupy vast amount of precious urban space. Through stations are much more efficient due to fewer shunting needs.
Often originating from termini, through stations became vast majority because of much smaller number of platforms required to accommodate the same number of trains, incomparably less shunting work and easy changing of direction.
Bremen, Germany: large through station with almost perfect connection to the city transport network due to short distances to the stops and high accessibility.
Track layouts of stations:
- **through** (a, b, c),
- **terminus** (d, e).
Criterion – size & functions:

a) passing siding – enables trains crossing when running from opposite directions or trains overtaking when running in the same direction with different speed,

b) small station – serve passenger and freight traffic in towns smaller than 20 000 habitants between junction stations,

c) medium stations – serve passenger and freight traffic on dedicated tracks in towns between 20 000 and 100 000 habitants,

d) big stations – serve passenger and/or freight traffic on specialized track groups or on separate stations in big cities over 100 000 habitants.
"Passing siding" vel "crossing loop" enables trains crossing when running from opposite directions or trains overtaking when running in the same direction with different speed. It should have at least one subsidiary track. At traffic intensity over 12 train pairs per day at least 2 tracks and in case the siding is built close to junction station - 3 tracks should be designed. On double track line for each direction one additional track for overtaking should be provided and links enabling change the track on the opposite.

- line capacity
- track minimum length
- semaphores: a – entering, b – exiting
- running directions
Every track layout should enable connections between main line tracks and all station facilities, also in case of double track main line switching between tracks is needed. So not only the passing loops are important but also the distance in between.
Small station

It has one track group for passenger trains and one – for freight trains. Usually there is 1 main track and 2 subsidiary tracks on single track line a) and 2 main tracks and 2 subsidiary track on double track line b). One or two side tracks and a dead end track facilitating shunting is required. It is equipped with a buffer stop and its length should exceed ½ length of a freight train.

Transverse layout

a) Single track line
b) Double track line

Longitudinal layout

1. The main track
2. The freight/passenger subsidiary track
3. The freight/passenger subsidiary track
4. The put-aside track
6. Loading track
8. The dead end track
10. The run-off track

Loading track opposite to the station building

1. The main track
2. The freight/passenger subsidiary track
3. The freight/passenger subsidiary track
4. The put-aside track
6. Loading track
8. The dead end track
10. The run-off track
Duties of a small station:
- Crossing and overtaking of trains
- Passengers handling (+luggage, mail, tickets)
- Shunting cars

Basic equipment
- Main, subsidiary and side tracks
- Station building
- Passenger platforms
- Passenger footbridges or tunnels, if required
- Warehouse for storage, loading ramps and yards
- Signalling and control devices
A typical track layout of a small station. Following elements are depicted: station building, platform, signals and signalling tower, turnouts and cargo handling facilities. Each signal, turnout and other traffic control device is given an individual number or description.
These illustrations depict typical layouts of small size stations. From a track length, operation and compactness point of view, all of these are optimal in one way or another.
A view of a small station. This station on a narrow gauge single track line is dedicated to passenger traffic, hence the quite large number of platforms and no cargo bays or other equipment. Note the coordination of train and bus timetables. Passengers can easily change mode of transportation.
This tiny station was built in a very limited space between a mountain slope and a deep river gorge. Main parts of this station are spread apart: passenger platforms are visible right ahead, cargo warehouse is to the left and a depot is hidden behind the trees on the other bank of the river.
A more complex track layout. Typical one-sided station with platforms on the main line tracks, and freight subsidiary tracks to the right. Signs and signals of various kinds can be seen here.
Medium station

It can arise from a small station as a result of developing of the basic track layout. When at least 2 lines merge in the station it is a medium junction station. Characteristic property of the medium station is separation the subsidiary track for freight and for passenger trains and its specialization. Basic types of layout are transverse and longitudinal.

- tracks numbering
Duties of a small station:

- Crossing and overtaking of trains
- Passengers handling (+luggage, mail, tickets)
- Shunting cars
- Loading, unloading and storage of cargo
- In some cases – rolling stock maintenance

Basic equipment

- Main, subsidiary and side tracks
- Station building
- Passenger platforms
- Passenger footbridges or tunnels, if required
- Warehouse for storage, loading ramps and yards
- Signalling and control devices
It is a station serving for one kind of traffic only and consists of a few specialized track groups or even separate stations creating a junction.

The subsidiary freight track are split from the main line before the passenger station and on the passenger station the tracks for regional and intercity traffic are split too.

The station is intended for mutual reception and sending trains from various directions, for exchange of locomotives and crews, building and decomposing trains and for preparing the passenger trains for service.
Passenger station equipment

- Station building
- Audio-visual information system
- Underpass and elevator
- Grade crossing
- Footbridge
- Platforms and shelters
Freight station equipment

- Warehouse
- Loading ramp
- Loading yard
- Gantry crane
- Attempt road
- Container transporters
Stations - classification (3)

Criterion – operations (usually apply to big, specialized stations):
- marshalling
- loading
- transshipping (port, airport)
- parking
- passenger
- freight
- mixed freight-passenger
Its main task is combining of freight trains from marshalled, selected cars coming from various directions or delivered from local loading points and intended to go together to the prescribed destination.

Basic duties of the marshalling yards are:
1. Reception of the train.
2. Preparation to marshalling.
3. Cutting the train on selected car groups and directing on separate tracks according to the intended direction.
4. Accumulation of the cars coming from various trains.
5. Putting the cars in order and combination of new trains.
6. Sending the trains from the departure group to the destination stations.

P – reception group, G – hump, K – classification & accumulation group, O – departure group
There are 3 types of marshalling yards:

1. **Plateau yard without hump** – shunting an marshalling is performed by means of locomotive which pulls or pushes cars on selected tracks.

2. **Plateau yard with hump** – the cars are pushed on a artificial hill (a hump) and propelled by gravity run down on classification tracks where are braked by retarders.

3. **Ramp yard** – whole length of the yard is sloped and shunting is done by gravity. It exists quite rarely due to the specific terrain requirement.
Loading station serve for goods loading and unloading from/to warehouses and loading yards. In case of **transhipping station** – for goods loading from/to road/air/water transportation means to railway cars. The stations can be specialized to serve in bi-modal /intermodal systems according to specific technology. Transhipping stations are also built on borders of different railway gauge (e.g. PL/RUS).

Typical station consists of reception/departure track groups, loading group, sometimes it cooperates with a marshalling yard.
Container station

Specific type of loading station specialized in container management, stacking, loading and transshipping from/to:

a) road transport, b) air transport, c) sea transport.

PO – reception group
O – put-aside tracks
Ł – loading group/tracks
PŁ – loading yard
UŁ – gantry crane track
S – gantry crane
W – dead end track
Big passenger stations are often combined with a parking station, where passenger cars are prepared for service, maintained, repaired, cleaned, refilled with water etc. Sometimes the service is performed on parking track group on the passenger station.

Schemes of parking stations: a), b), c) with a loop, d) with a sharp reverse track