INTELLIGENT SIGNALLING SYSTEM

Solutions and Integration Service Provider

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Traffic Control Technology Co., Ltd.

Contents

About Us

Traffic Control Technology Co., Ltd (TCT) is the most innovative industry player in China market. We are the first Chinese Communication Based Train Control (CBTC) and GoA 4 Fully Automatic Operation (FAO) signalling system provider.

TCT has deployed signalling systems for 65 lines, cumulated mileage 2612 km. We are currently the number one urban transit market player in China.

As renowned industry innovator, TCT invests heavily on R&D. Our strong R&D team allows our continuous innovation on world leading technologies, such as I-CBTC signalling system, vehicle-to-vehicle communication system, breakthrough CBTC application on heavy haul railway, as well as our AI-based train intelligent detection system.

Being customer centric is TCT' s strategic priority. We are committed to maximize customer value by providing tailor made system solutions.

TCT' s products cover both construction and operation for the whole life cycle.

TCT was selected as one of the first 25 high tech companies to be listed on China' s STAR Market technology innovation board in 2019.

31 Cities **65** Lines Accumulated operating mileage **2612** km, equivalent to the total mileage of the world top **4** urban rail networks.

Hanoi, Vietnam
Cat Linh - Ha Dong Line

Beijing
Metro Yizhuang Line
Metro Changping Line
Metro Yanfang Line
Daxing International Airport Express
Metro Line 5
Metro Line 7
Metro Line 11
Metro Line 13A & 13B
Metro Line 14
Metro Line 16
Metro Line 17
Metro Line 19
Metro Line 28

Shenzhen
Metro Line 7
Metro Line 10
Metro Line 12
Metro Line 13
Metro Line 14

Tianjin
Metro Line 6 Phase 1 & 2
Metro Line 7
Metro Line 8
Metro Line Z4
Metro Line 10

Foshan
Metro Line 2

Chongqing
Monorail Line 3
Metro Loop Line

Hohhot
Metro Line 1

Suning
Shuo Huang Railway Renovation Project

Changsha
Metro Line1

Xiamen
Metro Line 3

Luoyang
Metro Line 1

Dalian
Metro Line 3
Tram Lushun Line

Shijiazhuang
Metro Line 2
Metro Line 3

Guiyang
Metro Line 1
Metro Line 2

Nanning
Metro Line 4
Metro Line 5

Taiyuan
Metro Line 1

XI 'an
Metro Line 5

Zhengzhou
Metro Line 3 Phase 1 & 2

Shenyang
Metro Line 4 Phase 1

Urumqi
Metro Line 1
3 Stations and 2 Sections

Qingdao
Metro Line 13

Jinan
Metro Line R2
Metro Line 4
Metro Line 8

Hefei
Metro Line 5

Ningbo
Metro Line 4
Ningbo-Xiangshan Urban (Suburban) Railway

Suzhou
Metro Line 6

Hangzhou
Metro Line 10
Hangzhou Deqing Regional Rail

Dongguan
Metro Line 1

Chengdu
Metro Line 3
Metro Line 5
Metro Line 8
Metro Line 13
Metro Line 27
Metro Line 30
Metro Ziyang Line

Wuhan
Metro Line 5

Quality Prover Safety Assurance International Standard

Our Product Meets These International Certifications:

Achieved IRIS Management System Certification which complies with IRIS Revision 02.
Achieved Quality Management System Certification which complies with ISO 9001:2008.
Achieved ISO 14001 which complies with ISO 14001:2004.
Achieved OHSAS 18001 which complies with OHSAS 18001:2007. *IRIS - International Railway Industry Standard.
Achieved ISO 14001 which complies with ISO 14001:2004.
Achieved OHSAS 18001 which complies with OHSAS 18001:2007. *IRIS - International Railway Industry Standard.

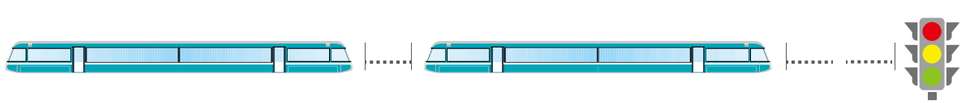
Redundant ATO system (model: ATO-500) has passed the Lloyd's railway safety assessment and reached the Safety Integrity Level (SIL) 2.
Interlocking System (model: TCT-TI-FLOCK-200) has passed the Lloyd's railway safety assessment reached the Safety Integrity Level (SIL) 4.
ATP system (model: LCF-500) has passed the Lloyd's railway safety assessment and reached the Safety Integrity Level (SIL) 4.
ATS System (model: TICS-300) has passed the Lloyd's railway safety assessment and reached the Safety Integrity Level (SIL) 2.

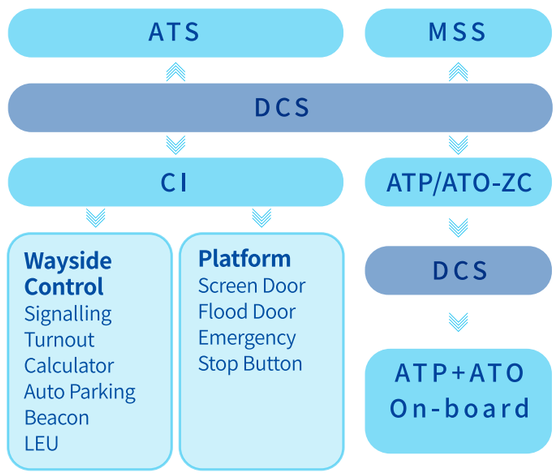
TCT’s CBTC Solution

Zero system failure led delay for more than Five-Minutes

Systems adhere to European standards.

IEEE 1474 for CBTC
IEC standards for safety: IEC 62278, IEC 62279, IEC 62245, IEC62280
CENELEC : EN50126, EN50128, EN50129



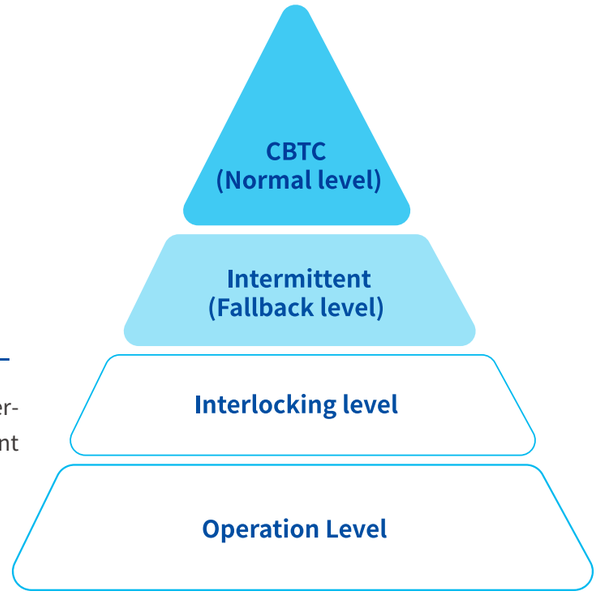


Moving block

design headway up to

90 seconds

Our flexible system design is configured via different levels, can be customized to meet different customer needs.



Features

- Operation accidents: 0.
- High system reliability and the lowest average operation failure in the industry.
- Customized solutions.
- Prompt and responsible customer service.
- Localized technical support and spare parts supply.
- 100% on-time delivery.

signalling system solution 55 lines / 30 cities

over 2017 km

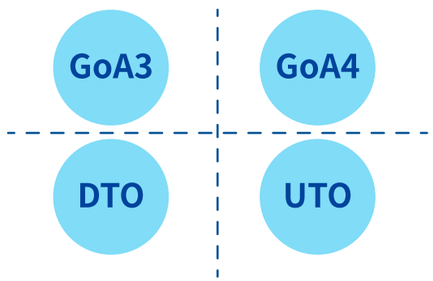
Fully Automatic Operation System（FAO）

Pioneer of Intelligent Transportation in China

- Compliant with IEC62267 and IEC62290 100% compliant with 236 mandatory requirements.
- Additional 61 optimized functions achieved.
- Follows IEC62267 and IEC62290 standards.

TCT’s FAO system can realize various automatic functions:

- Power on for rolling stock
- Self-diagnose
- Operation in depot
- Operation in main line section
- Stop in station and dispatching
- Back to depot
- Dormancy power down
- Washing automatic control



Safe and reliable **Flexible operation** **Energy conservation**

Safe and reliable
Flexible operation
Energy conservation

Features

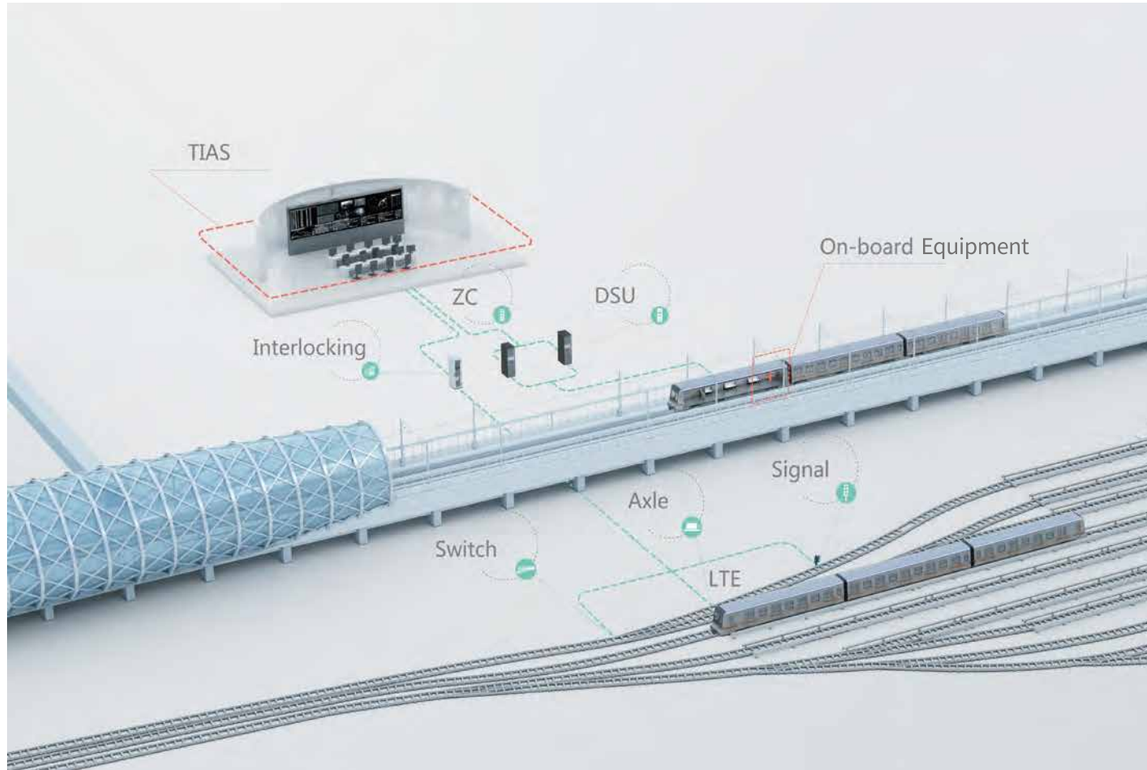
Train traffic control oriented integrated automatic system (TIAS):

- Integrates and optimizes various related systems such as ATS, trains, monitoring, broadcasting and CCTV, etc.
- Uses LTE to cluster burden multi-specialty data.
- Saves more than 33% of manpower compare to CBTC.

Yan Fang Line Operation Performance
(30/12/2017-30/04/2019)

Indicator	Unit	Benchmark	Actual Performance	Performance Achieved (Yes/No)
Train service delivery	%	⩾99.75%	99.9975%	Yes
Train punctuality	%	⩾99.60%	99.9950%	Yes
Train withdrawal rate	Times/Ten thousand km	⩽0.055	0.015	Yes
Failure Rate	Times/Ten thousand km	⩽0.10	0.075	Yes

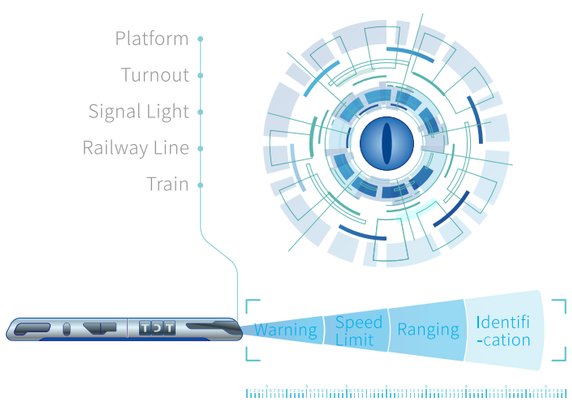
TCT’s innovative interoperable FAO system has been successfully applied on Beijing Daxing International Airport Express, and will be further used in Beijing line 17 and line 19.



Train Intelligent Detection System (TIDS)

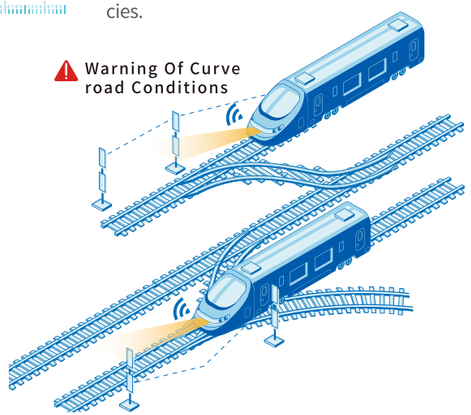
TIDS-Tireless Sentinel

In the case of breakdown of the existing signalling system, the train will be turned under the Manual Mode. In view of the unstable working state of the Manual Mode, the identification ability will vary from person to person, etc. A system shall be needed to assist the driver to judge the distance of the train ahead and give hints, so as to avoid the collision or switch splitting caused by human errors.



In the new generation Train Intelligent Detection System (TIDS), laser radar, vision and other sensor technologies are used to detect and protect the front line of the train along with using the intelligent algorithm of deep learning. Calculate the safe travel distance according to the train running speed, and carry out overspeed protection. Ensure the safety of the train and the operation efficiency of the line under emergencies.

TIDS is added with trackside sensors on the basis of vehicle-mounted device, covering the all operation scenarios including areas of turnouts and curve roads. Operation data are transmitted among different scenarios, forming a “star chain”. This realizes the real-time interconnection with the train and further extends the train range of visibility, which provides higher-level safety protection.

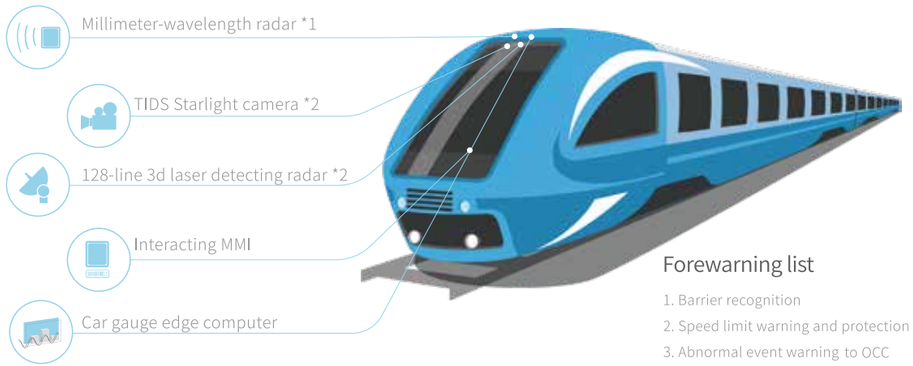


Functions and Characteristics

- Train positioning: this system can independently obtain the real-time train speed, combine the vehicle TIMS, laser and image information, realize the real-time train positioning, and upload to OCC through LTE.
- Intelligent obstacle detection: this system is equipped with radar and visual sensors, combines with the intelligent algorithm of active identification, and realizes the detection of the train and obstacles on the operation line ahead of the train

Cases

- Upon the requirements of the preliminary research system to determine the product design and development, indoor testing, on-site testing, trail testing and other processes, relevant tests have been conducted on the routes of Beijing, Hong Kong, Chengdu and other cities. Presently, the TIDS is being installed on the M-trains of Tsuen Wan line , Hong Kong. Stability tests have been implemented and onboard TIDS are under installation. Meanwhile, engineering application implementation is being carried out in Metro 17, Beijing.



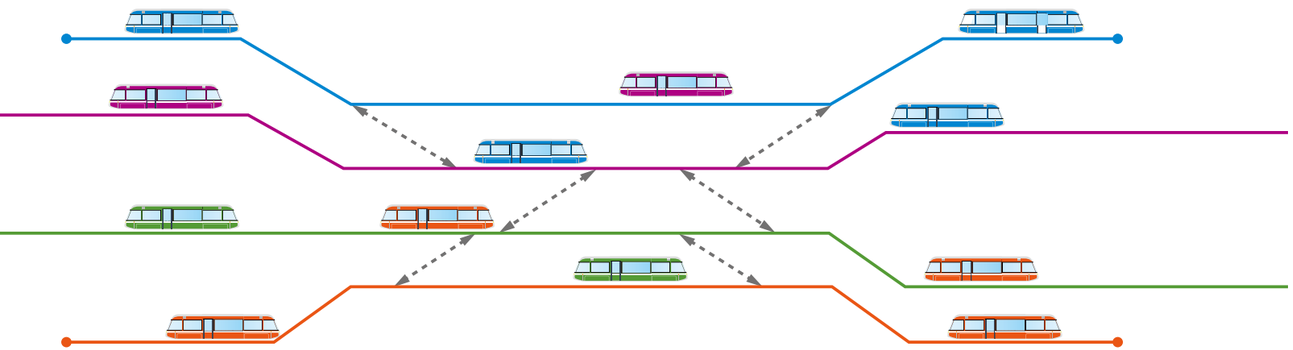
Product Indicators

- SIL2 Certificate
- Error reporting ratio⩽0.01%
- Fail-to-report ratio ⩽0.01%
- Speed detecting accuracy 1km/h
- Distance measuring accuracy 2m
- The longest detecting distance 300m (While-line monitoring can be realized upon the mounting of trackside TIDS.)

I-CBTC Solution

Interoperable CBTC Among Different System Providers

- Interoperability (I-CBTC) based on advanced CBTC technology.
- Enhancing dispatch flexibility to decrease passengers' transit and travel time.
- Can support various signalling systems.
- Communication interoperability achieved by LTE.
- Resources sharing.



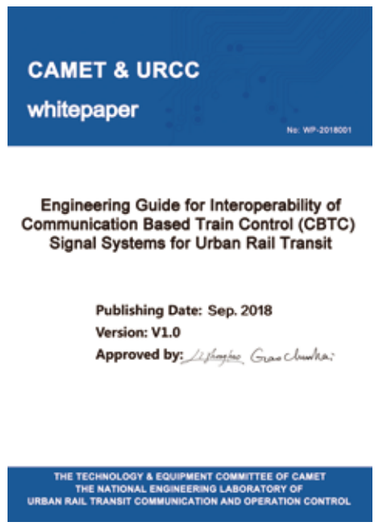
Features

- Reduces total investment and significant saving on train purchase.
- Reduces civil works.
- Less limitation on public bidding and construction.
- Decreases the vacancy rate of lines and equipment.
- Can be applied to various transit systems.
- Flexible dispatch.

Chongqing Interoperation Project

Chongqing' s interoperable CBTC on Metro Line 4, Metro Line 5, Metro Line 10 and Metro Loop Line is the first pilot project on interoperability in China. TCT played the leading role in this national project.

After the successful implementation in Chongqing, our interoperability technology became widely accepted by other major cities across China, such as Beijing, Qingdao, Guiyang, Changsha and Hohhot.


CAMET & URCC

whitepaper

No: WP-2018001

Engineering Guide for Interoperability of Communication Based Train Control (CBTC) Signal Systems for Urban Rail Transit

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Approved by:

THE TECHNOLOGY & EQUIPMENT COMMITTEE OF CAMET
THE NATIONAL ENGINEERING LABORATORY OF
URBAN RAIL TRANSIT COMMUNICATION AND OPERATION CONTROL

TCT also actively participated and led the formulation of national industry standard - " The Instruction of Interoperable CBTC Signalling System Construction ".

Vehicle-to-Vehicle Communication

State of the art Control Technology

Minimized wayside equipment (Interlocking, Wayside ATP, etc.).

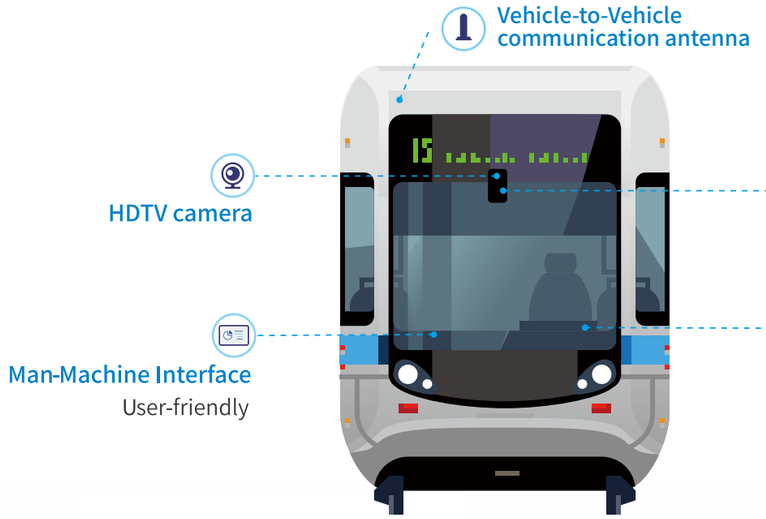
Design headway of 80s.

Safety: SIL4 Level.

Reduces cost by 30% compare to CBTC.

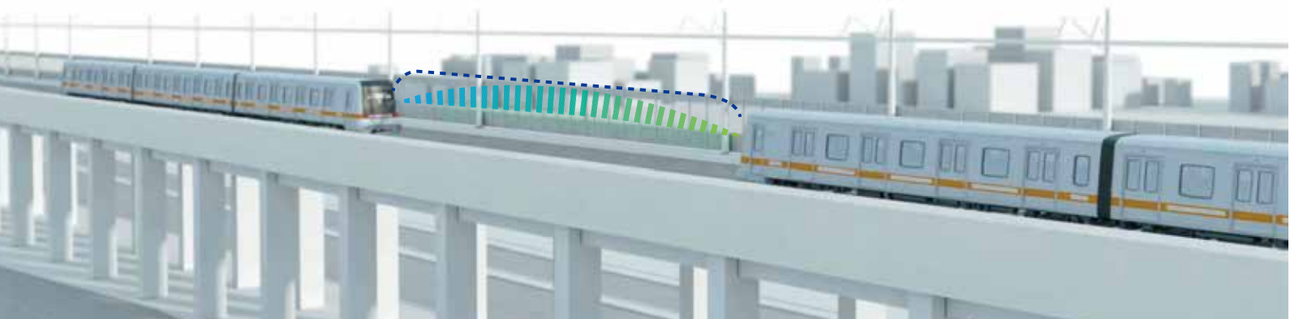
Environment perception technology.

On-board equipment to fully support train control.



Direct Communication Between Vehicles

Achieves safety tracking and operation



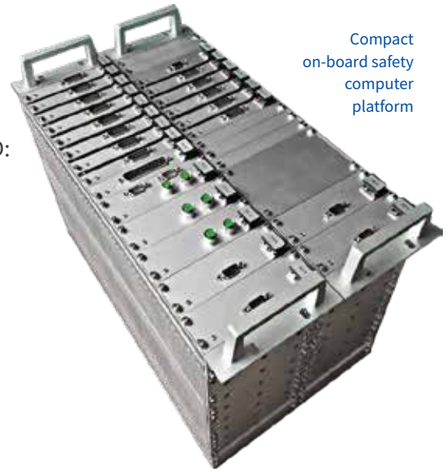
Features

- Direct communication between vehicles.
- The on-board computer calculates the movement authority (MA).
- The technology could be applied to Tram, Light Railway Transit, and Metro operation.

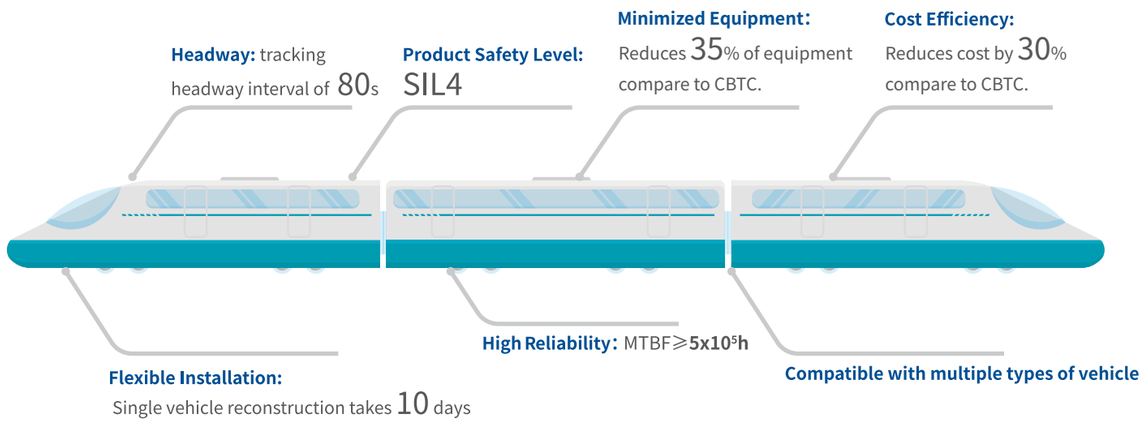
Milestones

TCT established integrated testing platform for R&D:

- Continent for upgrading and extention.
- Able to realize interface compatibility for C2+ATO, CBTC and so on.



Compact on-board safety computer platform



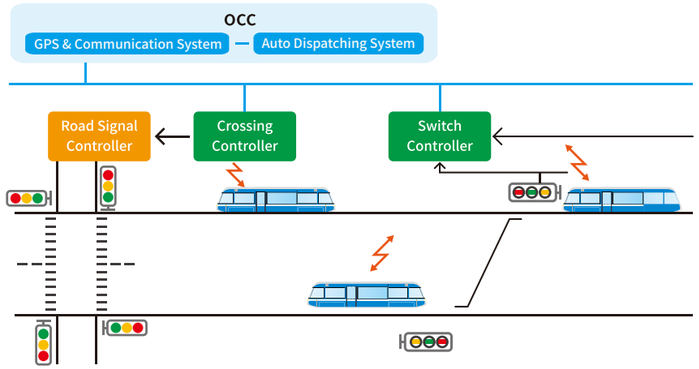
Techniques

- GPS positioning.
- Detection and control with switches and grade crossings.
- TIDS (Train Intelligent Detection System) - improves the operation safety and efficiency.

Features

- Less wayside equipment.
- Reduces maintenance workload.

System Architecture



CBTC Re-signalling

Compatible with Existing System

- Seamless upgrade to the new system.
- Flexible migration strategy.

Strategy	Strategy 1 Section By Section	Strategy 2 Big Bang Change-over
Method	Method 1 Subsystem By Subsystem	Method 2 Parallel Re-signalling

Features

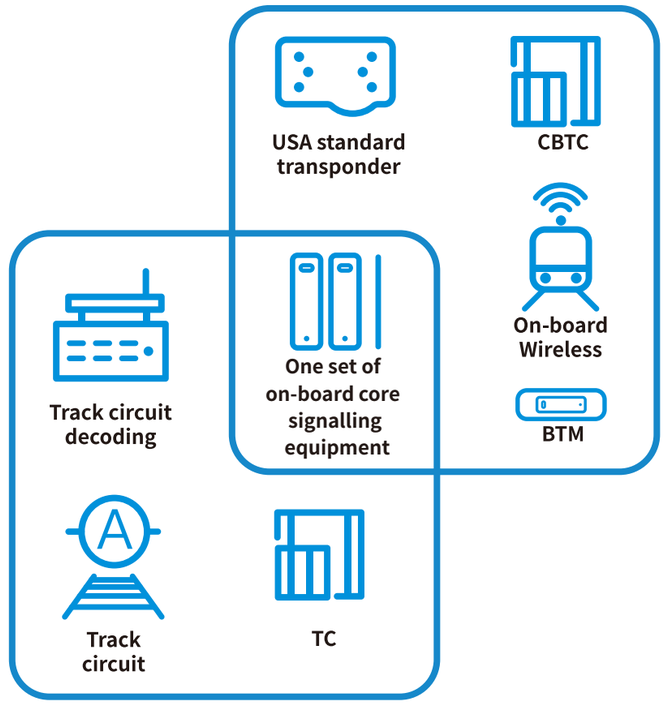
- No interruption during operation.
- Reduces the risk to disturb daytime revenue operations.
- Cost-effective and time efficient.
- Flexible configuration and saves space.
- Compatible between both new and existing system, such as CBTC and track circuit.
- Seamless cutover.

Case

Beijing Metro Line 5

TCT provided one set of on-board equipment that was compatible with both track circuit and CBTC system for each vehicle for Beijing Metro Line 5.

- One step on-board equipment installation.
- One step retrofit of vehicle.
- One set of equipment.



Beijing Metro Line 5

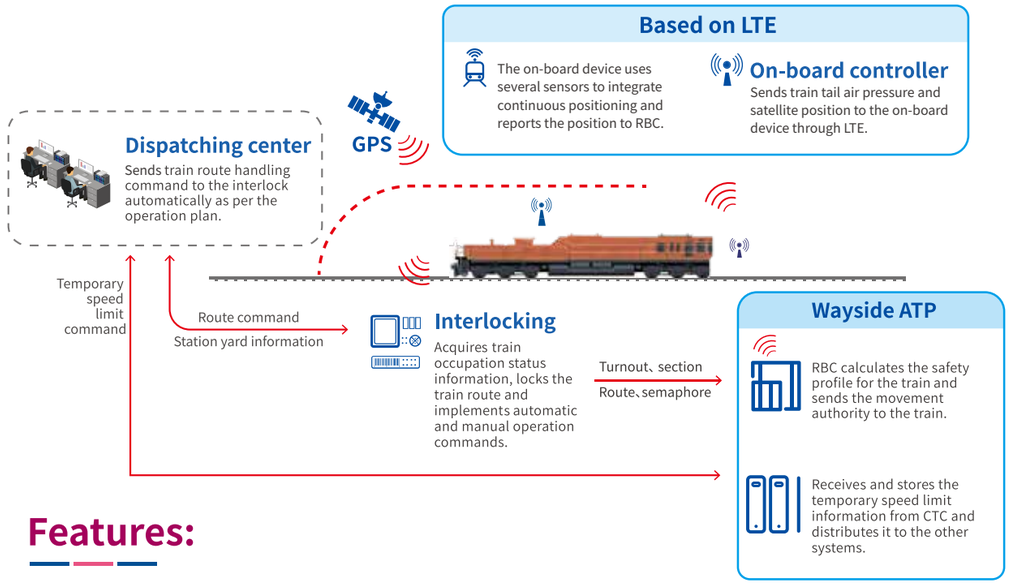
- Retrofitted 61 vehicles
- Increases RAM
- Decreases system failure rate by 20%
- Big bang changeover can be realized

Heavy Haul Railway Signalling System

Future Heavy Haul Railway-Moving Block Based Heavy Haul Railway Signalling System

TCT’ s newly developed moving block technology provides heavy haul railway an innovative solution for the new generation of train control system.

- Improves efficiency.
- Promotes automatic level of heavy haul railway (GOA2).
- Improves system safety.
- Reduces 20% of cost by replacing the track circuit to axle counter.



Features:

Integrates LTE technology with train-to-ground communication.
Uses satellite navigation technology for train positioning.
Safety brake model based on heavy haul railway.

Pilot Project in Shuohuang Heavy Haul Railway

Simulation-based Training System

Interactive design to deepen the understanding of various professional roles for better team work

Intelligent training system based on real life scenarios provides the flexibility to meet specific customer needs.

- Applicable for trainees of rail transit institutions or metro operation companies.
- Real operation data, easy to modify.
- Based on CBTC and FAO system and highly customizable.
- Leverages Virtual Reality technology.

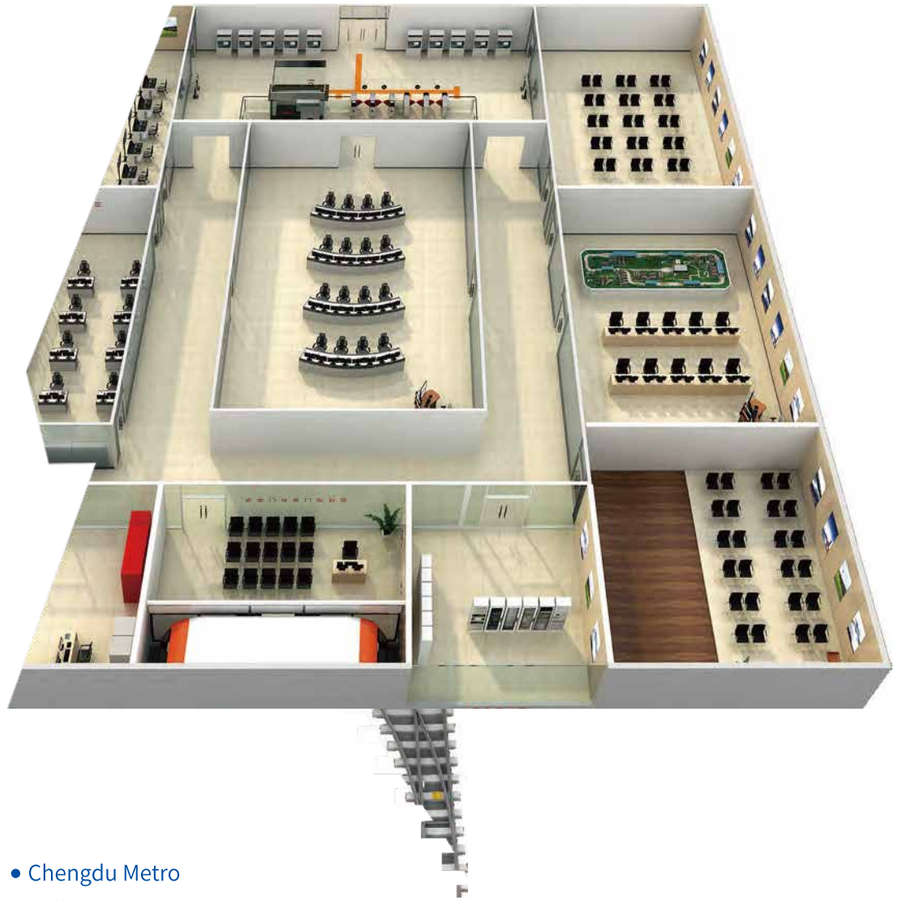
Signalling System
Telecommunication System

ISCS System
Mechanical and
Electrical System
Power Supply System

Operational management posts:
Operation Dispatching, Train Dispatching, Passenger Dispatching, Power Supply Dispatching and Environment Dispatching

Maintenance management posts:
Rolling Stock Maintenance, Telecommunication and Signalling Maintenance and Power Supply Maintenance

Automatic Operation:
Map adding, shifting, routing control and switch control
Manual Operation:
Manual pull switch, guide routing, and axle-counter restoration
Emergency Operation:
Fire rescue, passenger evacuation and train rescue

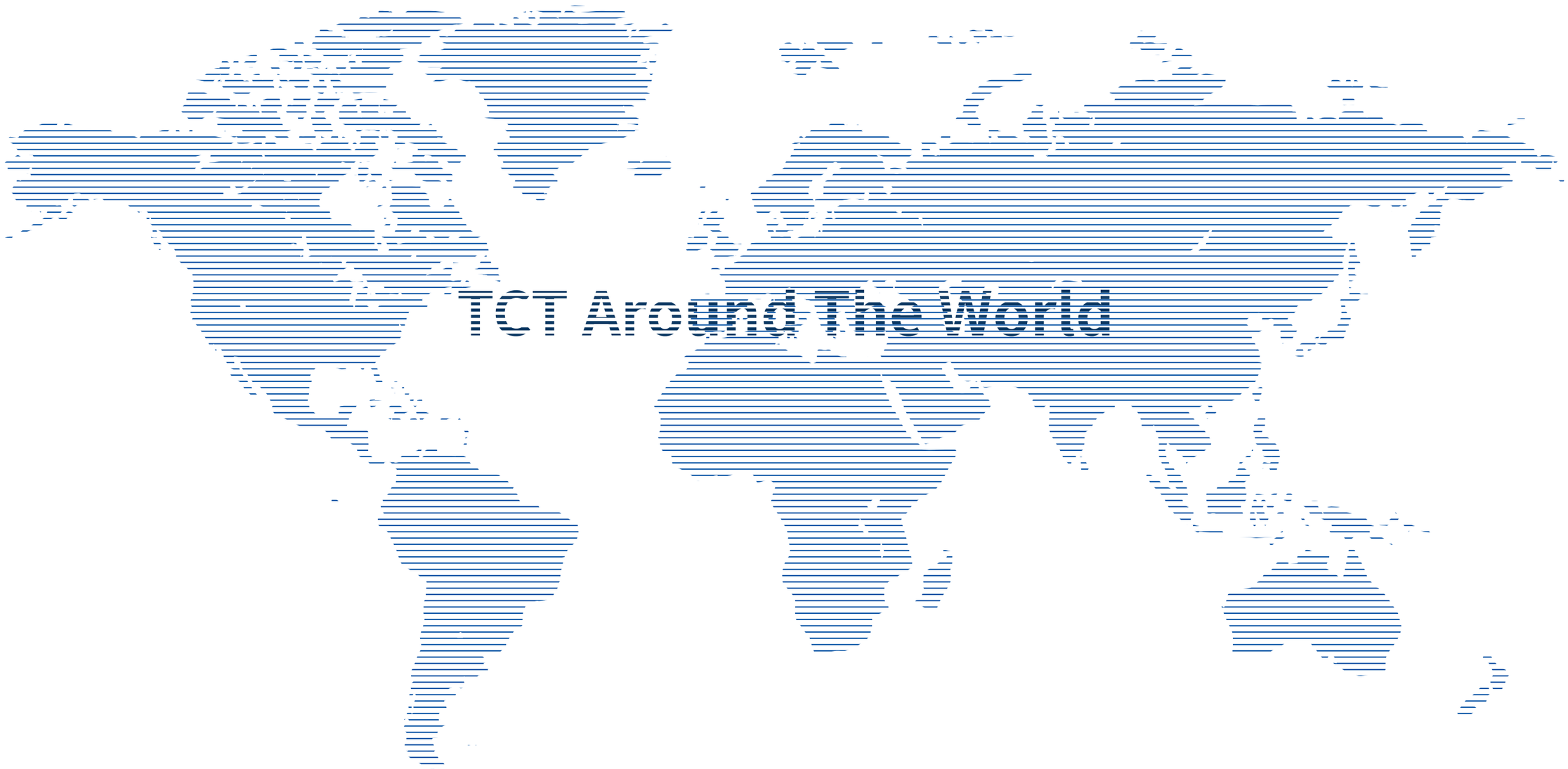


- Chengdu Metro
- Beijing MTR Corporation
- Beijing Vocational College of Transportation







- Traffic Control Technology Co., Ltd.
- Traffic Control Technology America LLC
- Beijing AI for Rail Technology Co., Ltd.
- Beijing Elephant Technology Co., Ltd.
- Beijing Funengtong Technology Co., Ltd.
- Beijing Yunjie Technology Co., Ltd.
- Urban Rail Innovation Network Center Co., Ltd.
- Inner Mongolia Traffic Control Anjie Technology Co., Ltd.
- Tianjin Traffic Control Technology Co., Ltd.
- Traffic Control Technology Equipment Co., Ltd.
- Shandong Traffic Control Technology Co., Ltd.
- Qingdao Traffic Control Technology Co., Ltd.
- Traffic Control Technology (Shanghai) Co., Ltd.
- Suzhou Traffic Control Technology Co., Ltd.
- Chengdu Traffic Control Technology Co., Ltd.
- Chongqing Traffic Control Technology Co., Ltd.
- Guangxi Jiaokong Zhiwei Technology Development Co., Ltd.
- Shenzhen Traffic Control Technology Co., Ltd.
- Foshan Traffic Control Technology Co., Ltd.
- Wuhan Traffic Control Technology Co., Ltd