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# Turning South London Orange

## Analysis by the Thales team

**8TH JANUARY 2016**



OPEN

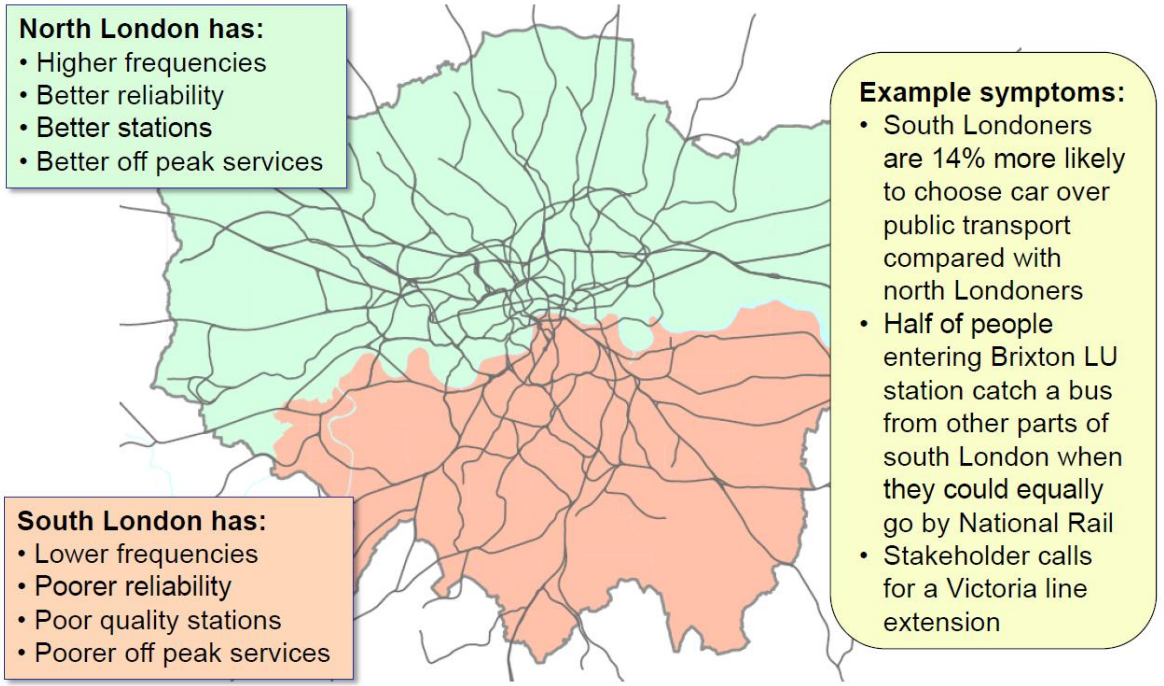
# Introduction

## What we know:

- South London is poorly served
- Many factors involved
- Mixture of engineering, political and regulatory

## What Thales have looked at

- Technical aspects, as befits our expertise
- Narrowly defined, but with wider implications







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# Our focus: signalling and control systems

## Modern signalling & control systems

### Part 1 - Network Characteristics & performance

- Existing System – current status & future plans
- How performance could be improved & constraints
- South Central Suburban – current performance
  - Causes of Delay
  - Station Dwell Times
  - Junctions

### Part 2 - Potential Benefits & Implementation Issues

- Traffic Management
- Automatic Train Operation

### Part 3 - Recommendations

Increasing capacity

Improving Performance







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# Signalling & Control: Existing Infrastructure

## Resignalled in 1980s – conventional signalling

## Control from entry-exit panels at three locations. No Automatic Route Setting (ARS) for the SC suburban routes

- London Bridge,
- Victoria Area Signalling Centre (at Clapham) and
- Three Bridges

## Recent Resignalling Projects focused on asset (interlocking) replacement

- Victoria Area & London Bridge Resignalling








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# Signalling & Control: Future NR Plans

## Future Suburban Resignalling Plans mentioned in Network Rail Route Study:

- CP5/6 resignalling projects could present opportunities to resignal for increased platform/train lengths (12 car).
- CP5 Wimbledon Loop – signal spacing improvements & interlocking renewals (2015/16)
- CP6 Norwood Interlocking replacement
- CP6 Balham - Clapham re-signalling opportunity
- Control of this entire area is expected to migrate to Three Bridges when Traffic Management programme is implemented.







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# Improving Performance - benefits

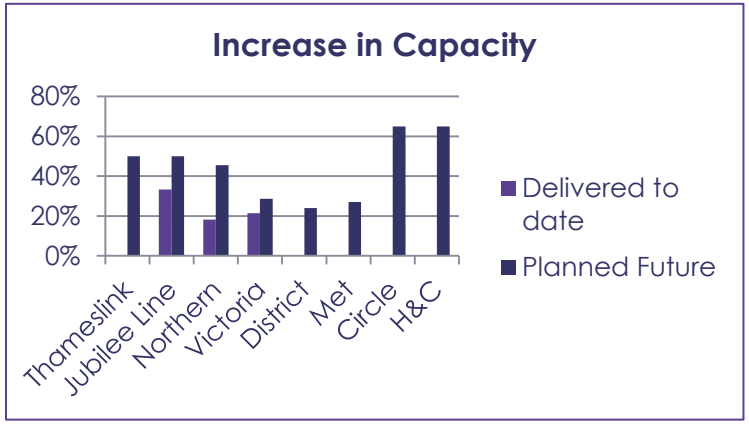
## Modern Signalling & Control systems can deliver

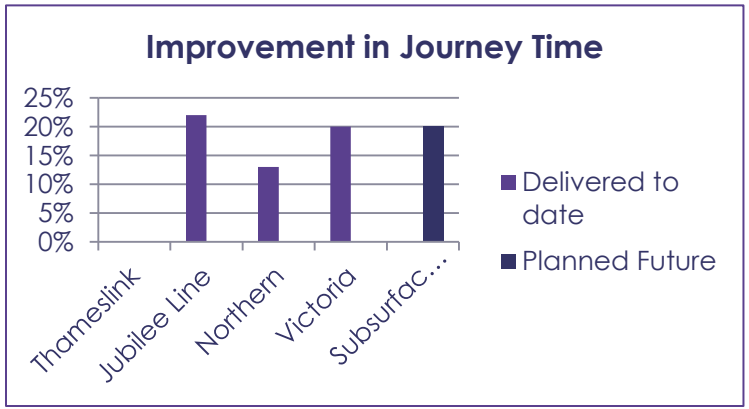
- Additional capacity
- Greater stability of service
- Reduced journey times

## There is usually a complex trade off between the factors above

## The benefits realised vary but can be in the region of

- 18-65% in capacity
- 13-22% improvement in journey time







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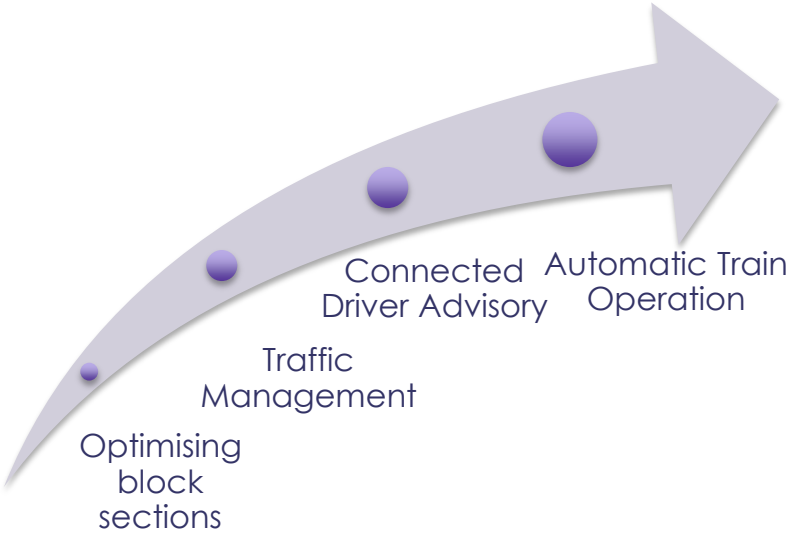
# Improving Performance – techniques & limitations

## Performance is typically increased by

- Reducing length of signalling sections (Shorter fixed blocks or moving block)
- Upgrading control systems to give better decision support
- Providing advisory speeds from the control system to the driver (C-DAS)
- Driving & stopping trains automatically with Automatic Train Operation (ATO)




## Performance is typically limited by:

- Junctions/ network complexity
- Dwell Time
- Operations at terminal stations







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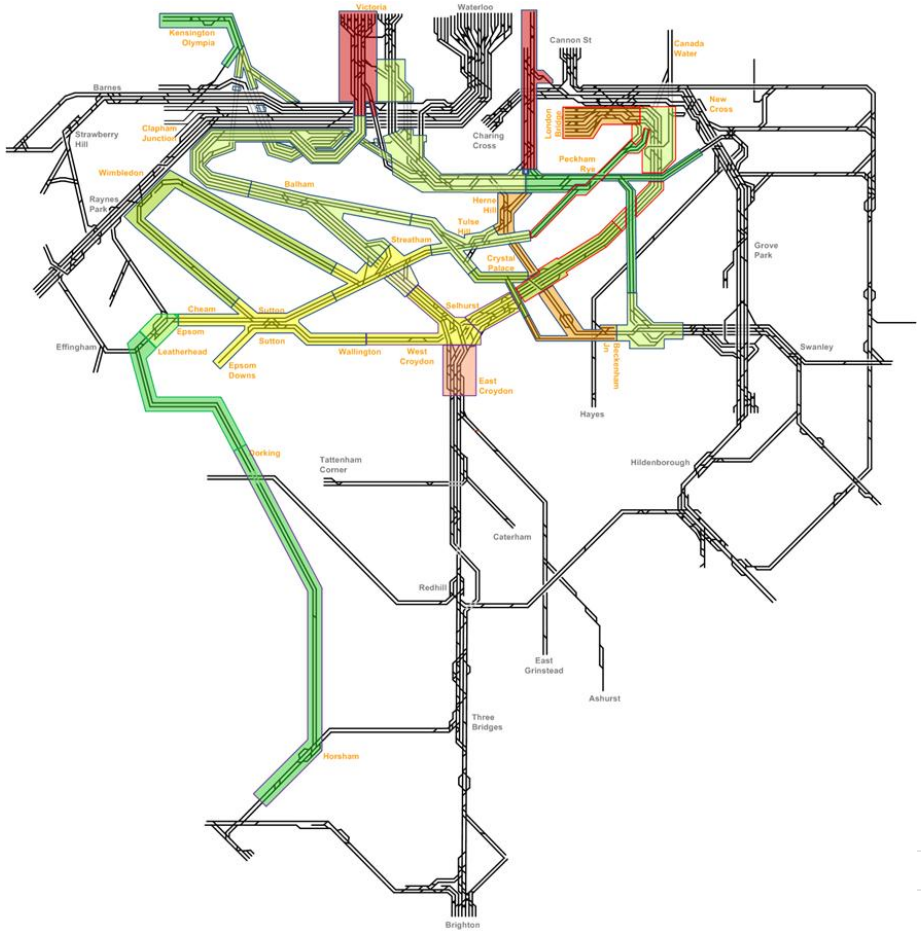
# We have analysed South Central Suburban section




| Total Delay (mins) | |
|---|---|
| | 300,000 - 350,000 |
| | 250,000 - 300,000 |
| | 200,000 - 250,000 |
| | 150,000 - 200,000 |
| | 100,000 - 150,000 |
| | 50,000 - 100,000 |
| | 0 - 50,000 |





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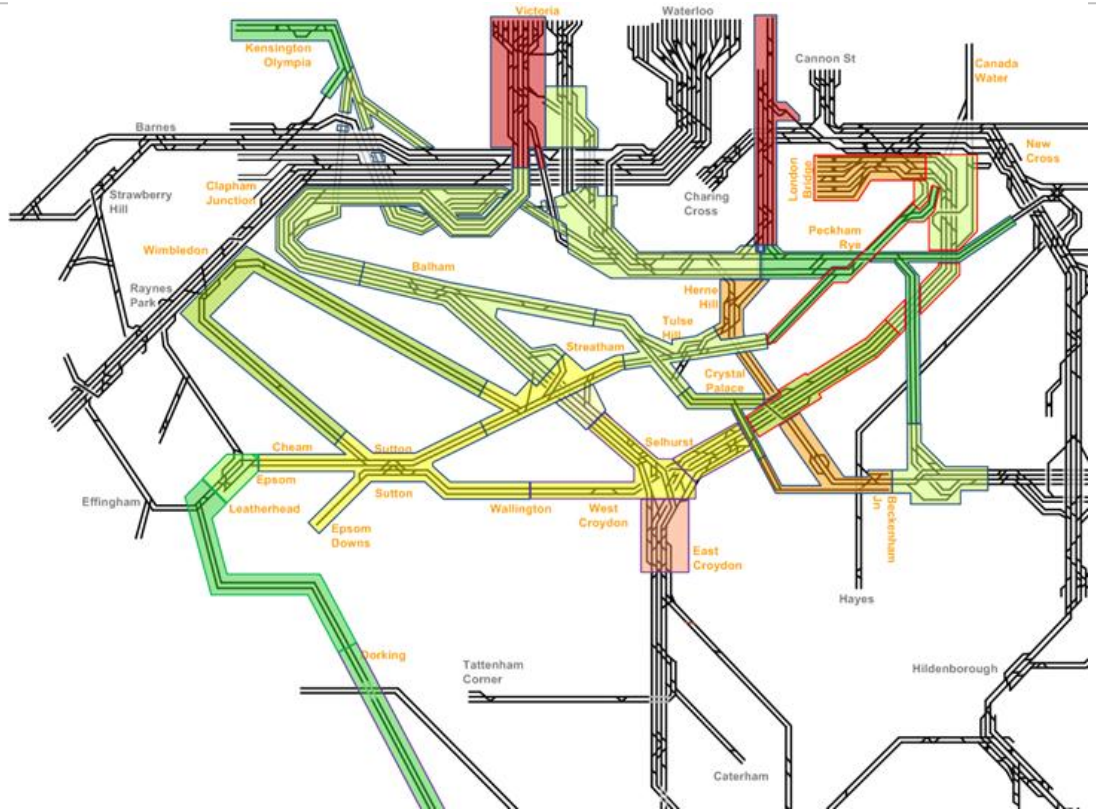
# Delays in South Central Suburban

## Delays concentrated in 5 areas:-

- Victoria Central (Victoria 1)
- Blackfriars (Victoria 6)
- Herne Hill (Victoria 9)
- London Bridge Central (London Bridge 9)
- East Croydon (Three Bridges 1c)







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# Delays in South Central Suburban

## CP4 (2009-14): Suburban South Central

- 822k minutes of Primary delay
- 2505k minutes of Reactionary delay
- Reactionary = 3 x Primary, so delay ripples/has knock on effects through network

| Delay | SC Suburban | North London | National |
|---|---|---|---|
| Primary | 25% | 44% | 55% |
| Reactionary | 75% | 56% | 45% |







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# Top 5 causes of delay in South Central Suburban 'hotspots'

| | | SOUTH SUBURBAN HOTSPOTS | | | | |
|---|---|---|---|---|---|---|
| | | Vic 1<br>Vic Central | Vic 6<br>Blackfriars | Vic 9<br>Herne Hill | LB 9<br>Ldn Bridge Central | TB1<br>East Croydon |
| CAUSES OF DELAY | Technical fleet issues | 13.7% (1st) | 15% (1st) | 15.5% (1st) | 15% (1st) | 13.6% (1st) |
| | Train crew issues | 8.3% (2nd) | | 6.1% (4th) | | 8.2% (2nd) |
| | NR signalling operations | 6.7% (3rd) | 7.1% (3rd) | | 7.1% (3rd) | 6.6% (3rd=) |
| | Track circuit failures | | 7.4% (2nd) | 6.9% (3rd) | 7.4% (2nd) | |
| | External fatalities & trespass | 6.6% (4th=) | | | | 6.6% (3rd=) |
| | All codes – unexplained | 6.6% (4th=) | | | | 6.6% (3rd=) |
| | Train operations | | 6.9% (4th) | 8.1% (2nd) | 6.9% (4th) | |
| | External (Train operators) | | 6.2% (5th) | | 6.2% (5th) | |
| | Points failures | | | 5.1% (5th) | | |
| Top 5 causes as % of total delays | | 48.9% | 42.6% | 41.6% | 42.6% | 41.5% |

- Top 5 issues account for 40-50% of delay (North London & National are similar)
- Rolling Stock failures is biggest cause of delay ~13-15% (North London ~ 18%)
- NR Signalling operations ~6-7% of delay (North London ~2%)
- Freight not a issue (unlike North London & Nationally)







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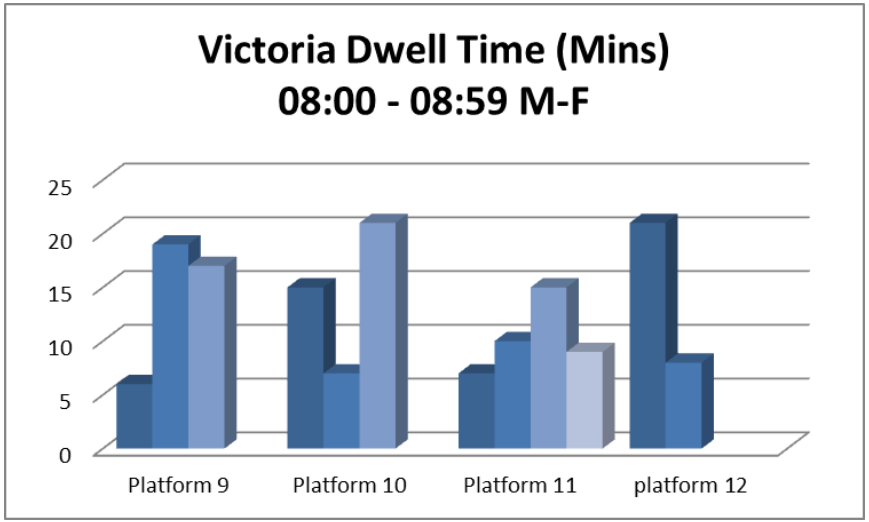
# South Central Suburban Network Characteristics

## High Susceptibility to Reactionary Delay

- Platform Utilisation at key stations – long occupation times due to splitting/joining
- Diagram in-balancing & resource unavailability
- Network Pinch Points – Herne Hill
- Signaller overload & misrouting
- Lack of macro level dispatch management

# Station Utilisation: Working Timetable - Victoria

## High platform occupancy caused by complex service patterns with splitting and joining. Delivering ~13-15 tph from 4 platforms




| Platform Utilsation | Platform 9 | Platform 10 | Platform 11 | Platform 12 |
|---|---|---|---|---|
| Occupied | 65% | 70% | 65% | 45% |

| Departing | | | Arriving | |
|---|---|---|---|---|
| H/Code= 2 | 11 | | H/Code= 2 | 13 |
| H/Code= 3 | 3 | | H/Code= 3 | 0 |
| H/Code= 5 | 1 | | H/Code= 5 | 0 |
| tph | 15 | | tph | 13 |

## Performance looks like its optimised for service pattern (stock/crew?) rather than capacity







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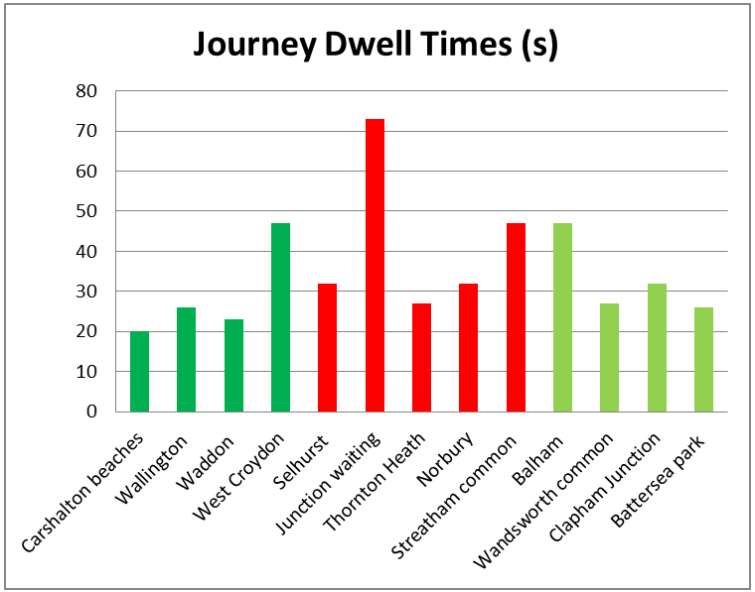
# Station Dwell Times

## South Central Suburban Journey

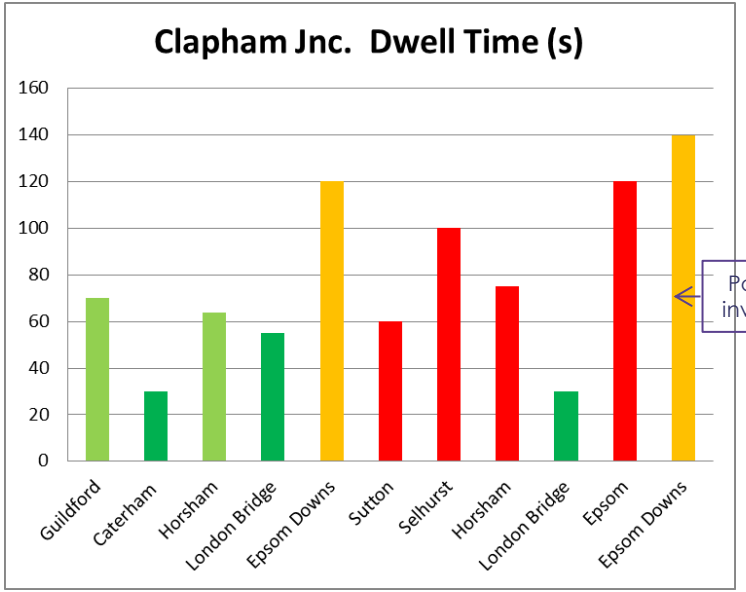
- 08:14 Sutton to Victoria (49 mins, 11 miles)




| LOADING |
|---|
| Light |
| Fair |
| Busy |
| Very Busy |

## Clapham Jnc Platform 15

- Evening peak from 16:45-17:45







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# Station Dwell Times

## Sutton - Victoria results

- 15% of journey is dwell time/stationary waiting junction
- Slow junction & Victoria approaches

## Station Dwell time could be reduced by

- Optimised stock design
- Metro style stations operations

## Junction wait time could be improved by

- Different timetable management
- Metro style junction signalling & traffic management

## Providing opportunities to increase capacity & improve Journey time for passengers








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# Turning South London Orange

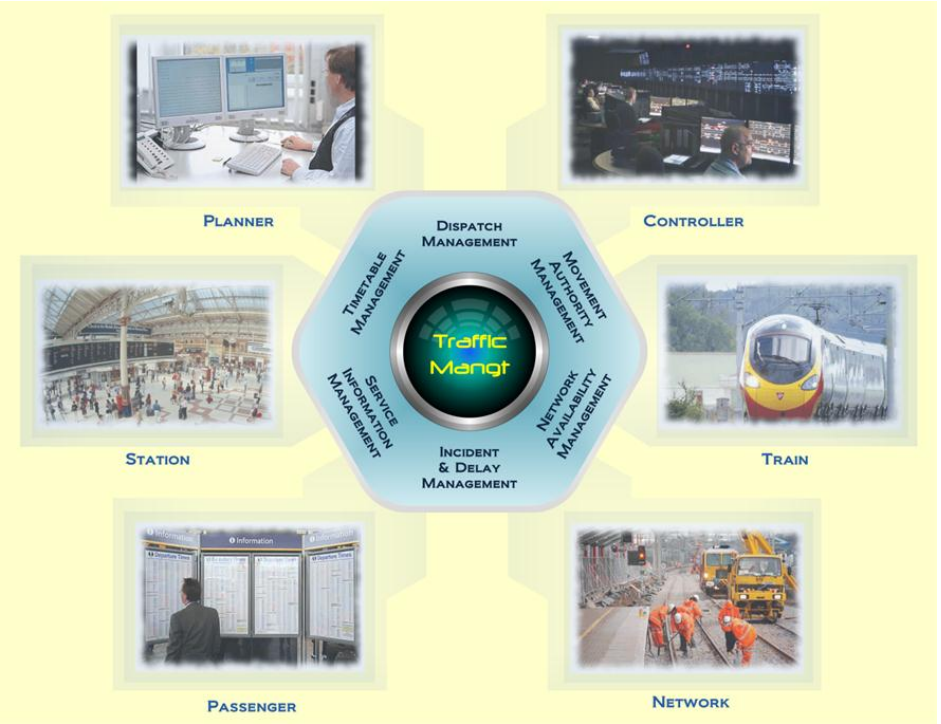
# Part 2 – Potential Benefits & Implementation Issues

# Potential of Traffic Management

- Traffic Management can help reduce Primary & Reactionary delay
- By integrating railway operations it also delivers benefit in other areas

But…..

- Signalling & control is just part of the story
- Changes to Rolling stock, station operations, timetables etc. will also release capacity & improve performance







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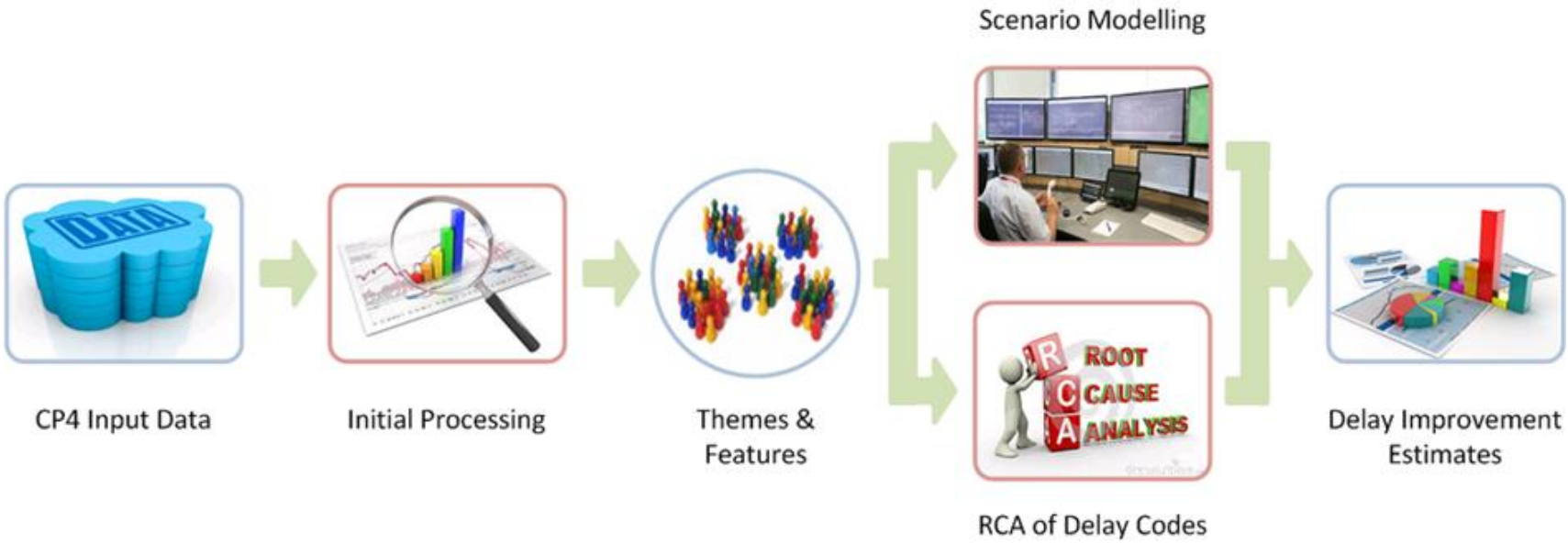
# Quantifying the Benefits of Traffic Management

## Benefits need Modelling for a complex network like SC Suburban

- Benefits depend on type of implementation – operational support or fully integrated
- We have data from other simulation scenarios to give an idea of what could be possible







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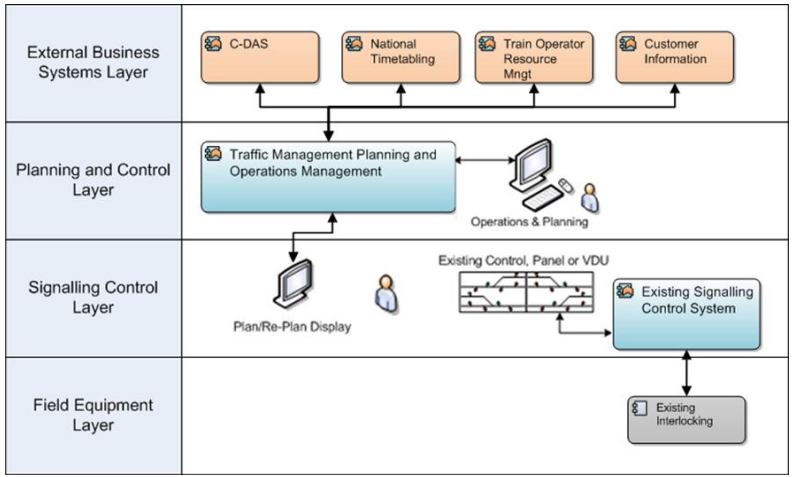
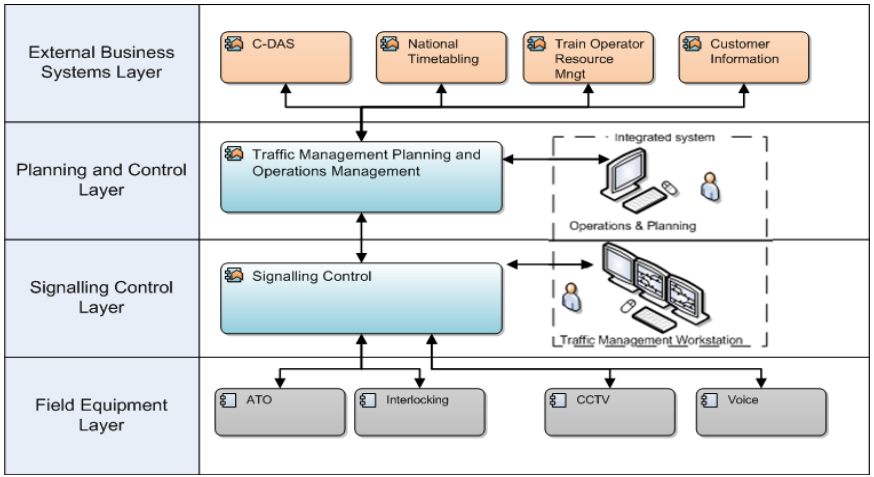
# Traffic Management; Different Implementation Approaches




## TM Operational Support

- Conflict identification and decision support
- Plan management –including contingency management
- Quick to implement & non disruptive




## Fully Integrated TM

- Additionally automatically drives signalling & train control systems
- Builds upon TM Operational Support







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# Traffic Management: Potential for SC Suburban

| Expected reduction in Delay with TM | Primary Delay | Reactionary Delay | Total Delay |
|---|---|---|---|
| Operational Support | 6% | 15% | 13% |
| Fully Integrated | 15% | 25% | 21% |

- **TM could reduce delays by ~13% as a quick fix in isolated and in the longer term by up to 21% if fully integrated**
- **This would need to be modelled in detail to confirm predictions are viable**

| Expected Improvement in Hot Spot Delay issues with Integrated Traffic Management | Primary Delay | Reactionary Delay |
|---|---|---|
| Technical Fleet Delays | 6% | 16-22% |
| Traincrew | 6% | 16-22% |
| NR Signalling operations | 90% | 90% |
| Track Circuit failures | 6% | 16-22% |
| External fatalities & trespass | 6% | 16-22% |
| All codes - unexplained | 23% | 48% |
| Train Operations | 0% | 16% |
| External (Train operators) | 0% | 16% |
| Points failures | 6% | 16-22% |







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# Automatic Train Operation

- **Metro has shown that ATO can release an additional capacity (~15%) by**
  - Consistency of Driving technique
  - Increasing station approach/departure speeds
  - Reduced recovery margins – 20 to 40 sec reduced typically to 10-20 seconds
  - Improved platform/junction times
- **In addition to delivering reduced energy consumption – typically 10-20%**
- **…… but this is in an environment with few junctions, captive fleets, all trains with the same braking performance etc….**







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# Automatic Train Operation

## ATO could provide benefit for SC Suburban, but unlikely to be same magnitude

## Key issues for implementing ATO on the South Central Suburban include

- **Major re-signalling project** - ATO requires an underlying Automatic Train Protection System e.g. ERTMS/CBTC
- **Train fitment challenge** - ATO would require fitment of all trains running over route
- **Mixed Fleet** - Challenging for suburban environment with mixed fleet with varying braking performance. Performance achieved will be limited by poorest performing services.
- **Complex migration strategy**







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# Part 3 - Recommendations

# Turning South London Orange - Conclusions

Our technical analysis shows clear potential – although clearly the impact would be even more substantial if wider considerations were also brought to bear (train operations, crew changes, etc)

- **Better utilisation of the capacity that already exists**
- **Improving capacity**
- **Reducing platform dwell times**
- **Other considerations**







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# Better utilisation of the capacity that already exists

## We believe that it is possible to make better use of the capacity that already exists using Traffic Management to:

- reduce some primary delays through better decision support, in particular delays caused by some signalling operations
- reduce a large proportion of reactionary delays through better prediction and resolution tools
- allow improved usage of the capacity already available by producing optimised "journey plans" that take account of current and predicted conditions, and by implementing these "journey plans" automatically using Automatic Route Setting

## Future application of C-DAS would allow better implementation of the "journey plans" via speed profile information presented directly to the Train Operators

# Improving capacity

## We believe that it is possible to improve capacity as follows:

- **Using newer, improved braking profiles** & re-signalling the infrastructure, even with like-for-like traditional fixed block signalling will improve signalled capacity
- **Imposing a minimum brake rate** for freight and passenger vehicles using the route, capacity improvements could be gained by revised signalling layout
- **Applying metro style signalling to junctions** would improve route setting and route release times, e.g. by using shorter blocks and earlier release of point deadlocking using axle counters rather than track circuits
- **Optimising the service pattern for capacity** rather than for staff or rolling stock constraints – this would reduce platform occupation times
- **Optimising the service pattern around junctions** – reduce the time during which junctions cannot be used
- **Reduce station dwell times**

# Reducing platform dwell times

## Platform dwell times can be reduced using:

- **Better rolling stock design** – increased door areas, increased passenger accessibility, reduced obstructions
- **Metro style count-down timers** to departure
- **Improved passenger information** – identifying coaches with passenger space and directing passengers at the platform
- **Non-stopper services**, carrying large volumes of passengers through stations, reducing congestion on stopping services

# Other considerations

## Potential application of Automatic Train Operations (ATO) to reduce variations in driving style and to accurately implement the TM "journey plans"

- Would need to be applied to ATP-fitted rolling stock
- Would require all rolling stock using the route to be fitted
- Feasible for ETCS-fitted rolling stock

## Interoperability between sub-urban and intercity services

# Conclusions

- **Modern Signalling & Control Systems could deliver benefits**
- **But they can only have a limited impact if implemented in isolation of other improvements**
- **Actually, South London needs a holistic approach which incorporates changes to rolling stock, franchise operations, staffing, infrastructure, etc etc**
- **Only then could it properly and successfully be as 'orange' as North London**

Increasing capacity

Improving Performance







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