Application and Development of CTCS

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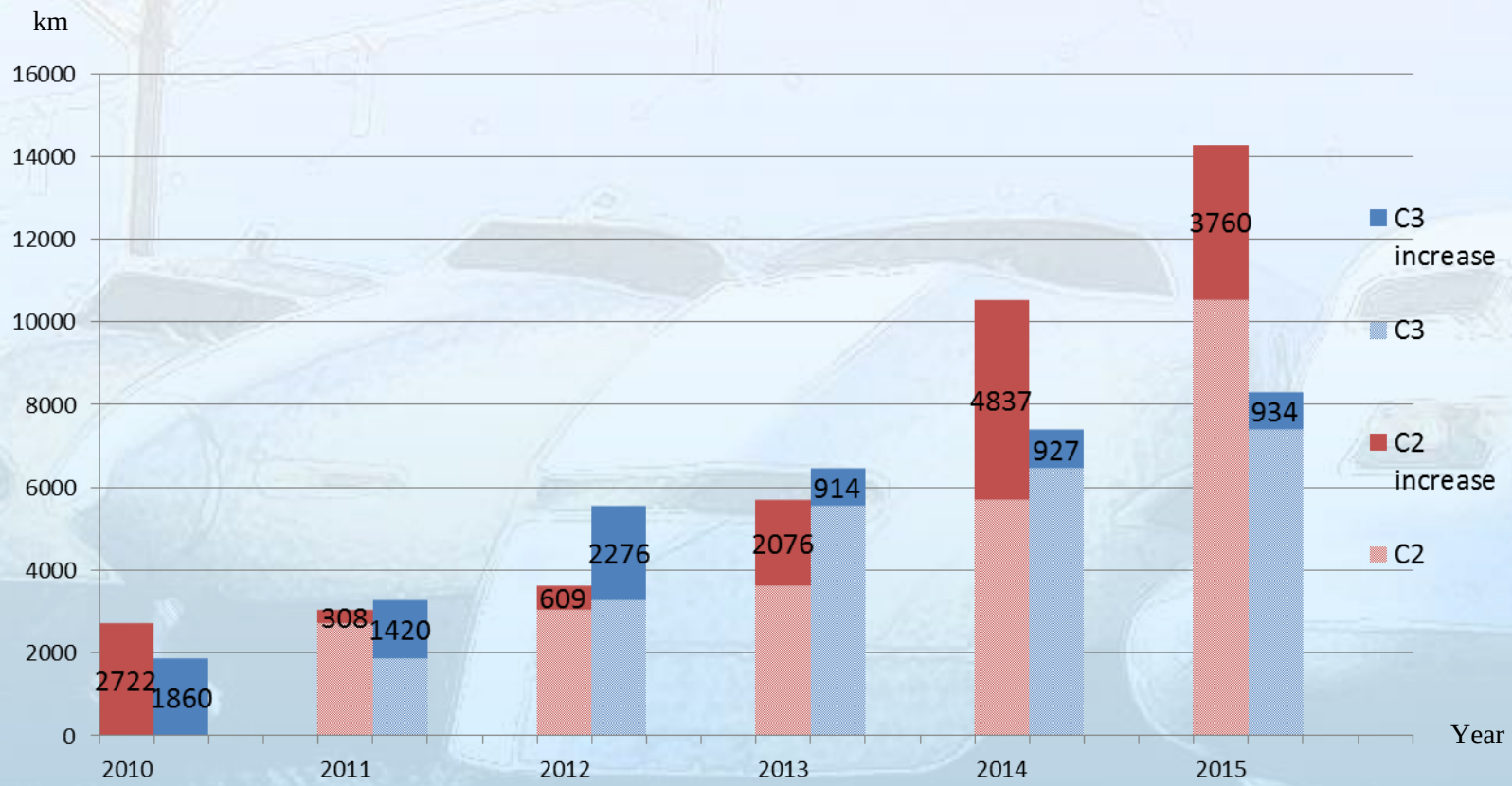
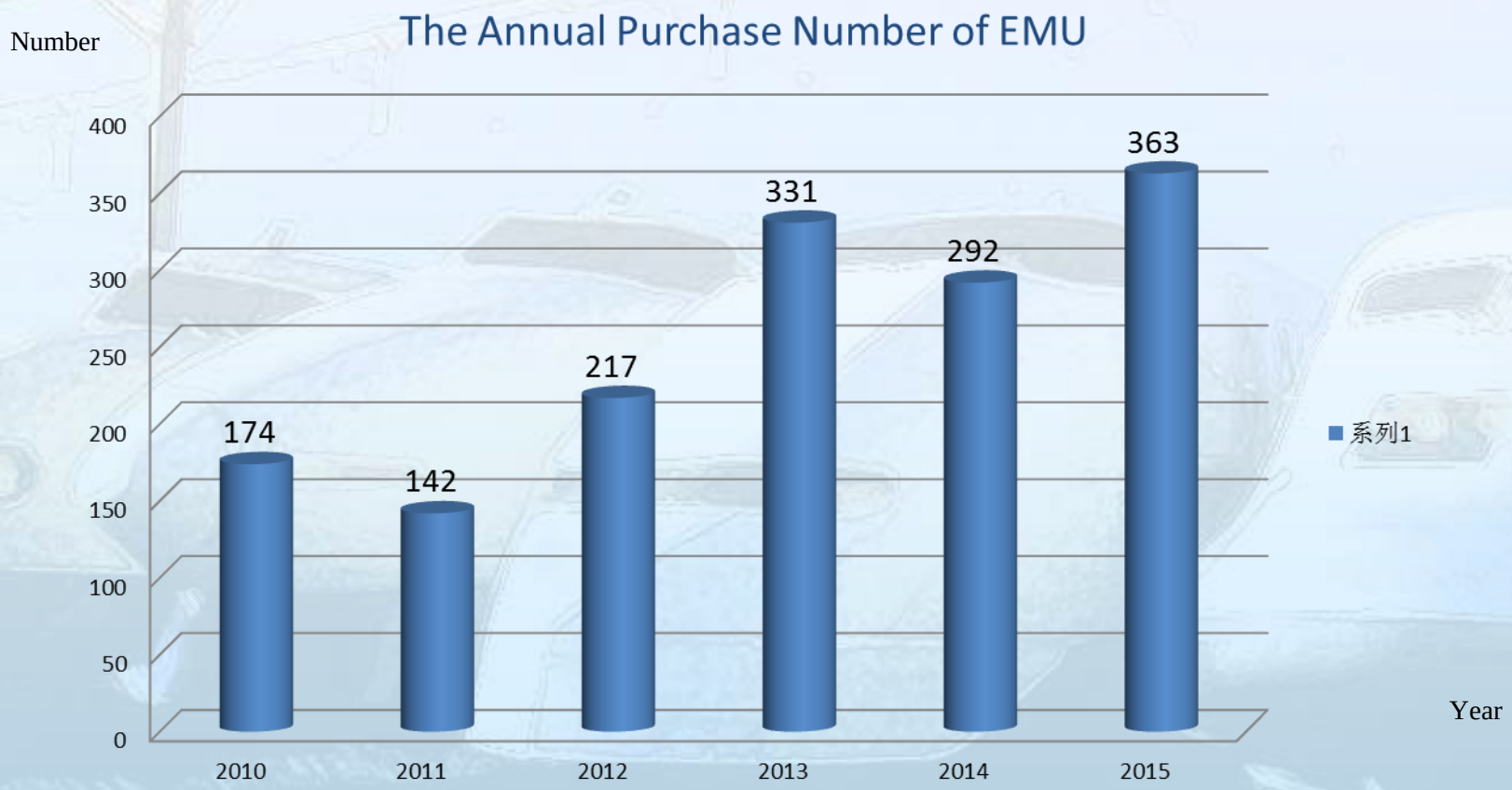
1. The Application of CTCS Trackside



Note: By the end of 2015, **14312km** of C2 lines and **8331km** of C3 lines are available.

2. The Application of CTCS Onboard



Note: By the end of 2015, **1887** EMU are put into operation.

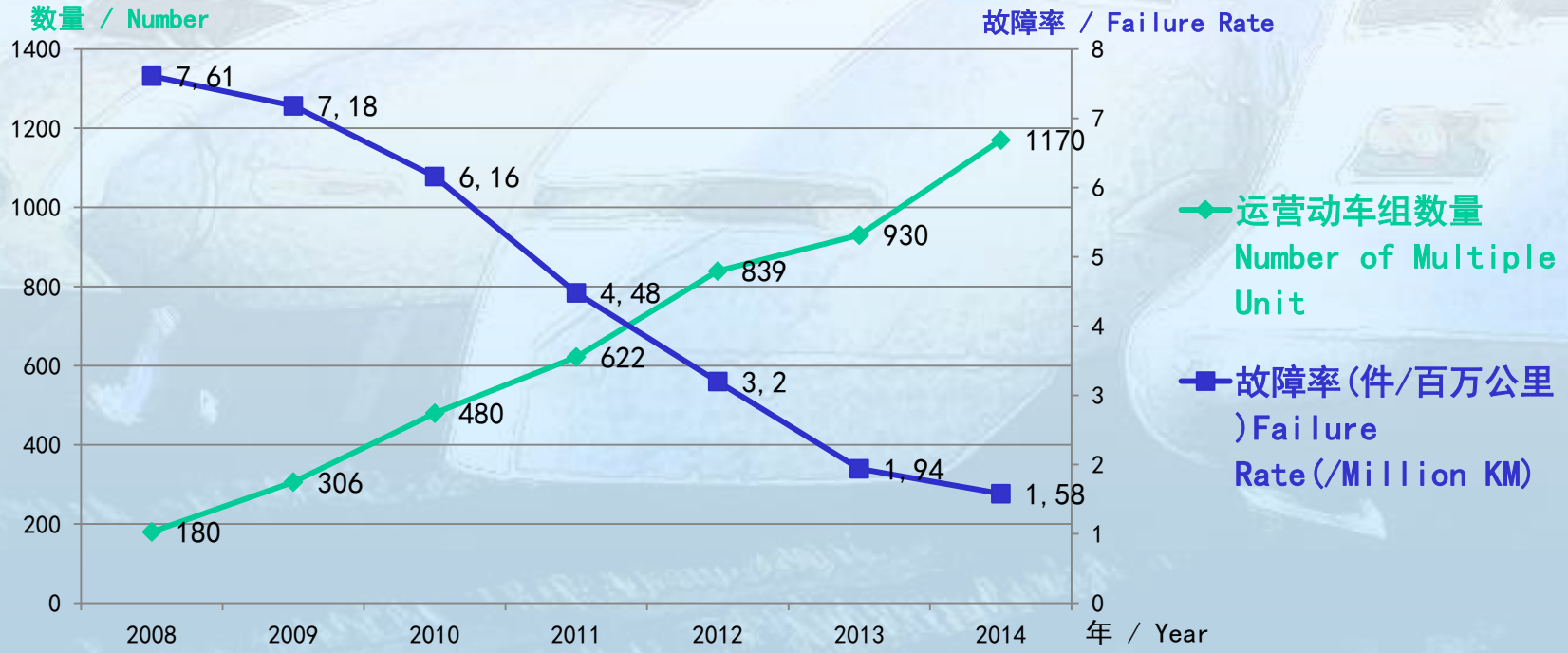
3. The Complete Standard System

Since “CTCS specification – General” was issued in 2004, there are more than 40 CTCS standards were drafted and issued. The standard system includes:

- CTCS-3 FRS (V1.0)
- CTCS-3 SRS (V1.0)
- the Specification of the CTCS-2 Onboard
- the Specification of the CTCS-3 Onboard
- the Specification of the Radio Block Center
- the Specification of the Temporary Speed Restriction Servers
- the Specification of the interfaces of Train Control Center
- etc.

4. The Operational State of Train Control System

➢Since C2 System in 2007, and C3 System in 2009 were put into service, the improvements and optimizations of onboard and trackside system have been implemented. Currently, the system operates stably.



5. The Interoperability of the Different C3 Platforms

- The interoperability of different onboard platforms has been achieved. It means that EMU equip with different ATP platforms can be operate on the lines with different RBC platforms flexibly.
- The interconnection of the RBC platforms between Wuguang line and Guangshen line was achieved based on directly communication by the end of 2013.
- The interconnection of the RBC platforms between Wuguang line and Zhengxi line was achieved based on directly communication by the end of 2014.

II. The Optimization and the Improvement of CTCS

II. the Optimization and the Improvement of CTCS

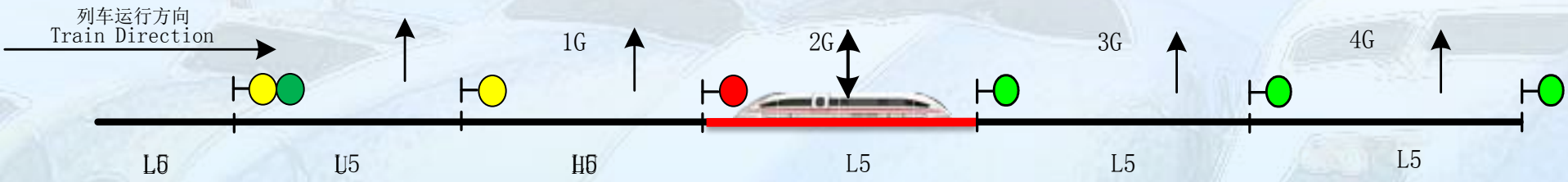
1. the Optimization of CTCS-2/3 Trackside
2. the Optimization of CTCS-3 Onboard
3. CTCS2+ATO for Intercity Railway

1. the Optimization of CTCS-2/3 Trackside

- The function of the section track circuit logic sequence checking was added to the Train Control Center, which is the trackside equipment of CTCS-2/3.

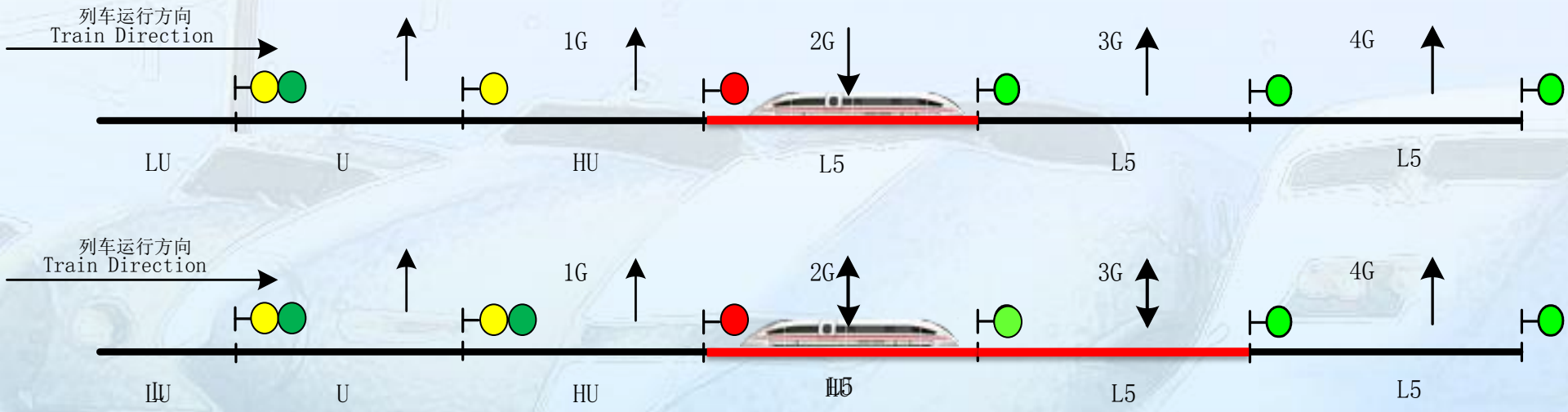
- To improve the safety of section operation of the CTCS, and to prevent the signal proceed in wrong logic caused by section TC failure, the TC occupied logic checking function was also added to TCC which controls section TC coding（including station or repeater building）.

1. the Optimization of CTCS-2/3 Trackside



The Traditional Automatic Block Section

1. the Optimization of CTCS-2/3 Trackside



➢**The TCC checks the TC occupied and clear sequence. If the logic do not matched, the block section will keep occupied, and the protective signal will keep stop, then the MA of the following train cannot be override the protective signal.**

1. the Optimization of CTCS-2/3 Trackside

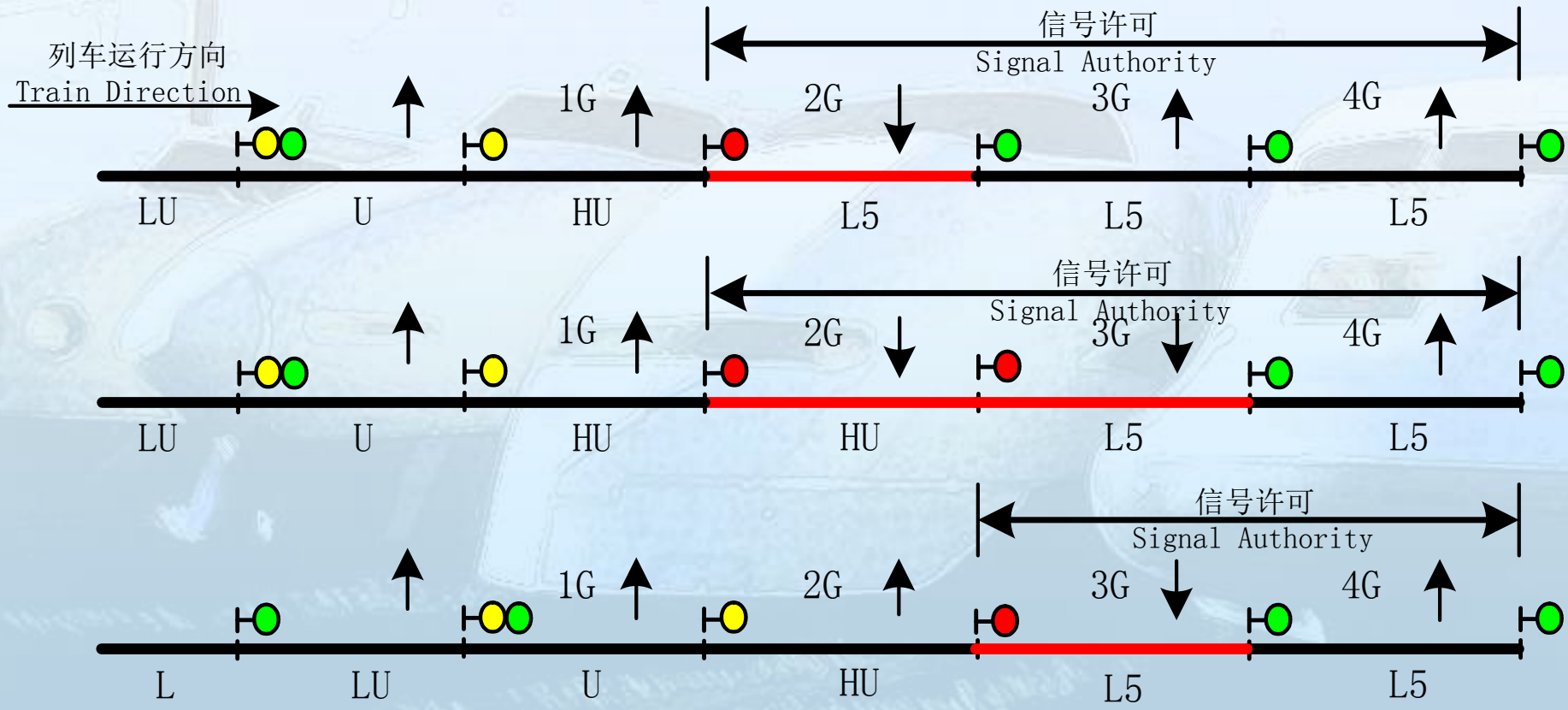
The technical difficulties：

- the judgment under the condition of the tight tracing
- the judgment under the condition of the track circuit failure
- the logic judgment of the connection between the station and the section, etc.

1. the Optimization of CTCS-2/3 Trackside

- TCC assigns a **Signal Authority** for each train dynamically, the range of the SA is from the block section which occupied by the train to the one which occupied by the front train, or the one which TC fails. Each train can be running in the range of its own SA only, and the SA extends automatically according to the clear of the front block section. The SA will be cancelled automatically after the train arrives in the station. The unique SA is assigned to each block section.

1. the Optimization of CTCS-2/3 Trackside

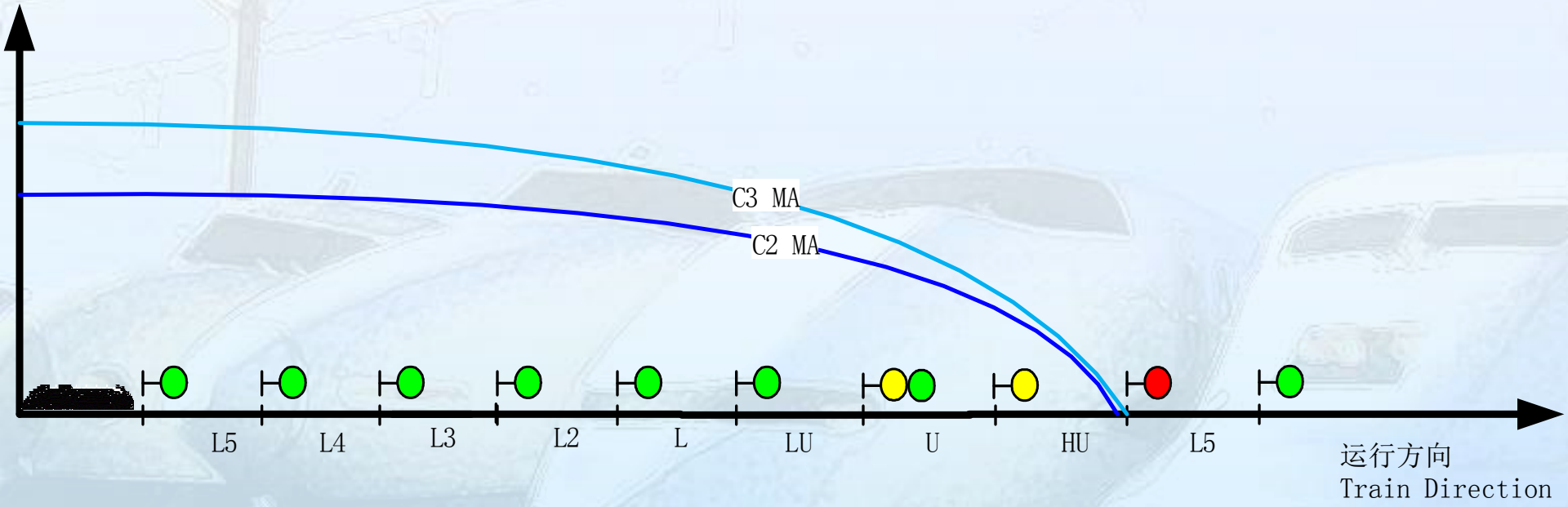


2. the Optimization of CTCS-3 Onboard

- **The backup system of the CTCS-3 is the CTCS-2. Usually , the range of C3 MA is the same as C2. In the case of some errors, the wrong C3 MA may cause the risk.**

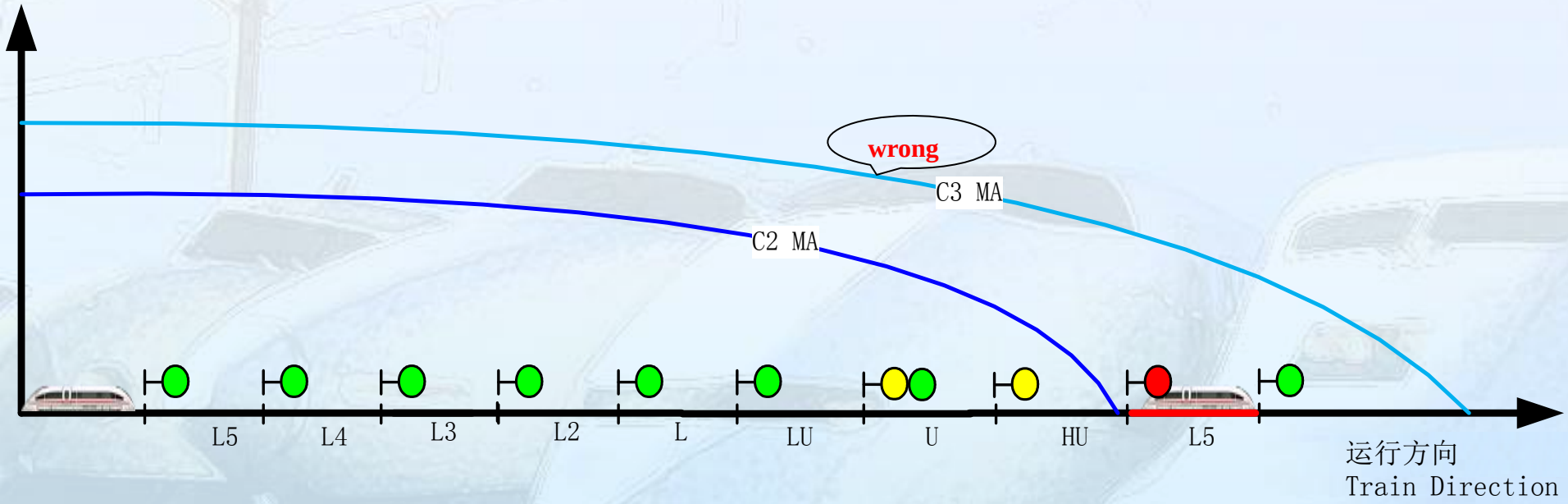
- **By the advantage of the unified track circuit of China HSL and unified Low-frequency information definition, the C2 MA can check C3 MA additionally.**

2. the Optimization of CTCS-3 Onboard



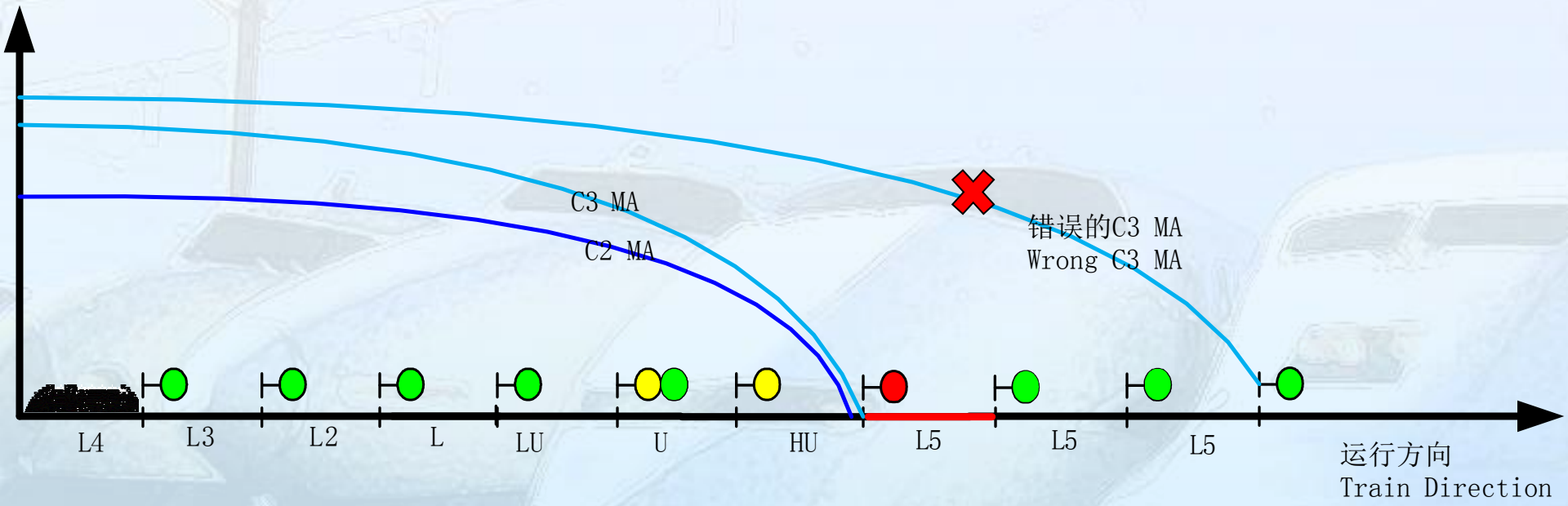
Normal State

2. the Optimization of CTCS-3 Onboard



C3 MA Extension Incorrectly

2. the Optimization of CTCS-3 Onboard



Shorten C3 MA by C2 MA

3. CTCS2+ATO for Intercity Railway

- In recent years, in order to satisfy the demands of economic development and regional transport, some developed regions in China, such as the Pearl River Delta region, Beijing-Tianjin-Hebei region, etc. are planning to build intercity railway system.

- Just for the Pearl River Delta region of Guangdong Province, more than a dozen intercity railway lines are planned and the total length exceeded 1000 km.

3. CTCS2+ATO for Intercity Railway

Pearl River Delta Intercity Railway planning diagram

3. CTCS2+ATO for Intercity Railway

the Characters of Intercity Railway Operation

1. The train speed is about 200 km / h.

2. High density operation, the headway is about 3 minutes.

3. Small distance between stations, The train will start (accelerate) and stop (decelerate) frequently.

4. Due to setting platform doors, the train was required to stop accurately.

5. CR trains will run on the intercity railway.

3. CTCS2+ATO for Intercity Railway

Solution by CTCS2+ATO System

1.Satisfied CR trains operation by using CTCS2 system.

2.To implement ATO function, the ATO unit is added to the existing CTCS2 system.

3.By adding radio unit, the information between onboard and trackside is exchanged via GSM-R.

4.Increase balise to achieve the accurate stop position

3. CTCS2+ATO for Intercity Railway

Under the Arrangement of China Railway

- **CTCS 2 + ATO project has been implemented since 2012.**
- **In 2015,it was tested in the trial section between Dongguan and Huizhou, which is 36 Km long and as a part of the Pearl River Delta intercity railway.**
- **The test covers 2 EMUs, 4 kinds of CTCS2+ATO systems from different companies.**
- **The Maximum speed of the test is 200km / h, the total running mileage is more than 30,000 km.**
- **150 Km intercity railway with CTCS2+ATO system in the Pearl River Delta region will be put into commercial operation in 2016.**

III. Conclusion

Conclusion

Technical development is a eternal topic. The Train Control System as one of the key technology of Highspeed railway, we should analyze and summarize the experience of the CTCS, cooperate closely with worldwide colleagues, and make a contribution to the development of the Train Control System of global railways.

Thanks