THALES

COUNTINGWORLD

The Customer Magazine for Axle Counter Systems

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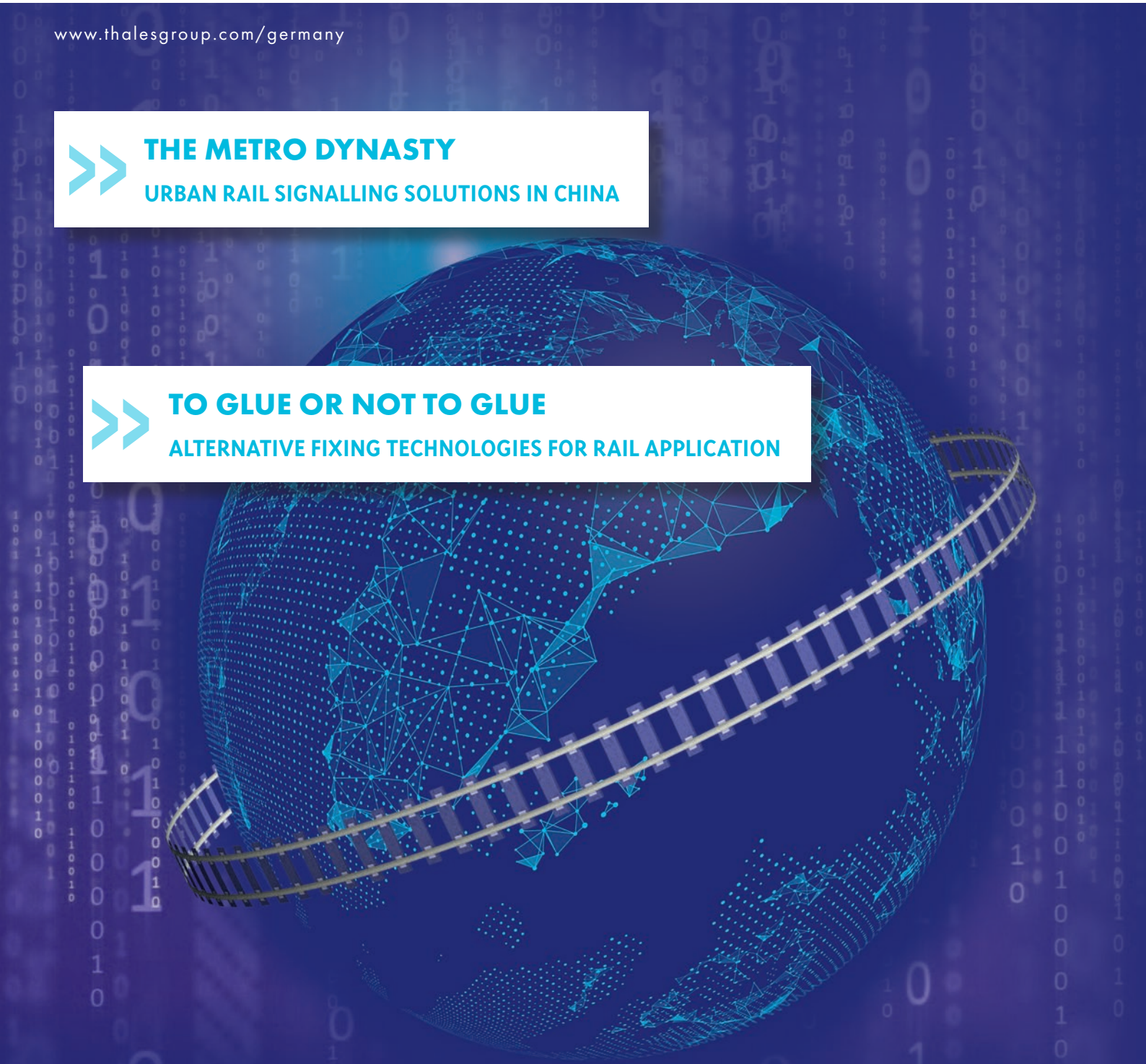
THE METRO DYNASTY

URBAN RAIL SIGNALLING SOLUTIONS IN CHINA

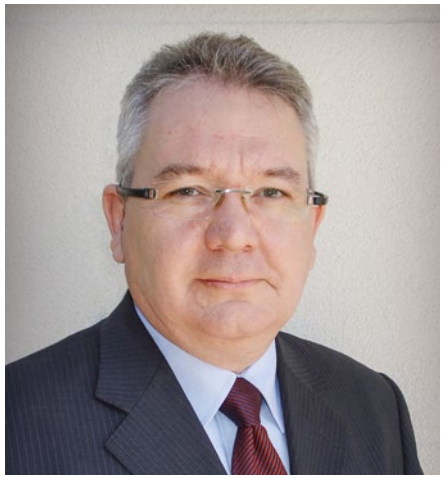


TO GLUE OR NOT TO GLUE

ALTERNATIVE FIXING TECHNOLOGIES FOR RAIL APPLICATION

FROM REVOLUTIONS AND EVOLUTIONS

THE HISTORY OF A TRACK BASED TRAIN DETECTION



Dear Readers,

AGING, OBSOLESCENCE AND INNOVATION

Looking back at the past editions of this Counting World magazine, it is obvious that there have been tremendous successes in the past years on delivery of challenging Main Line and Urban Line signalling projects in the world: even better systems, highly integrated, fully digital and automated with the latest in innovative design.

These project achievements are accompanied by increasing digitalisation, like paperless measuring processes, virtual presence during maintenance or real-time online support services. Once commissioned, these projects become part of the huge installed base worldwide, with a variety of new products and systems. The challenge for Thales and its customers is to keep this installed base running and serviced for many years.

But have we forgotten our proven legacy systems?

No, we haven't. The Infrastructure Managers, our customers, are maintaining in operation a very large amount of equipment, some installed several decades ago. Obviously they are continuously modernising their network, whilst minimising inconvenience for their own customers by limiting downtime; this very often requires a progressive approach to modernise existing installations.

Therefore, to fully support our customers, we at Thales dedicate a large amount of our development investment to keep the systems in operation continuously as long as possible. Even today, Thales in maintaining systems and products that are in service for sometimes more than half of a century

But how is this possible? Technologies are becoming obsolete often faster than it has taken to develop them – the availability of highly integrated circuits is constantly reducing – and the knowledge of ancient railway systems is fading.

Creating solutions that allow innovation to develop without scarifying the long-term support for safety systems

The key to success is the balancing act between global system renewal and individual component replacement. A clever modularisation and upgradation strategy is the foundation to allow for a long-term serviceability.

A good example is the latest Thales innovation: the Fibre Optic-based Axle Counter: the full benefit of this new technology is with the operation on a 100% fibre optic backbone. But individual modules of the system structure are designed to extend or replace outdated or obsolete systems in operation. Exchanging electro-magnetic sensor heads with fibre optic-based rail contacts without touching the existing copper cable infrastructure is one advantage. Changing ISDN transmission paths to DSL or even Ethernet without affecting the overall system integrity is another one.

The clever part of the system design is to allow the current proven technology to operate in parallel to the new innovative components within the boundaries of the approved safety system.

Innovative technology coexists with legacy systems

The most important innovations are therefore not always the large groundbreaking inventions, but the little improvements that bridge the gap between obsolete ancient legacy systems and most modern high-tech applications.

Read the latest technology updates as a member of the exclusive Counting World of Thales.

Alain LeMarchand
Technical Director, Mainline Railway Signalling
Thales Ground Transportation Systems

RMA Online takes off

myPRODUCTS

MYPRODUCTS OFFERS RMA REQUEST AND REPAIR TRACKING

As announced in the last Countingworld edition, Thales meanwhile has launched the new 'RMA Online' feature in myProducts. This application supports the whole repair process – from requesting a 'Return Material Authorisation' (RMA) to tracking the status.

With this easy-to-use application, an RMA document can be created with just a few clicks. Henceforward, 'RMA Online' brings higher transparency by automatic notifications and transaction overviews. An additional service app for easy scanning of the component's QR code will be available soon. 'RMA Online' furthermore enables an improved workflow in our factory resulting in shorter repair and turn-around time.

Since the Go Live, 'RMA Online' has shown a proven track record. Customers from numerous countries successfully handled thousands of repair transactions with this new service platform. Using 'RMA Online' also brought multiple new ideas for myProducts, the integrated e-Services platform. Customers have asked for additional applications, such as hardware and software compatibility checks, data sheet downloads, or additional value adding content, like type approvals, to be added to this user-friendly 'one-stop-shop', to even further enhance efficiency.
Experience the latest myProducts developments by visiting the website (just scan adjacent QR Code) with any device or contact us via info@myproducts-thales.com.

Success Story

China: the metro dynasty

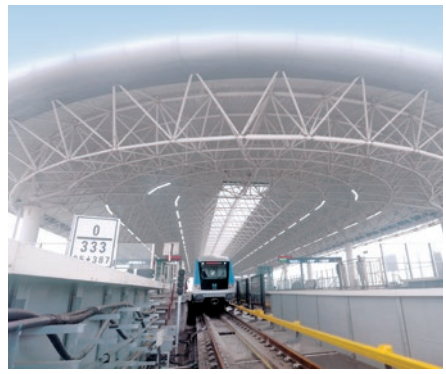
SIGNALLING SOLUTIONS FOR A BOOMING URBAN RAIL MARKET

Certainly, the People's Republic of China is currently the country with the fastest-growing urban rail network. By June 2017, 31 Chinese cities had existing metro systems with a total of 4400 km. 53 cities have metro projects under construction, and there are even more cities either planning or having new metros under approval.

In its 13th Five Year Plan, China intends a more sustainable, high-capacity public transit sector. Every city with over 3 million residents will start to develop or expand its urban rail network. Therefore China plans to spend round about 600 billion euros on transport infrastructure in the next 3 years.

One of China's key players in this booming signalling market is Thales SAIC Transportation System Limited (TST), which is a high-tech joint venture between Shanghai Electric and Thales. TST's core business is providing CBTC technology for the China metro market as well as signalling solutions for tram, monorail and intercity railways. Headquartered in Shanghai with project offices and branches throughout the whole of China, TST is currently safeguarding 29 metro lines in Shanghai, Beijing, Guangzhou, Shenzhen, Wuhan, Nanjing, Nanchang, Hefei, Ningbo, Jinan, Qingdao, Shijiazhuang, a total of 1082 km with 627 km in revenue and a total installation of more than 5000 Thales Az LM Detection Points! These achievements, benefiting 8 million passengers on a daily basis, have been only possible based on localisation.

Thales' SelTrac® CBTC System, with a 30-year zero-incident safety record, is a radio communication-based moving-block automatic train control system, which controls the movement of trains through continuous two-way digital communication. Each train



Wuhan Line 1

transmits its identity, location, direction and speed to the respective Zone Controller (ZC). The ZC calculates safe distance between two trains, braking distance and authorised train speed with automatic application of brakes in case of overspeeding.

The Thales Az LM Axle Counter System is the train detection device in the CBTC System. In normal operation, the status of a section is not influencing the CBTC, but, as a fall-back system, Az LM detects the trains in case of failures. It grants, together with the interlocking, a safe operation and the protection of the train. Based on the importance of the fall-back mode in the Chinese market, the Az LM became a well appreciated vital part of the CBTC System and is now used in almost all CBTC projects. In fact, Thales is not only supplying its Axle Counters to projects executed by TST, but also lines implemented by other signalling providers.

In order to meet the high reliability requirement, TST was the first company which introduced a 2-out-of-3 (2oo3) Axle Counter solution to the Chinese market for Shanghai Line 5. This project includes the signalling of the south extension of Shanghai Line 5 and the refurbishment of the existing part. Upon completion, the line will feature Fully Automated Operation (FAO). One of the challenges is that the implementation shall not impact the daily 16.5 hours of operation.

The metro network in Shanghai carries 11 million passengers on a daily basis, which demands highly robust system performance. In this context and based on the 2oo3 Az LM System, TST also developed an Ethernet interface which directly connects the Az LM to the ATP/IXL system in order to reduce discrete I/O hardware on both Axle Counter and ATP/IXL side and ensure safety. Thanks to the 2oo3 safe and redundant architecture, a much higher availability can be achieved, which is a common request of mega cities with overwhelming passenger flow. The innovation is geared to meet growing demand for FAO in China. The simplified and highly reliable solution will benefit the system as well as operation and maintenance.

THALES SAIC TRANSPORTATION SYSTEM LIMITED (TST)

To develop its activity in China, Thales, and Shanghai Electric Corporation (SEC) formed a joint venture in 2010: with the expertise and experience of both partners, TST is ideally fitted to respond to growing urbanisation and fast transport modernisation needs in China. 2017 is the most challenging year in the history with more than 10 revenue dates and 8 new lines going into operations. Shijiazhuang Line 1, with only two years for signalling delivery, went into revenue in June 2017, following Nanjing Line 4 early this year.

From Revolution and Evolution

THE HISTORY OF A TRACK BASED TRAIN DETECTION

The developments of axle counter systems had significant impacts on railway operations. Performance, availability and reliability of axle counter systems increased immensely over a century.

1904

Standard Elektrik Lorenz (SEL) starts development of wheel sensors and has the first trials.

In1959 SEL develops the **first electronic Axle Counter System.** Train wheels are detected when passing through an electromagnetic field. All data processing is performed by indoor analogue circuits **based on germanium transistor technology.**

>> Az 65SEL Axle Counter System

1970s

Railways all over the world start to discover the advantages of axle counter systems for train detection over track circuits. In order to optimise thermal stability, SEL changes the technology towards **silicon based semiconductors.**

>> AzL 70 Axle Counter

1980s

SEL becomes part of the Alcatel group. The reliability of train detection makes a quantum leap by moving the **wheel detection electronics next to the track.** The trackside electronic is born.

Even today all widely deployed axle counter systems rely upon this architecture using trackside electronics either in a trackside box or embedded into the wheel sensor. The trackside electronics do the signal evaluation and transfer the counting data **via analogue transmission to the indoor evaluator.**

>> AzL 70-30 Axle Counter System

1990s

The demand for reliable and highly available train detection is growing tremendously. Microprocessors enable more signal processing in a smaller space. Alcatel moves the indoor evaluator and trackside electronic to a fully microprocessor based system.

This enables the introduction of fault tolerant modem data transmission between the indoor evaluator and the trackside electronics. Analogue signal transmission failures are a thing of the past. **Alcatel is the first to introduce a digital interface** to its own interlocking, saving a lot of relay circuitry.

>> Az L90 Axle Counter System

2000

Microcontrollers become more and more powerful. The introduction of microcontroller redundancy boosts the availability of train detection further. Alcatel introduces the modular Axle Counter System Az LM. Versatile, with only 5 indoor components can it be deployed in **2-out-of-2 or 2-out-of-3 redundancy,** to fulfil the demands of highly available train infrastructure. Az LM is the **first system being developed and approved according to CENELEC safety standards.**

The modem data transmission between the indoor evaluator and the trackside is replaced by the robust IDSN transmission enabling higher data rates and thus shorter reaction times as well as more wheel sensors to be connected to one evaluator. Counting information and power for the trackside electronics is still transferred by only two wires. With the OCS Alcatel (One Channel Safe) protocol, Alcatel is the **first to introduce an IP interface** to its own interlocking.

>> Az LM Axle Counter System

2006

Merger of Alcatel with Lucent – transfer of its rail signalling business to Thales. The internet is connecting computers, telephones, and people with almost any physical channel below. The physical channels move into the telecommunication domain. Security of data transmission over telecom networks becomes an issue.

Thales replaces the OCS Alcatel protocol by the OCS SAHARA protocol enabling a **safe communication between indoor evaluator and the control system over telecom networks.** At the same time the introduction of an IP based diagnostic interface enhances the capabilities to remotely supervise the equipment.

>> Az LM Axle Counter System

2010

The networked world moves into railway infrastructure. More and more interlocking rooms get connected to the infrastructure operator's telecommunication network using the internet protocol. Thales introduces the autonomous communication between indoor evaluators over OCS SAHARA protocol. **Multiple indoor evaluators form a cluster and share detection points.**

The availability of railway lines must increase in order to grow capacity. Thales introduces the **slimline wheel sensor** Sk30K no longer needs to be removed for rail grinding or tamping - saving precious time of railway line availability.

>> Az LM Axle Counter System

2012

The networked world moves further into railway infrastructure: now **trackside elements start to be connected through telecommunication networks.**

Thales introduces ISDN/Ethernet Converter, enabling the internet protocol communication between the indoor evaluator and the trackside electronics. Thus the evaluator scales down to a powerful computing node, which can be located at any place in the infrastructure operator's network.

>> Az LM Axle Counter System

2016

Cost and space reduction drive new signalling system installations to use IP interfaces. **The Eulynx interface standardisation initiative** of European infrastructure operators gains traction.

Proprietary IP interfaces grow in parallel with the introduction of standardised, open interfaces. Thales implements the WNC, Intersig as well as the NeuPro interface. Thales invents the **rail contact in fibre optical technology** based upon Fibre Bragg Gratings.

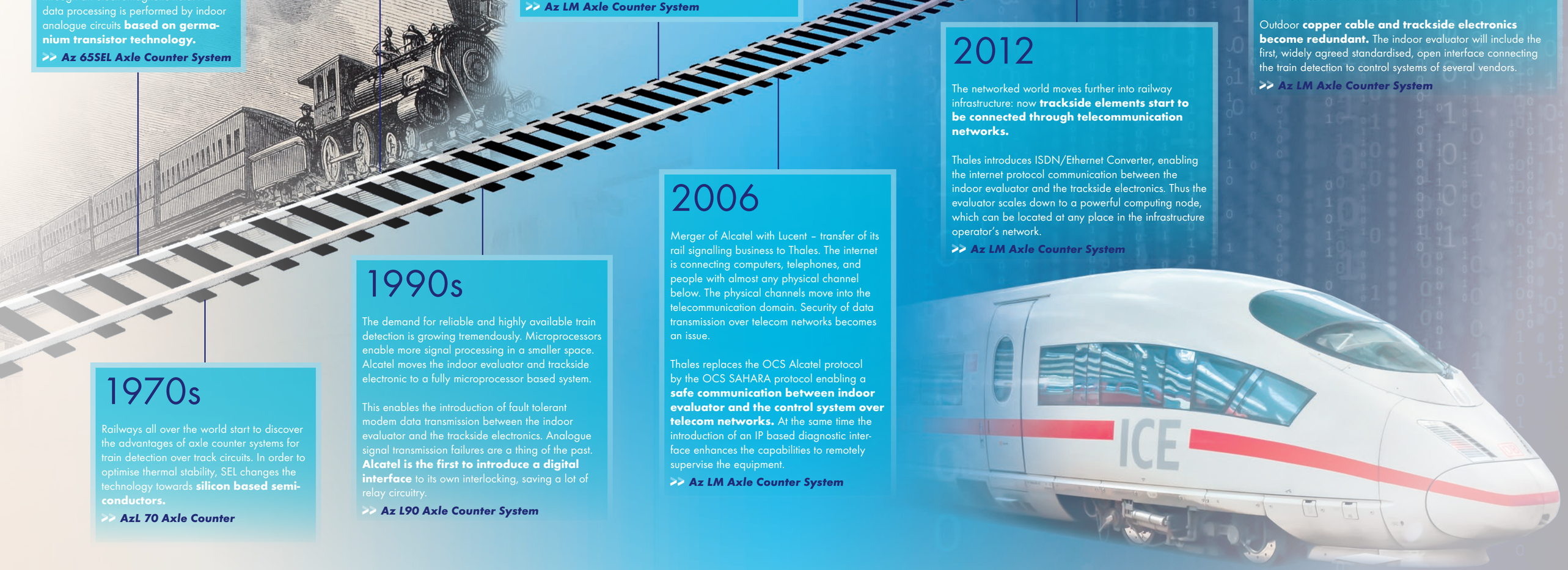
>> Az LM Axle Counter System

2018

Infrastructure operators will pilot the first operational installations of optical train detection, significantly decreasing investment as well as operational cost. Sensors do not need to be maintained any more before the rail needs to be exchanged. Thales will be the first to **introduce adhesive bonding of wheel sensors** to the web of the rail.

Outdoor **copper cable and trackside electronics become redundant.** The indoor evaluator will include the first, widely agreed standardised, open interface connecting the train detection to control systems of several vendors.

>> Az LM Axle Counter System



Success Story

Rail Contact SK30R: exploring new possibilities

THALES NEW RAIL CONTACT FOR GROOVED RAIL WILL BE APPLIED FOR DANHAI LIGHT RAIL TRANSIT (LRT), TAIPEI, TAIWAN

As a frontrunner in cutting-edge urban transportation technology, Thales has already delivered numerous metro projects in the Asian region, for example in Malaysia, Hong Kong, Singapore, Thailand and China. The recently awarded first LRT project in Taiwan represents a further key milestone for Thales, both extending its footprint in Asia and also introducing Thales' new solution with its Rail Contact Sk30R for grooved rail.

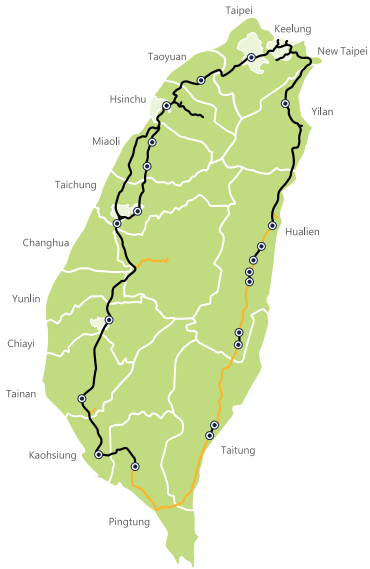
In the first half of 2017, Thales was awarded a contract for the design and manufacture of the signalling and communications system as well as the Operational Control Centre (OCC) for the Danhai LRT project. The Danhai LRT is Taiwan's second Tramway line and for Thales one of the first Tramway projects in Asia Pacific.

In undertaking this project, the New Taipei City government is preparing its public transportation infrastructure in anticipation of expected population growth. As of today, the government has further plans to build over 4 other similar lines in the next 4 to 7 years. Danhai, a popular township in close proximity to Taiwan's capital city Taipei, has been created recently and its population is expected to grow to 340,000 by 2041.

The Danhai project is the first project to employ a local Taiwanese solution to which Thales Italy contributes its global expertise and knowledge of critical rail system solutions. In regard to the project's train detection system, the usage of track circuits was not possible due to environmental conditions. In order to fulfil the customer's requirements, to find a solution for the rail type and under a close cooperation between Thales Italy and Thales Germany, a new Rail Contact was developed and approved in a record time of less than 9 months. Furthermore, a special protection box was developed by Thales Taiwan. This protection box protects the rail contact from the traffic without perturbing the detection principle of the Thales Axles Counter System.

Protection box

As proof for the strong partnership and the confidence in the Thales solution, both forged during the Danhai project, local industrial giant China Steel Corporation (CSC) awarded Thales the implementation of the signalling system for the extension of the Light Rail Transit in Kaohsiung (the second largest city in Taiwan with almost 2.8 million inhabitants). This new project includes the delivery of the interlocking system, traffic light priority systems, Automatic Vehicle Localisation System (AVLS) and - of course - Thales Az LM Axle Counter System with the new Detection Point Sk30R. It has a modified receiver part in order to keep the same working principle with a grooved rail, while the emitter part stays unchanged.



THALES: MAIN PROVIDER FOR AXLE COUNTERS IN TAIWAN

With more than 7000 Detection Points installed since 2000 on the TRA network (Taiwan Rail Administration), Thales is the most important Axle Counter provider for Taiwan's main line network, while TRA is one of the largest Thales Axle Counter customers in the world.

The latest award of the South Link project strengthens this position.

Initially applied as a secondary system overlaying track circuits, Thales Axle Counters are today used as the primary train detection system due to their outstanding performance. The Az Lm System is mainly used in larger applications like stations while Az LS is used for block sections and level crossings.

To glue or not to glue ...

ALTERNATIVE FIXING TECHNOLOGIES FOR RAIL APPLICATIONS

Within the last one hundred years the development of adhesives has made several quantum leaps. In 1909 Baekeland issued the first patent for adhesives. In the following decades various plastics and epoxies were developed and invented. The big breakthrough with metal- and plastic-bonding was achieved in 1960 with the cyanoacrylate-adhesives.

Today high performance glue and adhesives are a key technology in our daily life. Aircraft industry: adhesive bonds have been used for more than 60 years. Today 100-150m of adhesive bonds in each airplane keep it safely in the air. Automotive industry: for more than 15 years adhesive bonds have been the key means to safely hold windscreens, brake pads and whole car bodies. Railway rolling stock industry: adhesive bonds have been adopted from the aircraft industry enabling the usage of glass panes as bearing elements in passenger cars.

So what are the differences and challenging requirements in railway infrastructure industry and why is bonding not a popular joining technology in railway infrastructure industry, and especially for trackside elements today?

Key challenges met:

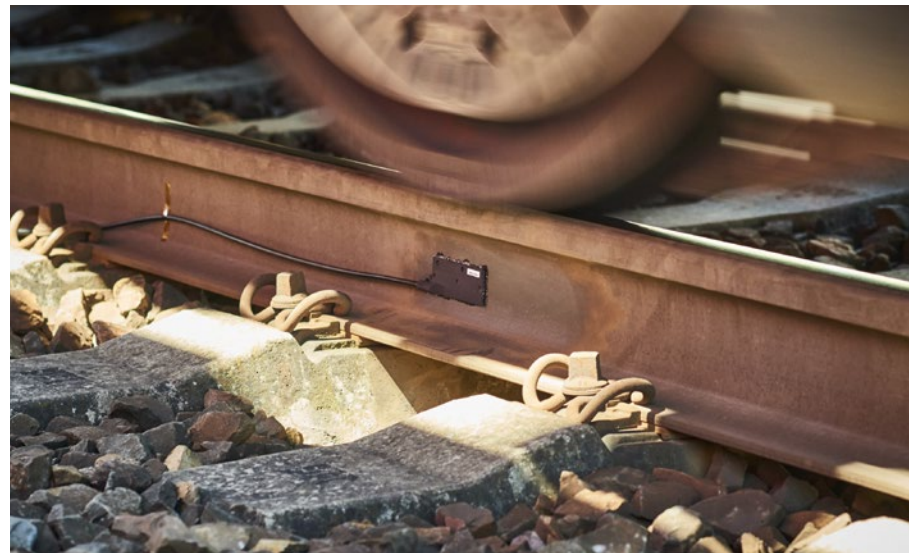
1st challenge: most metalworking industries have had welding, clinching or screwing for centuries. The changing of running systems seldom happens without any special need. Today adhesive bonds hold firm for at least 15 years, equal to classical metalwork connections. Other industries with first-class safety requirements now have several decades of experience with adhesive bonds.

2nd challenge: trackside installation works have to be performed in almost all climatic and weather conditions on this planet. In order to achieve a continuous high quality gluing result on a steel rail, cleanliness and evenness of the metal surface must be accomplished. All of this is achieved today by defining and using the right tools and methods.

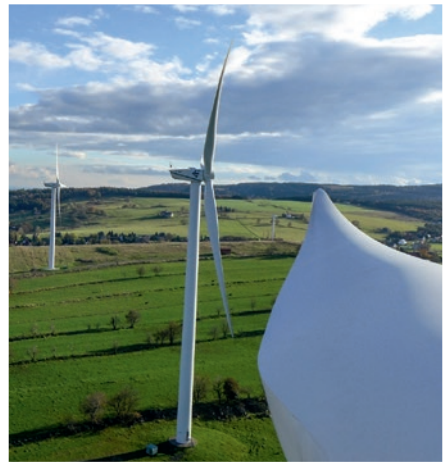
3rd challenge: the time for installation and repair needs to be as short as possible. Every minute saved on the track decreases costs and increases operational performance as well as staff security. Again, defining and using the right tools and methods makes it possible to equal and to supersede the benchmarks set by the classical metal-work connections.

Thales takes adhesive bonds to the rail

The Silver Bullet was found by bringing together experiences gained in other industries with Thales' expertise in the railway infrastructure industry. Together with our technology partners fos4X, expert in fibre optics, and IFF GmbH, expert in adhesive bonding, Thales has developed the methods and tools to glue fibre optic wheel sensors to the rail web, in the shortest time, reliably and safely.



Sensor glued to rail



Wind turbines - sensors are glued inside of rotor blades

Two-component adhesives based on epoxy seemed almost perfect for the task: high resilience, great force closure. But the repetitious accuracy of the handling of a liquid adhesive at the track turned out to be the key skill, which with all the best intentions as well as the best training of the track side staff could not be achieved. Thales decided to go for something more prefabricated, which can be handled with tools of the size for a railway man rather than those for a surgeon and found heat activating foils to deliver what Thales has been looking for.

Heat activating foils serve all mechanical requirements and can be applied with highest repetitious accuracy under all climatic and weather conditions at the track. And, using heat helps to make the perfect connection within seconds instead of hours. The heat is applied using induction, delivered in seconds, highly accurately and exactly at the place, where it is required. For many years drivers of certain German cars from Bavaria have experienced the outstanding performance of industrial gluing with inductors with every ride. In the automotive industry adhesive bonds applied through induction have here fully replaced the classical bonding of the car body. Thales is now taking this technology to the track for the mounting of fibre optic wheel sensors.

fos4X rotor blade sensing

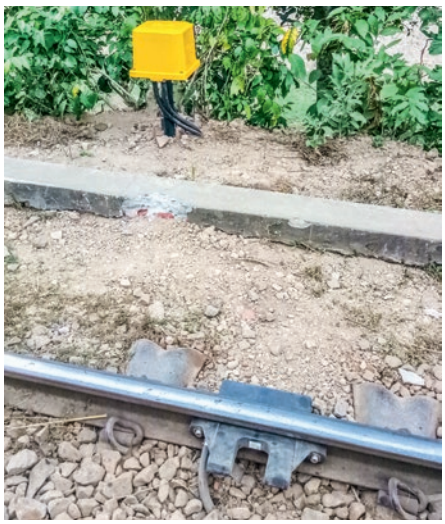
An innovative and fast-growing Industry 4.0 company with wind energy as its core market. fos4X develops solutions for monitoring and control of wind turbines based upon fibre optic sensing technology.

IFF

A company founded in 1991 as a technical consultancy firm for joining technologies. IFF GmbH develops smart bonding methods for customers requiring robust processes and maximum product quality. Since 2003 IFF GmbH has developed and manufactured a custom-made induction technology optimising manufacturing and joining processes.

Mix it up! Compatibility of Sk30K and EAK30H

BANGLADESH: SUCCESSFUL DEPLOYMENT OF SLIMLINE WHEEL SENSOR WITH 'MUSHROOM' ELECTRONIC UNIT



Compared to the Thales Rail Contact Sk30H, the slimline wheel sensor Sk30K has lots of advantages, such as fewer mechanical parts (four only!); it is easy to install and maintain (no mechanical adjustment required, no need for re-adjustment), an installation over the sleeper is possible, and there is practically no need for dismounting during tamping and grinding – to mention just a few benefits.

The latest introduction of the new multimode Analogue Board simplifies the exchange of the rail contact model while protecting the customer's investment in the well proven Electronic unit EAK 30H ('mushroom EAK'). With the new Analogue Board it is now possible to upgrade existing Zp30H installations with the Rail Contact Sk30K by keeping the EAK 30H on site. To ensure a smooth and easy replacement, several upgrade kits are available, and positions of the mounting holes of the Sk30H are compatible with the Sk30K.

Of course, the parallel operation of the Sk30K and Sk30H with the EAK30H is also possible. As one of the first customers, Bangladesh Railways will benefit from the advantages of this technological upgrade. The first installation on a trial site supervising a single section between the two stations Rajendrapur & Sripur demonstrated the accurate performance as well as the suitability and compatibility of the updated technology in the Bangladesh Railway environment and operation.

BANGLADESH RAILWAY (BR)

The first railway was started on 15 November 1862. At present, over 2.8 thousand kilometres of railway line network is connected to 44 districts of the country employing over 25000 regular employees.

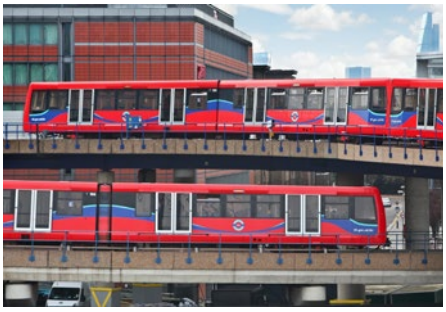
Bangladesh Railways operate on multi gauge infrastructure, like broad gauge, metre gauge and dual gauge.

DLR ACE exchange programme – an unexpected experience

In order to further increase the reliability and to mitigate against obsolescence of the Dockland Light Railway (DLR) train detection system, it was decided to replace the existing 23-years-old Thales L-90-3 technology with the Az LM System. Notably, on the track, the change will be visible due to the use of the most recent product, the Sk30K sensors and EAK30K electronic units. Internally the change will be apparent by the extra space created in the equipment rooms by the reduction of relays and an enhanced diagnostic interface. Upgrading to Az LM will also provide additional axle counter system functionalities and will reduce the impact of system failures on the DLR operating system.

The upgrade to Az LM is planned to be done in engineering hours without any major closures of the DLR, therefore minimising the impact on passengers. The new system will be installed in 'Station Controller Migration Clusters' alongside the existing system and will be integrated using bespoke switchover cubicles. This will then allow the new system to be 'over and backed' during engineering hours to facilitate the required testing.

System availability is a key DLR priority, and any change is considered a potential risk. Usually for a good reason, the saying, 'never change a running system' can hold some truth! With this in mind, Thales has performed a compatibility check on the existing rolling stock of DLR, namely the Bombardier B92 and B2007 trainsets with the new Sk30K sensors with the EAK30K slimline electronic unit.



Two DLR-trains on West India Quay

The compatibility checks were carried out at Canning Town station. The setup comprised two EAK30K sensors temporarily installed and the corresponding Sk30K sensors clamped to the rail. The installation was run in shadow mode and had no operational responsibility or impact. Against the recommendation to install the sensor close to the traction rail due to personal protection and EMC concerns, it was decided to test this installation location as well. This was due to operational constraints during the migration from old to new which may make it necessary to use the un-favoured installation locations close to the traction rail.

Analysis of the measurement data showed that at both installation locations relative to the traction rail, the interference level of trains caused no disturbance to the Az LM outdoor equipment during monitored operating hours. This leads to the conclusion that the rolling stock type B92 and B2007 is compliant with Az LM outdoor equipment (EAK30K+Sk30K) according to EMV04 under the observed circumstances.

So in summary, the results of the session were as expected; however, the pleasant surprise came when the team did not encounter any rain during four days in a city where statistically it rains on 36% of days per year!

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