# Suburban Commuter Rail System

# S-Bahn

# Chongqing - Tongliang Testline

**Beijing in September 2015**

# Content

- Aim of the Feasibility Study
- Historical Background
- Special Features of German S-Bahn
- Tongliang Testline
  - Line Schemes
  - Passenger forecast and operation concept
  - Civil works and stations
  - Technical issues
  - Vehicles and equipment
  - Vehicle marshalling, workshop and depot
  - Construction planning, investment costs
- Economical evaluation and suggestions

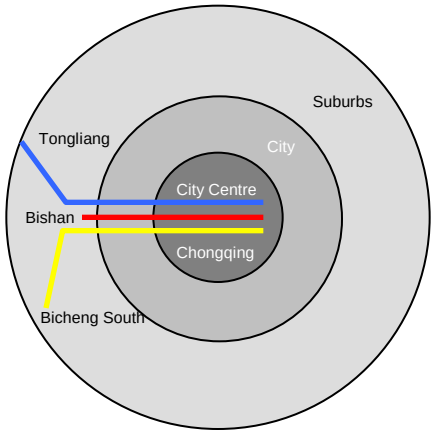
# Aim of the Feasibility Study

- Introduce the concept of the German S-Bahn in China
- Verify the feasibility of the Chongqing-Tongliang Testline (S-Bahn)
- Advise CRT on the most suitable S-Bahn concept (technical, operational, financial) for the introduction of such an S-Bahn
- Apply the advantages of the German S-Bahn system to the Tongliang Testline, addressing the local particularities and requirements for the most efficient project implementation
- Lay the foundation of the Chongqing S-Bahn network system with the Tongliang Testline
- Facilitate the implementation of the project
- Prepare & support a nationwide promotion of the S-Bahn concept introduced by CRT

# German S-Bahn Historical Background

- About 100 years ago, cities were looking for electrically powered railways with high capacity but more reasonable investment costs than the metro
- S-Bahn stands for Schnell-Bahn (German for „fast-railway“), which is supposed to link suburban areas and city centers with a direct access
- The trains should not necessarily comply with the mainline railway standard but be able to share tracks and stations with the railway when running outside of town
- Most of urban public transport systems are DC-traction powered. Since energy efficiency of AC-Systems for traction is now a requirement, dual-traction power systems were introduced within the last 20 years. Particularly, the Hamburg S-Bahn system has the greatest similarity with the case of Chongqing today

# S-Bahn Key Features




- S-Bahn connects suburban areas with city center
- Run-through operation, sharing infrastructure with other mass transit and main railway lines
- Limited investment, limited operation cost, starts with moderate passenger demand in suburban areas with the potential to deal with increasing demands later on
- S-Bahn can cope with high demand in city center similar to mass rapid transit system (metro)

# S-Bahn Systems in Germany

## Sharing Tracks with metro and mainline railway

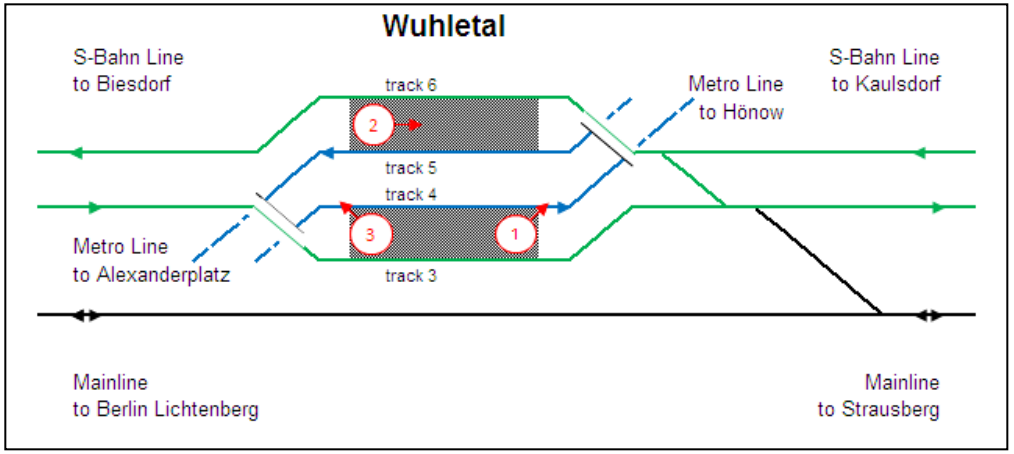

Germany's S-Bahn trains

- share tracks with mainline passenger trains, freight and private passenger trains
- use the same signalling and operation control system

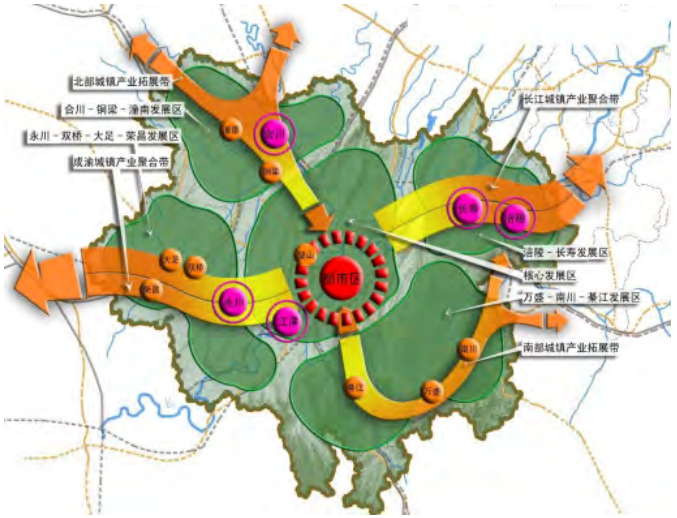
# S-Bahn Systems in Germany

## Sharing Infrastructure with metro and mainline railway




# Why Tongliang Testline (S-Bahn)?

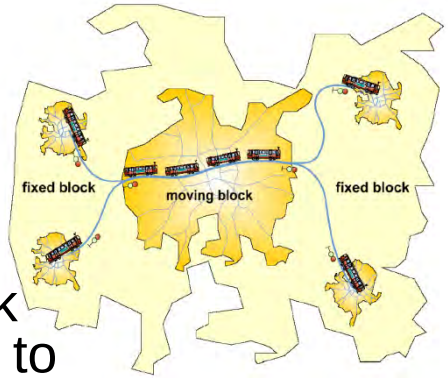



- Chongqing is one of China's major cities
- Chongqing becomes the economic center of Yangtze River in 2020
- Chongqing's development focus is the "one hour economic circle"
  - Connecting the main urban center with development nodes of the suburban area
- Tongliang is the only county within the “one hour economic circle” without railway connection to Chongqing
- Extension of the existing Metro to Tongliang is not reasonable
  - Long distances, high investment costs, low speed, passenger demand
- S-Bahn is the right solution
  - Multifunctional use of rail infrastructure
  - Promoting the idea of high demand in city center but lower demand and lower investment costs in the suburban area

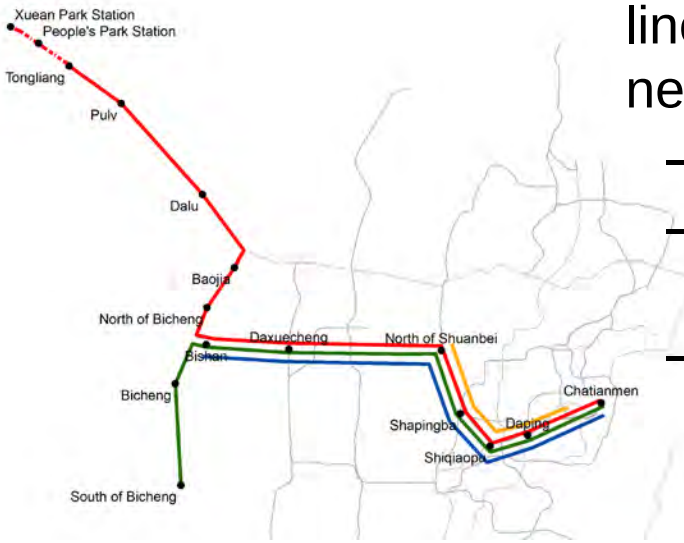
# S-Bahn System

## Low Investment, Low Operation Costs

- More energy efficiency due to change from DC to AC traction power
- Low investment due to signalling system extension (change from moving block to fixed block system)
- Alignment at grade
- Flexible operation mode due to dual power rolling stock (some trains terminate in Bishan, some trains continue to Tongliang)
- It is recommended to extend the existing Metro line 1 OCC to integrate the Tongliang Testline (S-Bahn) from Bishan to Tongliang
- The OCC shall integrate all features currently installed within the SCADA-system as well as within the environmental control system

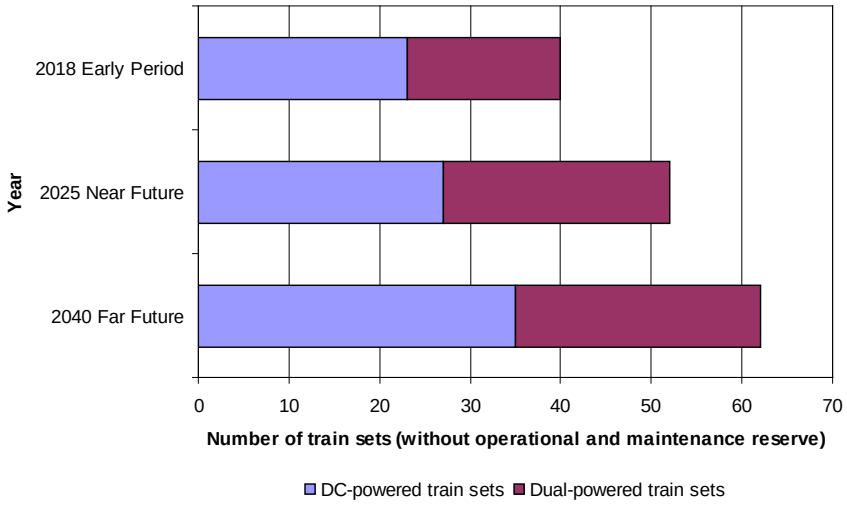


# Mixed Train Operation



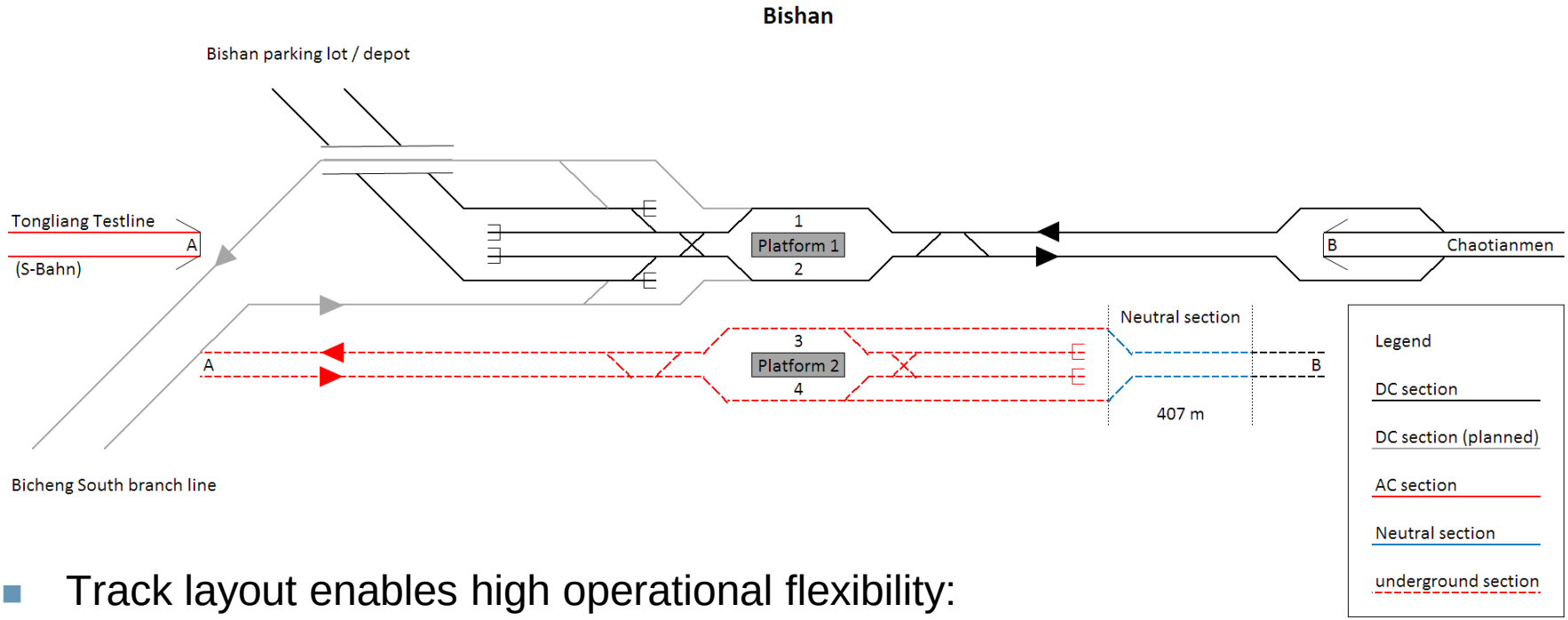

- Run-through operation and overlay of 3 lines will create the basis of the new S-Bahn network:
  - Bishan – Chaotianmen (DC-only, Metro 1)
  - Tongliang – Xiaoshenzi (Dual-powered, Tongliang Test Line S-Bahn)
  - Bicheng South – Chaotianmen (DC-only, Chengnan Branch)

The run-through operation starts with 17 train sets equipped with the DC/AC dual-power traction package.
In far future 27 dual-powered train sets will be required.



# Station Design Bishan

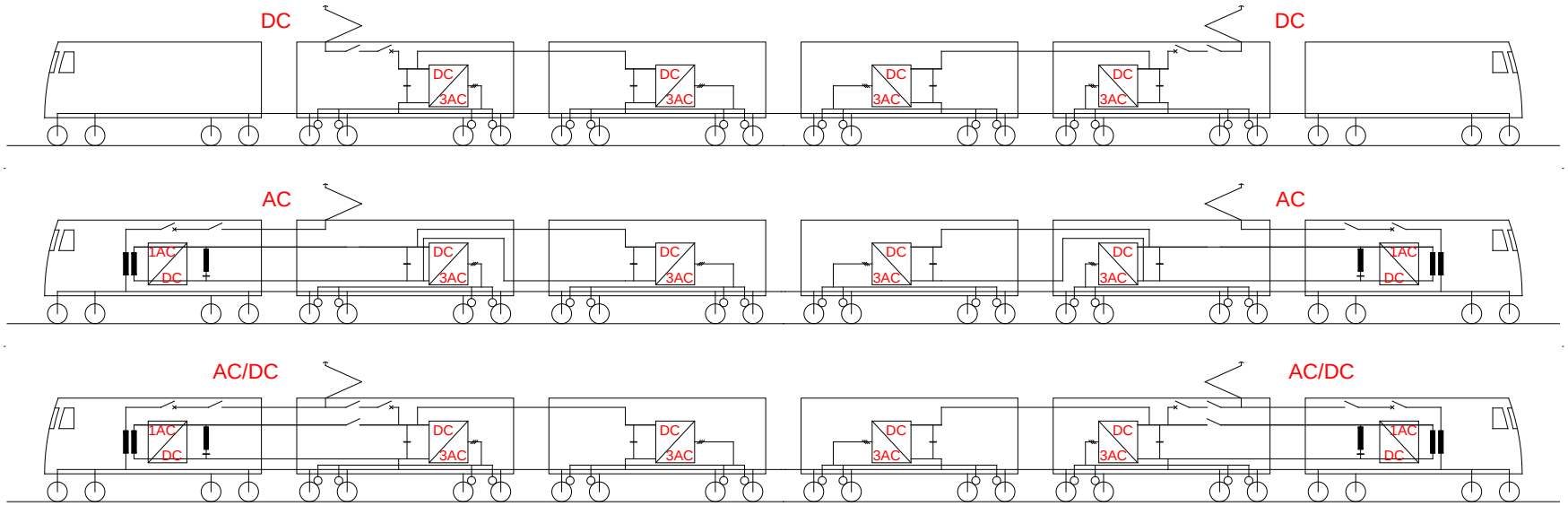
## Station Design Track Layout (two levels)



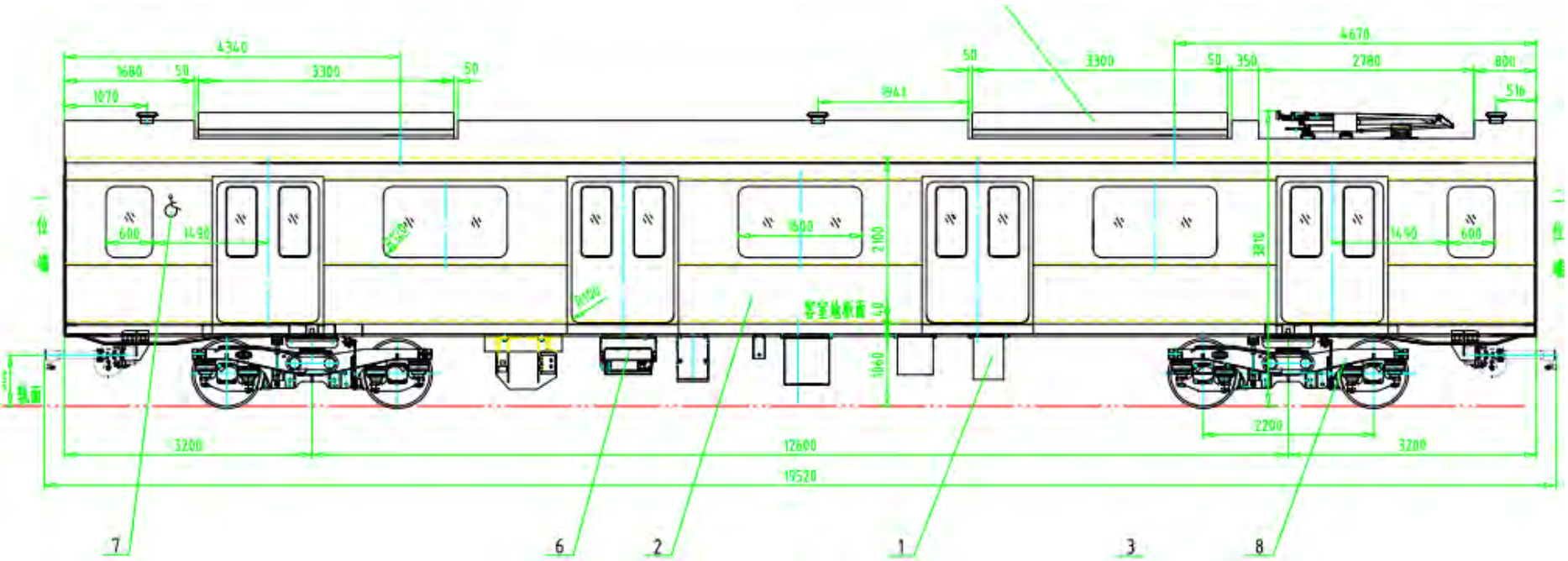

- Track layout enables high operational flexibility:
- Separate operation and reversing of 1,500 V DC and 25 kV AC trains
- Run-through operation from the Metro Line 1 section to Tongliang
- Reversing on platform in case of operational disturbances by using track connections in front of the platforms
- Independent operation of trains in the depot area (depot access tracks separated from reverse and stabling tracks)

# Rolling Stock

## Modular concept for DC (Metro), AC, and AC/DC trains

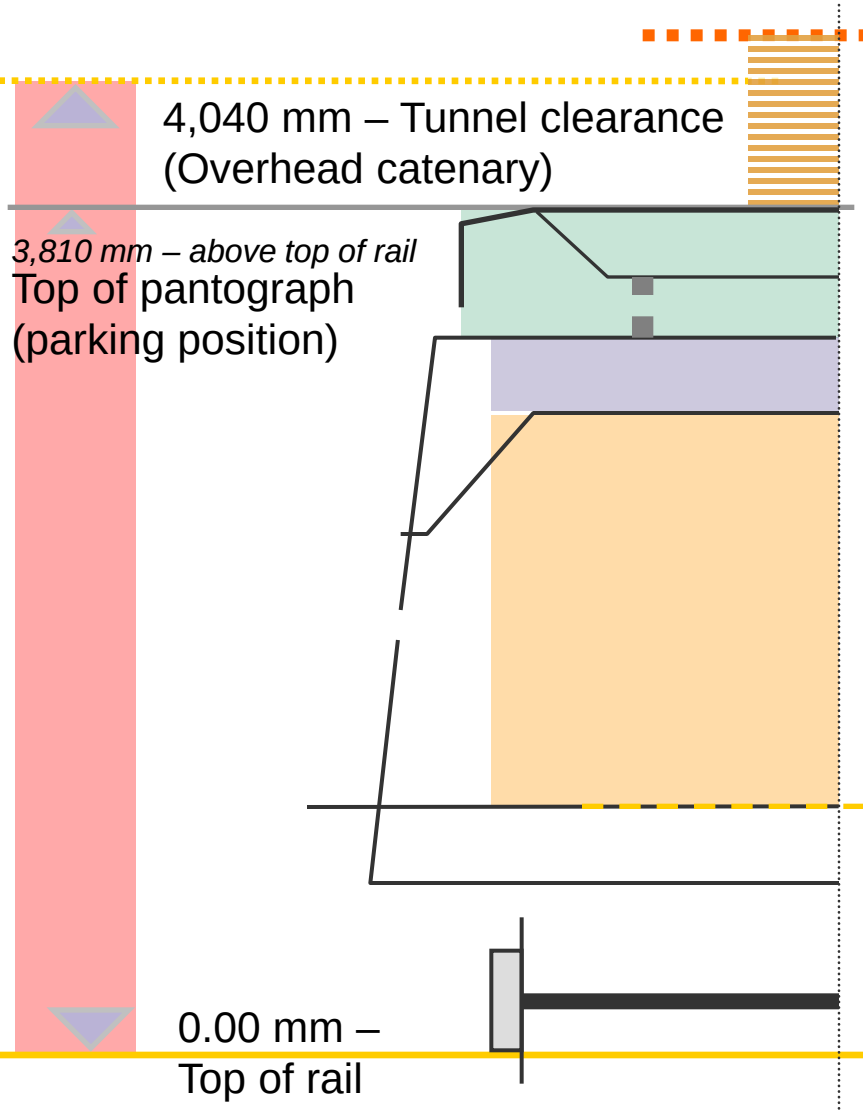


# Metro type „B“ car Chongqing Line 1




Status quo situation of Motor car with Pantograph (1.5kV DC)

# Vehicle Gauge vs. Tunnel Clearance




*4,140 mm – above top of rail*

Top of Chinese pantograph (working position 230 mm above parking position for 25kVAC)
➡100 mm in excess of tunnel clearance

**Options** for reduction of height excess:

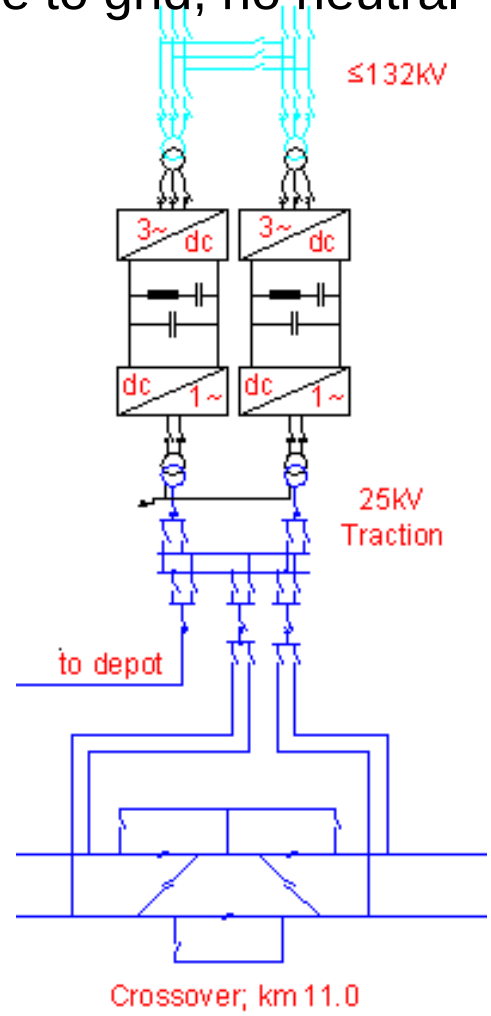
- Application of pantograph with lower lifting height above parking position in working position (<230mm)
- Application of pantograph with lower heigth in parking position
- Reduction of construction height of roof/ceiling (e.g. ventilation ducts)
- Lowering of car-ceiling in area of roof slot for pantograph

*1,100 mm – above top of rail*

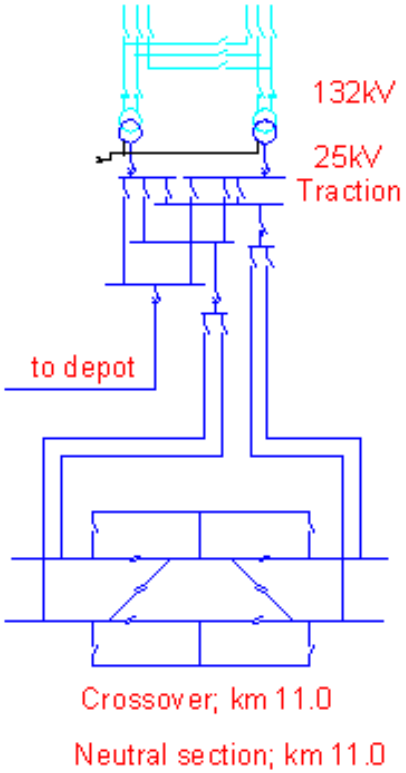
Top of floor

# Traction Power Supply

Innovative 3AC -1AC inverter traction power substation (low interference to grid, no neutral sections)



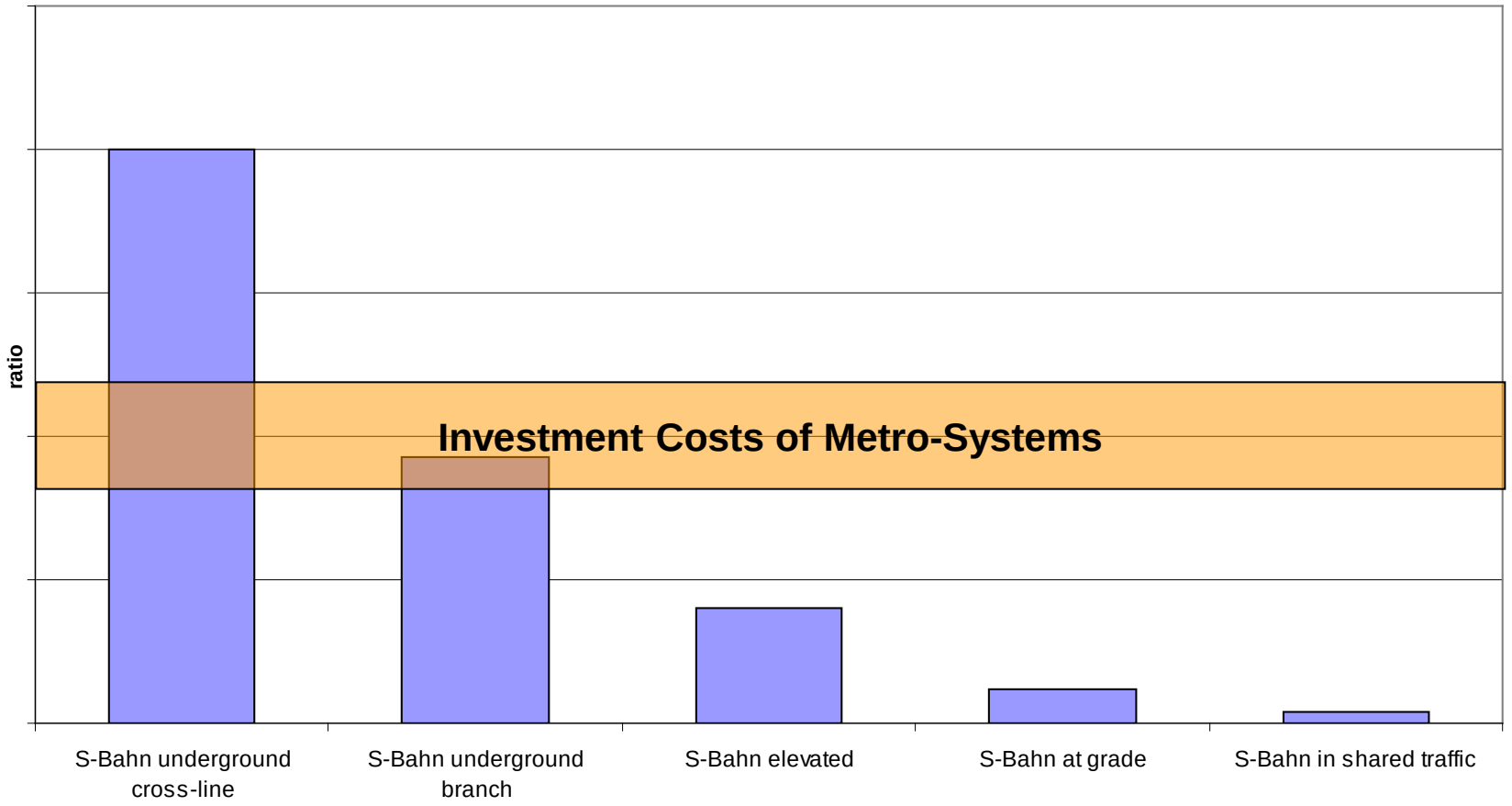

Standard transformer traction power substation in V-connection (low cost)



# Infrastructure Investment Costs (European Standard)

Comparison of investment costs (per km):

- S-Bahn infrastructure (double track line) vs. Metro infrastructure



# Parking Facilities

- The operator shall build & operate parking facilities at the stations
- Providing car parking facilities for Park and Ride (P+R) services
  - increases the catchment area of the S-Bahn system
  - will help to limit cars entering the CBD
- Land adjacent to stations shall be linked to CRT
- The distribution and pricing of the parking facilities should be integrated into the S-Bahn fare system


# Investment

- The total investment is
  4.154 billion RMB (500 million Euro)
- The benchmark figure for Tongliang Testline is around
  129 million RMB per km
- Even if one assumes a cost increase of 20%, the total cost are more reasonable than those of LRT (300 million RMB per km ) or Metro (500 million RMB per km) systems
- The estimation does not consider cost for civil structures and land acquisition:
  - Bishan station accounted to Metro line 1.
  - The government of Tongliang and Bishan county has declared to finance the civil structure cost for the stations of Tongliang, Polv, Dalu, Baojia and cost for the land

# Tongliang Testline (S-Bahn) is financially viable

- Calculation of Net Present Value (NPV) and Internal Rate of Return (IRR) from the viewpoint of the operator CRT
- Using cost and revenue cash flow streams
  - Tongliang Testline (S-Bahn) investment costs (CAPEX)
  - Tongliang Testline (S-Bahn) operating and maintenance costs (OPEX)
  - Fare box revenues are derived from the travel demand forecast
- Discount rate: 4.6%
  - Represents terms and conditions of promotional loans granted by KfW Bank.
- The NPV is 353.9 mn RMB, the IRR is 5.37%.
  - CAPEX may increase up to 9.3% to achieve a positive NPV.
  - Even if the ridership is 8.6% less than the forecasted patronage, the financial viability remains ascertained.
- The major portion of the revenues must be used to repay the loans

# Find us here!

**Tilo Franz, Managing Director**
HC Hamburg-Consult GmbH

phone +49 178 / 78 45 514
email t.franz@hamburg-consult.de

**www.Hamburg-Consult.com**

HC Hamburg-Consult

Smarter Mobility


ASIAN PUBLIC TRANSPORT
NEWS CHANNEL
亚洲公共交通新闻频道
PUPLIC TRANSPORT NEWS FOR: CHINA + HONGKONG + TAIWAN + MACAO + NORTH EAST ASIA + SOUTH EASTH ASIA + SOUTH ASIA + AUSTRALIA + NEW ZEALAND