Signalling System in Railway Transportation

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In this era of advanced technology, signalling is very important. In fact, signalling is a huge part of our daily commuting. One example is the traffic light at road intersections. With its red, amber and green coloured lights, it is a signalling device designed to control, ease and ensure the safety of motor vehicles.

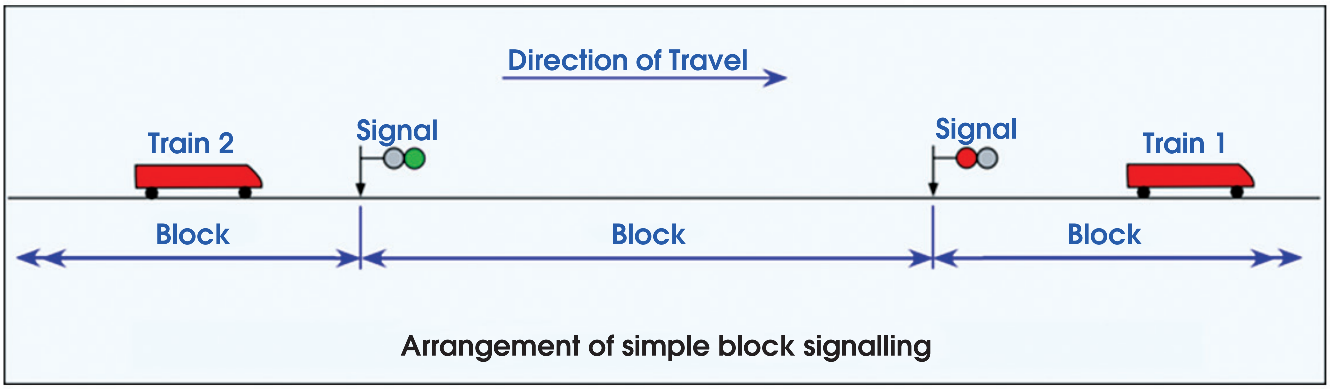

Figure 1: Fixed Block System

So what is signalling? In his book, *Introductory Signal Processing*, author Ronald Priemer defined a signal as "a function that conveys information about the behaviour of a system or attributes of some phenomena".

In the railway industry, signalling has 7 main safety functions:

1. Providing a safety margin distance between moving trains on the same track.
2. Protecting trains that pass through crossings or switches.
3. Protecting trains moving in the opposition direction.
4. Protecting trains at level crossings.
5. Ensuring that a driver obeys the speed limit to prevent derailment.
6. Assisting in traffic regularity.
7. Preventing a collision.

Besides the above safety features, signalling can also improve train transit speed and efficiency which will, indirectly, improve passenger handling capacity.

There have been lots of changes and advancements in railway signalling. At the start, railway signalling used track circuits and wayside signals to detect the presence of trains and to provide movement indications to train operator. The first generation signalling was also called Fixed Block System (Figure 1) as, at any one time, each block only allowed one train to move.

Therefore the train operator had to obey the traffic semaphore. When the traffic semaphore turned red, the train could not proceed to the following block and had to wait until the block ahead was cleared and the light had changed to green. The limitation of the Fixed Block System was that train throughput and operational flexibility were restrained.

In the next generation signalling, track circuits were used, based on in-cab signals instead of wayside signals. The coded track was developed and introduced at this time. This development was important because, with the speed codes transmitted from the wayside through the running rails to the train, the train speed could be monitored. In the event of speeding, an Automatic Train Protection (ATP) subsystem would initiate emergency braking to prevent derailment or collision with the train ahead. This generation permitted automatic driving modes with onboard equipment that was capable of detecting and reacting to the speed codes. But train throughput and operational flexibility were still limited by track circuit layout and number of available speed codes.

The next advancement in the signalling control system provided for more precise control of train movements. The train was supervised and controlled to follow a speed-distance profile. Unlike previously, the train no longer responded or reacted to individual speed codes. The wayside processor generated a coded message (permitted line speed, train target speed and distance-to-go to the target speed) to each track circuit. The onboard train equipment then calculated the speed-distance profile based on this information received, for the train to follow. This generation of signalling control could support automated driving modes and improved train throughput.

The fourth generation of signalling uses radio signals instead of track circuits as a communication medium between the train and the wayside. It is also referred to as Communication-Based Train Control (CBTC) signalling.

It permits a train to travel in moving block operation which separates trains based on a train's absolute position and the speed is based on the distance between trains. CBTC can support automated driving modes and offers maximum train throughput and greatest operational flexibility compared to the previous generation. In Malaysia, both LRT (Ampang Line) and MRT (Klang Valley) use CBTC signalling technology.

In conclusion, signalling technology plays an important role in railway systems as it maintains safety as well as increases the efficiency of the train throughput and passenger handling capacity. ■

BIBLIOGRAPHY

[1] Ronald Priemer. Introductory Signal Processing, 6th Vol. [Online]. Available: https://books.google.com.my/books?id=QBT7nP7zTLgC&printsec=frontcover#v=onepage&q&f=false Accessed on 30 June 2018

[2] Signalling. http://www.railway-technical.com/signalling. Accessed on 30 June 2018

[3] F. Richard Yu, Advances in Communications-Based Train Control Systems. 2015

[4] L. Lindqvist & R. Jadhav, Application of Communication Based Moving Block Systems On Existing Metro Lines.

[5] Signalling System. https://www.sgtrains.com/technology-signalling.html. Accessed on 3 July 2018

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