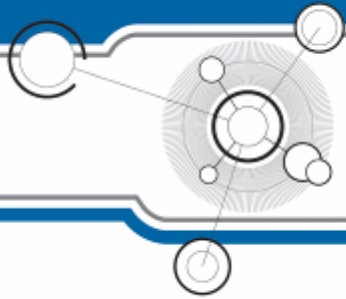


KeTech Systems Limited Platform to Train Transmission Technologies





KeTech Background



- KeTech's engineers have:
 - Provided PtT for last 15 years to LUL
 - Carried out PtT research for LUL
 - Provided systems on Jubilee and Victoria Line, trackside and on vehicle



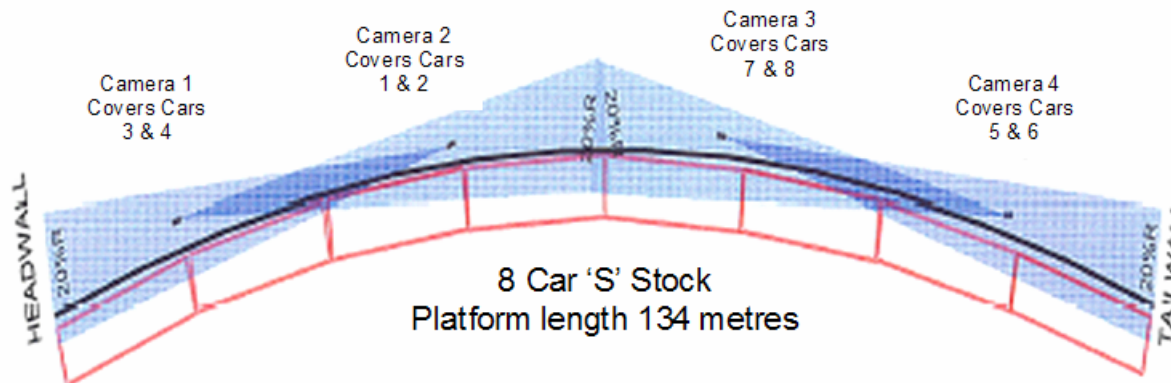
The Requirement

- Provide safe method of departure
- Real time picture displayed to driver from stopping point until last carriage has left the platform
- Reduced operational costs
 - On train - no guards
 - Reduced dwell time – greater train throughput
 - On platform – reduced maintenance, elimination of headwall mirror systems

The solution



- Cameras located on platform to view complete platform / train interface
- Images combined and transmitted to train
 - Role of transmission system is crucial, excellent dynamic performance a necessity
- Received and decoded
- Displayed to the driver in cab

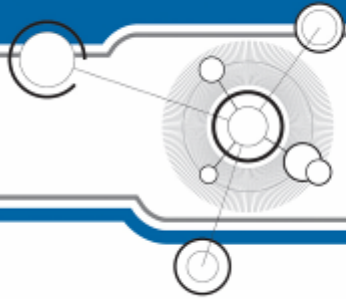




Key Performance Issues

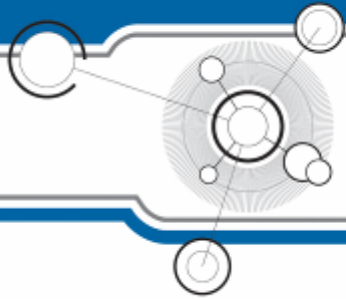


- Continuous coverage
- Safety Related System
- High Reliability
- Zero latency, full bandwidth
- Ease of installation and maintenance
- Flexible solution to accommodate all track configurations
- Licence free, low operational cost
- Non-public band transmission to reduce interference



Candidate Technologies **KeTech**

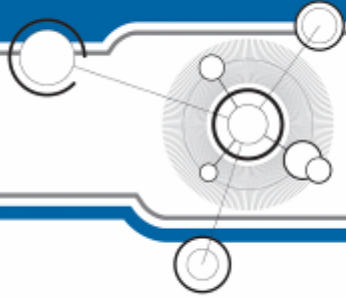
- Wi-Fi
- Optical Transmission (Infra Red LED, Laser)
- Microwave
- Leaky Feeder



Wi-Fi



- Off the shelf technology; well established standards, IEEE802.11a,b,g
- Digital System – introduces latency
- Utilises a public access band – open to interference from domestic Wi-Fi networks
- Subject to reflections and multi-path effects (frozen pictures & dropouts)
- Inefficient use of transmission bandwidth



Optical - Laser



- Can provide multiple video channels
- Suffers with critical alignment – installation and maintenance difficulties
- Very narrow (typ. $<2^0$) beam patterns, leading to difficulties in curved platforms
- Susceptible to dust build up and adverse weather conditions – reduction in system performance
- Maintainability



Optical - LED



- Generally single channel devices transmitting baseband video signals.
- Susceptible to dust build up and adverse weather conditions – reduction in system performance
- Range issues and track curvature - requires the use of multiple transmitters giving rise to interference problems at the point where transmitters overlap



Microwave



- A solution derived from established technology for Point to Point transmission of data & Video
- Full bandwidth, non compressed video transmission
- An effective solution for clean, straightforward, straight line environments, used to good effect in Far East
- Can provide high quality video performance and multiple channels



Microwave



- Active transmission equipment installed trackside
 - leads to access, clearance and maintenance issues
- Complex frequency management to prevent adjacent transmitters interfering with each other
- Unproven for complex scenarios - carries a significant risk
- Susceptible to reflections and multi-path effects (can be reduced by the use of COFDM)
- Relies on received radio signals from beacons to provide channel switching which gives rise to the potential for crosstalk
- Licensing regulations are unclear depending on frequency band utilised
- Transmitter positioning is site-specific. Track clearance issues and local features may prevent ideal locations being achieved leading to coverage compromise



Leaky Feeder



- Simple installation – only cabling is required
- Full bandwidth, non compressed video transmission
- In-built channel switching intelligence - interfaces to Train-borne signalling to provide highest integrity and eliminate crosstalk issues
- Common solution for all sites - channel switching intelligence is train-borne
- Consistent function on surface and sub-surface sites
- No active track-side equipment required
- Very low power operation - no licence required
- Variants allow bi-directional operation (Data & Video transmission)



Summary



- Leaky Feeder is:
 - Most effective technology in Underground environment
 - Most reliable
 - Proven
 - Flexible
 - Minimum Whole Life Costs