THE INTERNATIONAL RAILWAY SYMPOSIUM 2023
– SUSTAINABLE RAILWAY: CONNECTING NATIONS, PRESERVING FUTURES

Exploring Opportunities for Reduced Energy Costs

(Fulfilling an Obligation to Work Towards a Lower Carbon Footprint)

A presentation by Rod Anders

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An Introduction.

Rod Anders has a career in Railway Systems spanning over 30 years. He has contributed to many of the major rail projects in Malaysia such as KLS, ERL, Putra, RW-IP, IP-PB, KVDT2, MRT2 and RTS as well as many other rail projects in Australia, Singapore, Korea, Taiwan, Indonesia, Thailand, Uzbekistan and UAE.

PARSONS JTC AnsaldoSTS SIEMENS Marubeni Jacobs

Having seen many different specifications and approaches, some areas of opportunity to think outside the box and improve on the efficiency of the final system have come to mind and are outlined here.

The Mind-set of Approach

In the design and specification of any new railway system there is an obligation to build it with:

- Optimal energy consumption in mind
- The elimination of waste in both construction and operations
- Efficient long term energy usage

- We must be aware that the system designed today will be constructed in 3 to 5 years from now and will likely operate for upwards of 50 years in a very similar configuration to that in which it was commissioned.

Under the Mindset of Approach heading I want to touch on:

- Value
- Application and
- Scope

The Mind-set of Approach

Value

- A point to keep in mind is that every single piece of equipment that is eliminated is something that not only reduces capital cost but does not need to be designed, installed, tested and never needs maintained or replaced.
- Every energy reduction is a saving for the whole life of the railway.
- Although we can only guess at what social circumstances we will encounter in 15 or 20 years, we can be sure that energy will cost more and (associated) carbon emissions will be increasingly scrutinised.

The Mind-set of Approach

Application

- While looking at the ideas in this presentation, just because that particular direction or element is impractical or irrelevant in the actual design of your next railway, it is important for us to keep the concept and our frame-of-mind in the same place so as to come up with ideas and actions which are applicable. And some concepts will necessitate a paradigm shift, not just a modification.
- Some of the topics explored today are challenging to apply to a railway that is already operational but if the concepts are kept in mind, then some can be introduced during refurbishments and up-grades, nothing is static.

The Mind-set of Approach

Scope

Although the ideas in this presentation are varied and often overlap in their implementation and operational effect, the 25 or so topics are divided into some general headings:

- Alignment
- Rolling Stock
- Depot Design
- Station Design
- Systems and Integration
- Control Centers

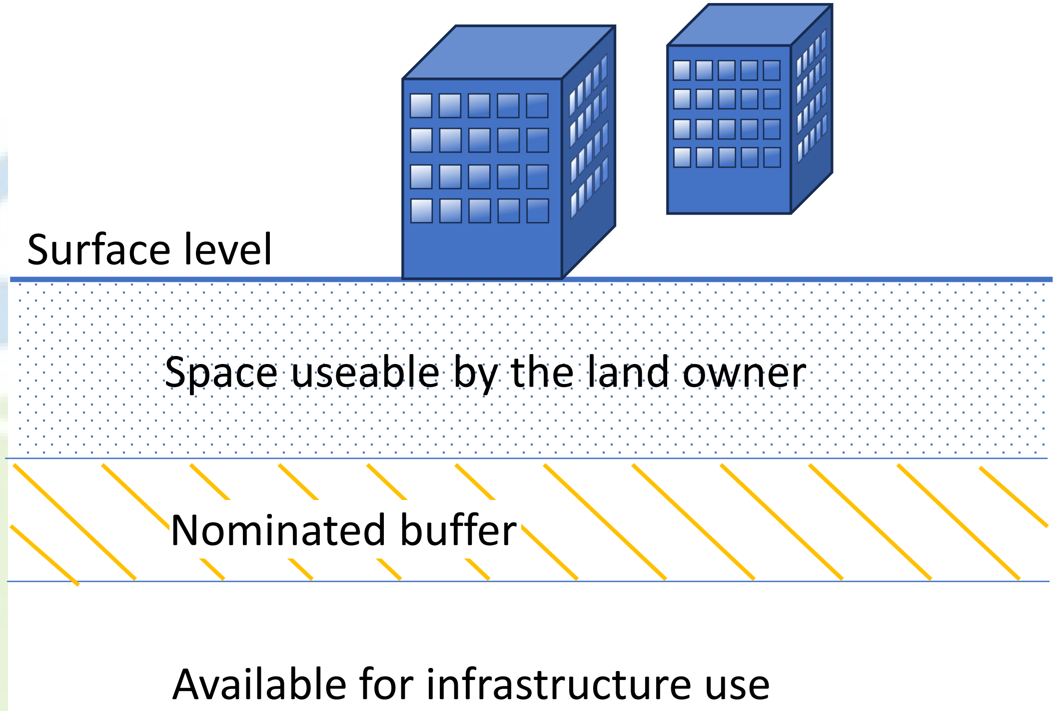
Alignment

Buildings or obstacles to a gentle curvature or gradient of alignment should be removed (unless of an historic or heritage value) because the introductions of speed changes to a system wastes energy as well as the tighter curves causing avoidable wear on rails, wheels and transmissions.

Previous rail systems here may have been compromised by the Malaysian land ownership regulations which do not easily allow the Government to appropriate the access to underground areas. This has been overcome in other countries and it would make sense to examine how other countries have approached this issue to ensure best result for the Nation with a fair outcome for individual land-owners. This would allow for standardised underground station structures and reduced curvature in the alignments.

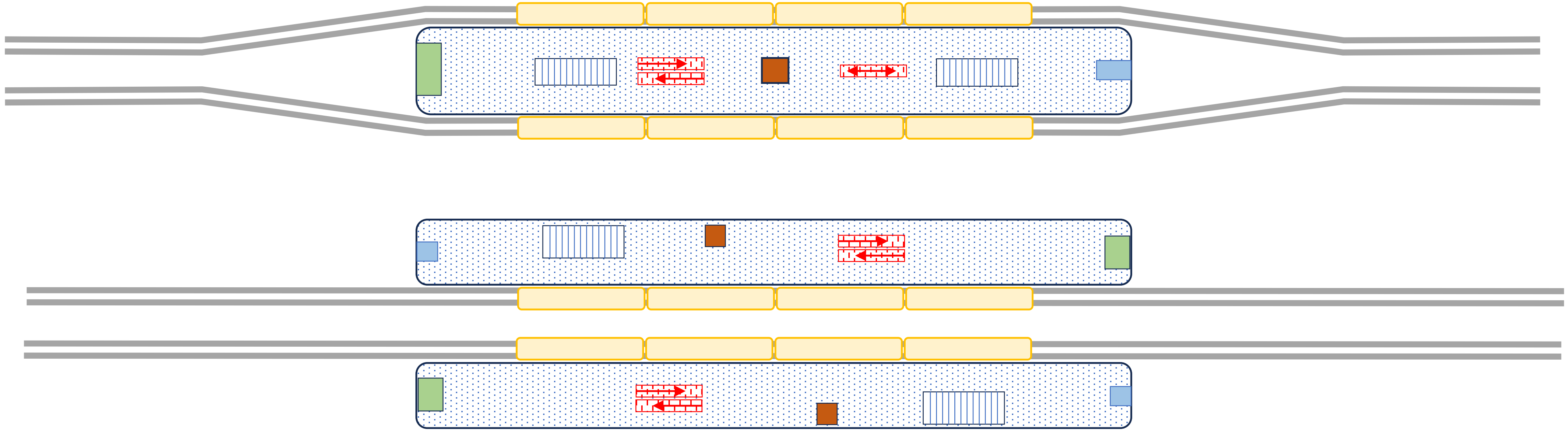
Alignment

Underground Alignment.
The solution adopted by some countries for urban locations is the 'buffer zone' where the surface owner has use up to a certain depth, then there is a buffer zone and below that the Government may enter freely for infrastructure purposes.



Alignment

Better access to land, giving an optimal corridor will allow more consideration to be given to standardising the platform layout for all stations. Center platform provides best operational flexibility as well as allowing streamlining of a number of facilities.



Rolling Stock

The RS designer is to focus on reduction of weight. All areas are to be considered. Superior grades of materials to be used in the primary structural elements of the carriages and bogies to ensure strength with lightness and durability.

Double glazed, single piece windows are already widely implemented but the heat transfer here might also be improved by the use of switchable glass which can darken only as necessary – and maybe even use solar power to activate it.

Interior fittings such as seats and panelling to be made out of lightweight materials, hand-rails to be made out of superior materials enabling mass reduction.

Power and Trailer bogies of the same design to allow reduced spares holding and maximum life from each component.

Rolling Stock

The only lit/moving advertising inside the train to be the same panels as the passenger information is displayed on.

Interior lighting only comes on when necessary. This can be either by way of optical sensors or by way of location trigger or a combination of both.

Consideration to be given to the number of daylight hours each train experiences and calculation as to whether roof mounted solar panels would provide worthwhile system battery charging.

Rolling Stock

Big Data could help in the real-time monitoring of the rolling-stock and track condition. By analysing the vibrations of the wheel-rail interface, wheel condition can be known, similarly, with hotbox detection, bearing conditions can be monitored and failing trains removed from service prior to serious damage or service disruption.

Depot Design

Review of depot design concepts can ensure improvements in operational efficiency. By efficiency, the reduction of empty running, avoidance of bottlenecks and the ease of access for maintenance are the focus.

The positioning of the wash-plant is one item sometimes forced into compromise, simulations of depot movement can be performed to ensure smooth traffic flow.

Overhead access areas can be maximised by utilising some stabling bays and providing easy, swift methods of traction isolation. This might be further enhanced by the use of retractable access platforms and possibly light overhead gantries to enable AC or solar panel servicing in stabling areas, that is, make some stabling bays dual purpose light maintenance bays.

Make the Depot Controllers console activate depot lighting so that not all the depot illumination is burning all night long.

Depot Design

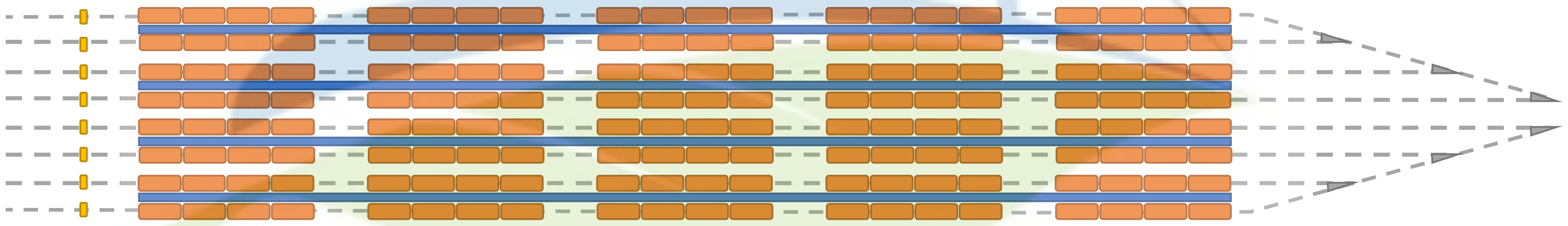
A quantitative approach to many of the features of a depot should be adopted. Numerous restrictive features are often incorporated (sometimes simply because some other system had that feature or) because a disaster scenario has been presented and mitigation is heavily applied. An analysis of the probability of the disaster and the probability of the specific sequence of events all occurring concurrently, may show that the disaster is too improbable to need to be factored into the design.

Analysis of movements should also be performed on:

- Launch sequence
- Wash plant
- Wheel lathe
- Transition tracks
- Throat failures
- Crippled train movements

Depot Design

As footprint is always at a premium, particular care should be given to the stabling areas where some train control systems demand excessive buffer distancing. Efficiency in this area can save hundreds of square meters of footprint of precious land-take.



Typical stabling layout for 40 trains

Depot Design

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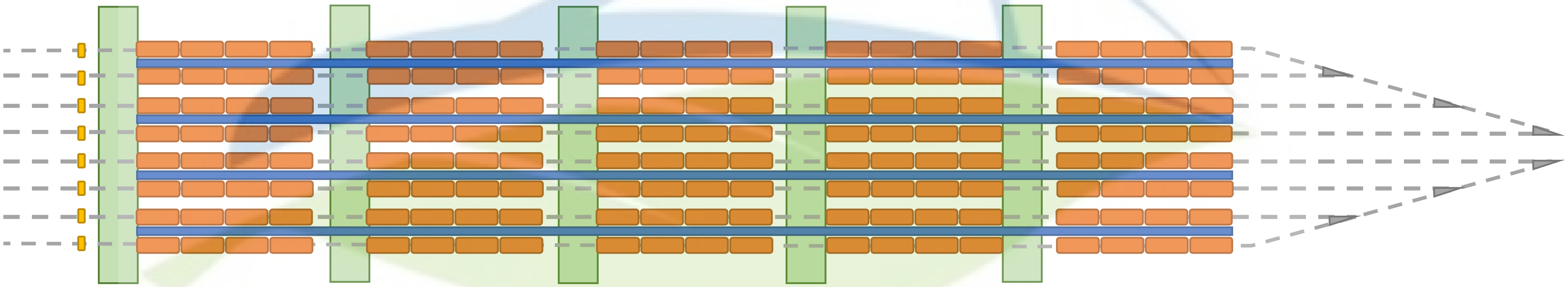

Reduce buffering distance from 20m to 5m

Depot Design

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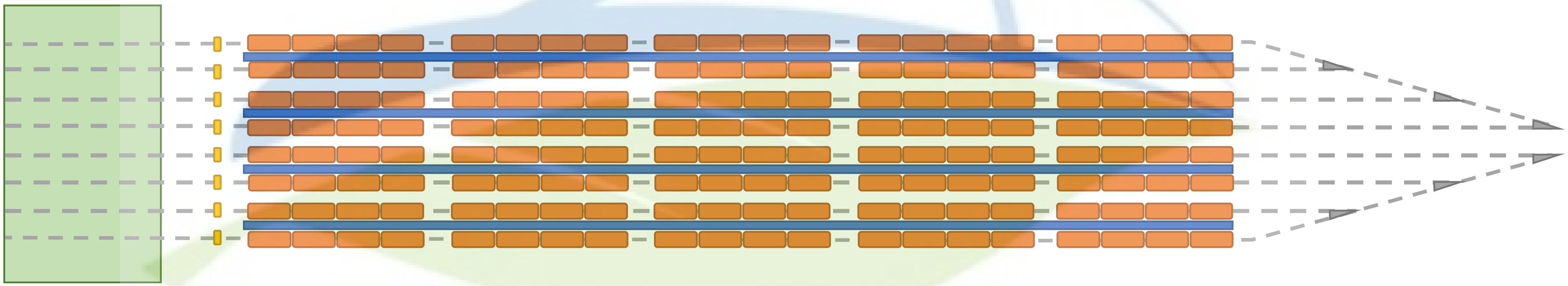


Footprint shorter by 75m; approximately 3,400 sq m of land area recovered, 1,200m of rail and 240m of platform

Station Design

There should be no illuminated advertising. All advertising should be of fixed panel or mural advertising which do not constantly consume energy.

Of course this will meet resistance due to the potential loss of revenue but there are strategies to mitigate this.

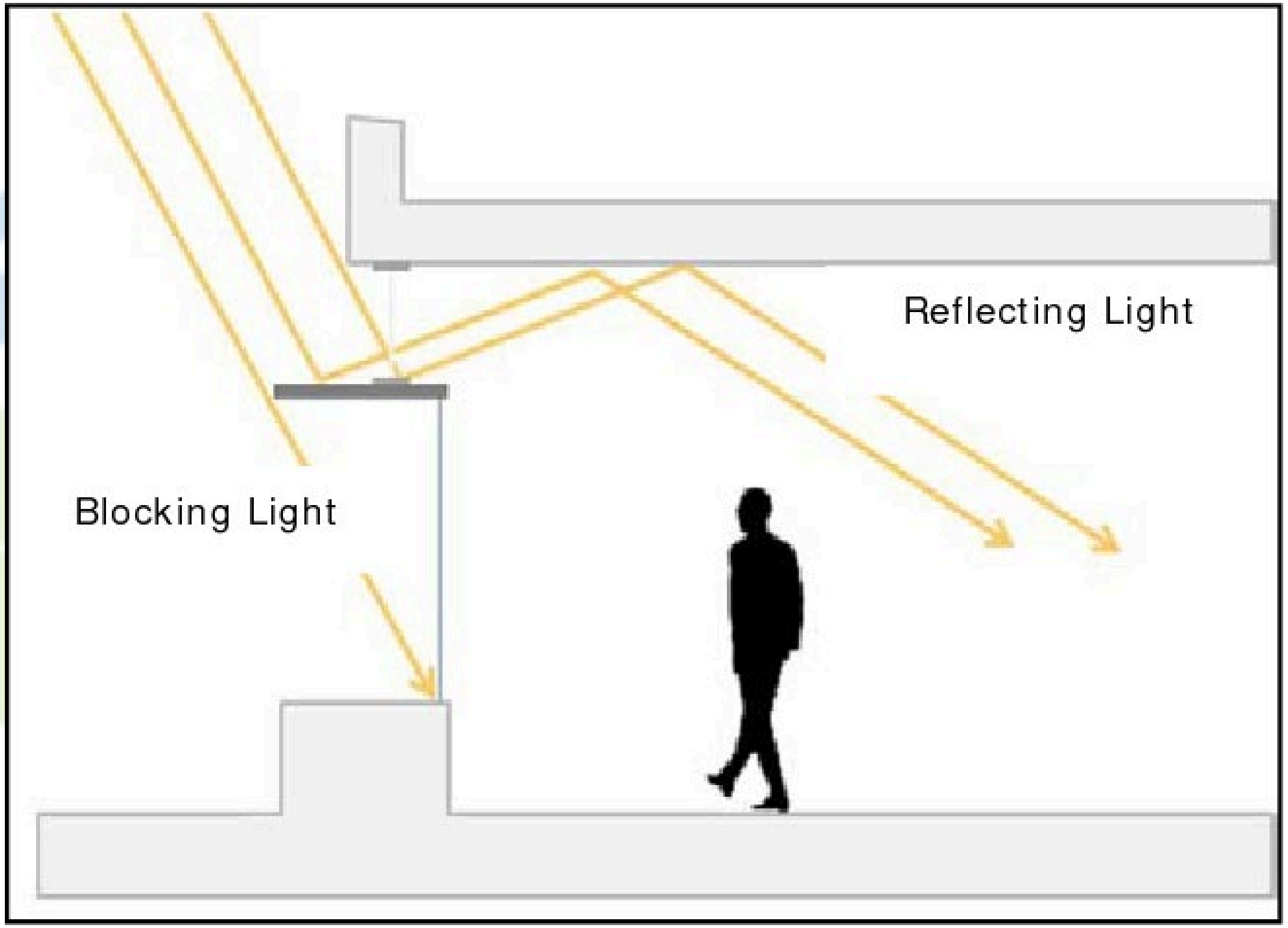
Station Design

Consider the introduction of 'light shelves' to increase use of natural light.

Lighting to be sensor activated.

Incorporate solar support wherever possible.

Ensure that all areas which require fire suppression are contiguous, thereby ensuring that a single suppressor room and single fire panel is required.



Station Design

Station platforms can be designed to operate for half a train. Such that in low utilisation periods, passengers are guided towards the front or the rear of the trains (at all stations) and all doors on the unused half remain closed. This allows less wear on train doors and their corresponding PSDs, lighting in half the platform can be switched off and escalators can be switched off. In this configuration, the passenger lift would be required to be located centrally.

Station Design

Prioritise bicycle parking by provision of covered areas with security posts and CCTV coverage.
Likewise bus access at stations ensuring covered egress for passengers and space for more than one bus to prevent congestion.

Systems and Integration

Civil

A significant area of cost and compromise has proven to be the interface and resulting integration between the civil structures and the rail systems.

Earthing is one of the biggest topics of difficulty. The earthing strategy for the operational systems should be defined prior to the design and award of the civils packages of work. In this way, the railway structures will be provisioned with the necessary grounding and grounding points to allow effective and safe integration with the operating railway to be installed into the structures. This would include room earth bars and earthing plates at appropriate intervals on all elevated structure.

The expectations of the depot equipment interface also needs to be defined at a more expedient time than is typically performed at present.

Systems and Integration

M&E

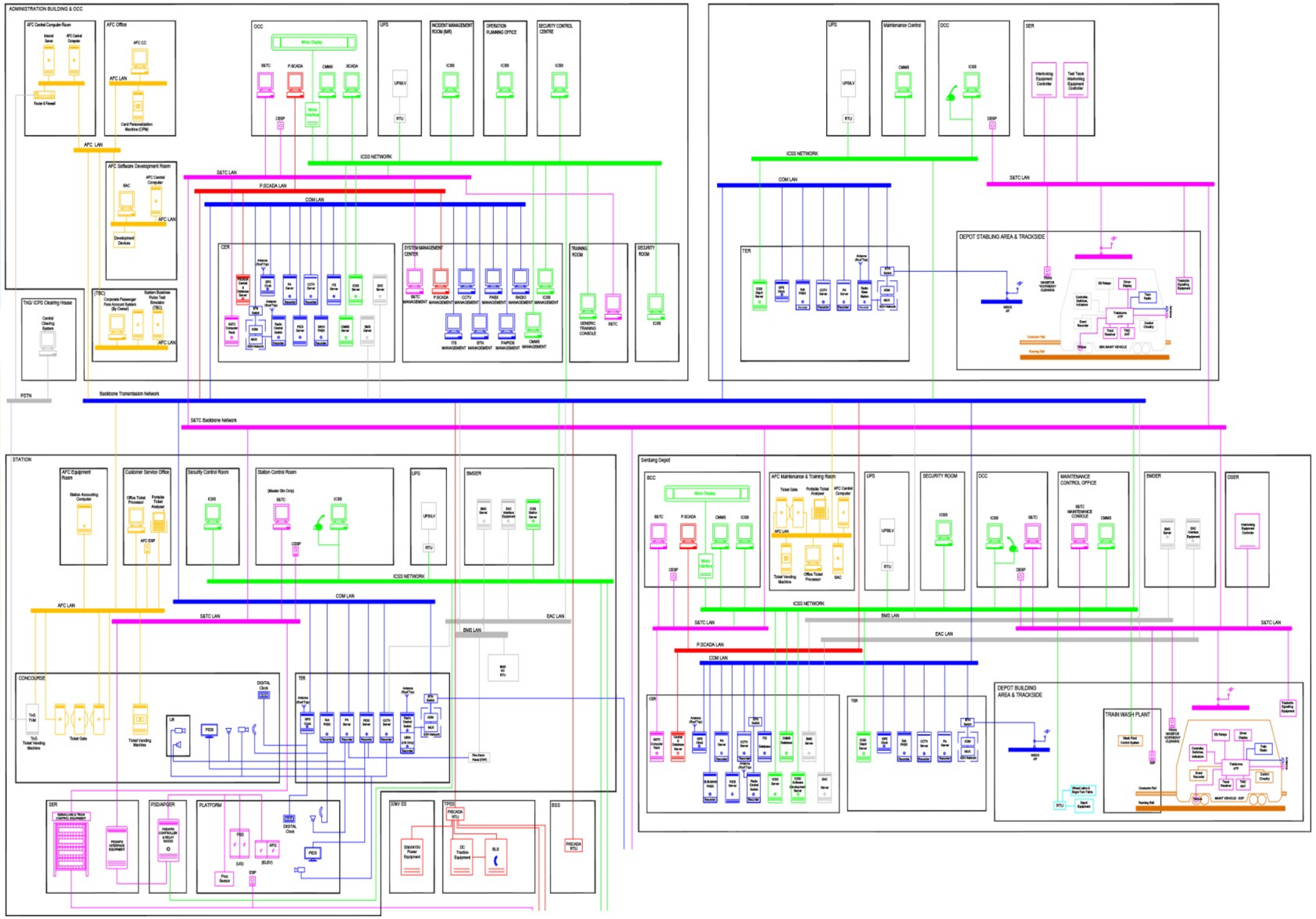
Essential systems power back-up is often either left with the M&E provider or split between M&E and the Systems providers. This is very inefficient in terms of foot-print, capacity, cost and maintenance (and spares). Here in Malaysia we have sufficient railway infrastructure to be able to accurately measure and record each system power requirement throughout the duty-cycle of the railway. This data can be used to extrapolate the emergency loads for each system and allocations can be announced. The provision of an intelligent UPS (allowing load-shedding etc.) can then be applied via one contract, systemwide.

Even if this full extent is not adopted, simply holding off on the award of the UPS contract until load figures have been better established will save a great deal of stress because all individual systems over-estimate in the first instance so as to avoid them having to foot the bill for an upgrade later in the detail design phase.

Systems and Integration

Comms

As the technologies in communications and signalling have grown closer, it now becomes optimal to merge the provision of fibre network cabling. No longer does signalling worry about the proximity of other cables which could induce voltage or experience cross-talk, as such there is no need for a separate cable for signalling, only separate fibres (provision of dark fibres). A great deal of the systemwide cabling could be combined to reduce cost and interface.



Systems and Integration

Comms

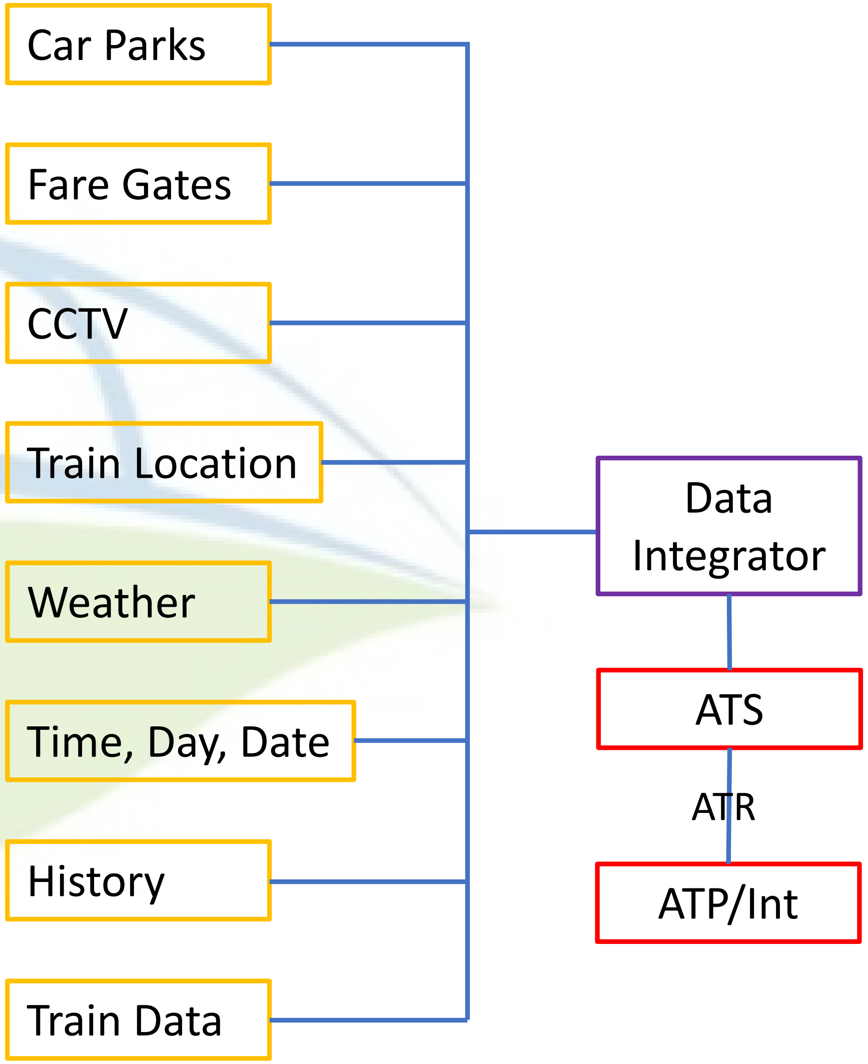
CCTV coverage of all passenger areas is now the norm and the argument that it allows for enhanced safety and security is unassailable, however there are instances where strategically placed mirrors would extend the field of view of some of the units, eliminating the need for some cameras.

The number of CCTV units in the rolling stock is sometimes more than absolutely necessary. This not only means more cameras but also higher capacity networks to facilitate the high data-transfer requirements.

Systems and Integration

Train-Control

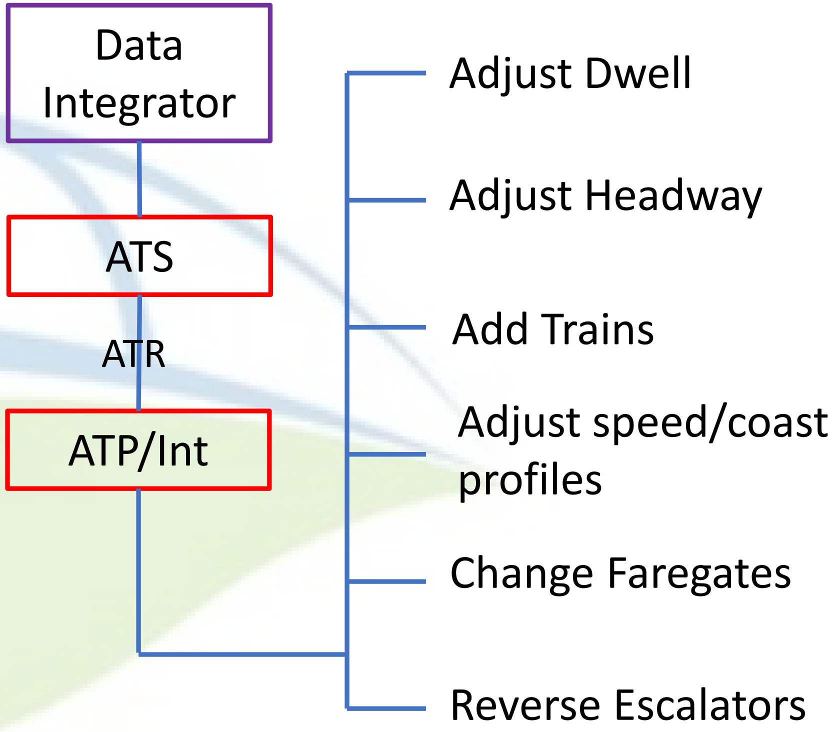
Presently service timetabling has the flexibility to schedule a change of service to accommodate several pre-determined levels of passenger demand; this could be further enhanced to support real-time changes in load. Effort spent at the design stage (either by the train-control contractors or the consultants) may add a little to the design cost but will save empty running costs (and the associated energy expenditure) for as long as the system operates. The suggestion here is to implement dynamic timetabling, incorporating multiple input factors that are received in real time, predominantly from high volume, bottle-neck points in the railway. Allowing schedules to be adjusted 'on-the-fly' to better serve the influx of passengers and reduce empty running.



Systems and Integration

Train-Control

The energy saving aspect of this comes about by way of the dynamic timetable being able to cut out unneeded trains, use more efficient speed profiles and pause surplus equipment. While at the other end of the scale, this concept would assist in "pulling all the stops out" at over-peak times to avoid overloading and long waits.



Systems and Integration

Traction Supply

Traction Energy Recovery Systems (TERS) allow all energy from regenerative braking to be captured and not just burnt off, this is of course especially beneficial in an underground environment.

TERS have been implemented here on some systems but others are using the older AARU which burns off surplus energy rather than re-injecting it into the power network. Retrofits could be possible on some systems.

Systems and Integration

Ticketing and Fare Collection
Gateless entry is now commonly used in Europe with great success. Initially there is a need for enhanced ticket checking personnel to catch out those who think its clever to beat the system but with some proportionate fines applied, this will quickly drop off.

The result is reduced mechanical hardware (and the maintenance associated) and reduced energy consumption, while still retaining full inter-network integration.

Control Centers

A full duplicated control center is often seen as a 'must have' but some review of this approach is suggested. While security is of utmost importance, how many terrorist or criminal intrusion attempts have been made globally over the past 2 decades – none as far as is publicly known. And if there was such an attempt, it would be likely that they would arrive with sufficient engineering expertise to ensure the achievement of whatever heinous action they had in mind, making a control transfer a moot point.


NST Image

Control Centers

The most likely scenarios which would trigger control transfer would be either:

- a general power failure,
- a catastrophic system failure or
- a fire.

These hazards are already addressed within the design and operating procedures but could be further enhanced to bring the likelihood of failure to an improbable level of ocurrence. This would likely involve:

- locally diverse hardware duplication,
- enhanced fire protection and
- carefully chosen materials for the construction of the whole control center (including the structure),
- either a diverse power supply from the National Grid or a local power source and
- some enhanced emergency operating procedures.

By ensuring that the systems control servers are in a very secure, fire proof environment, if the control center became uninhabitable, control could be moved to a nearby station, any station, any number of stations in the system could be ready to assume control.

Control Centers

There are also logistical problems to overcome in the transference of control to a remote location unless that location is already staffed and the staff are fully aware of what has transpired to cause the control transfer.

There are several different potential configurations which would enable reduced equipment provision. Even in the situation where a BCC is provided, duplicated server hardware is not required at the BCC location in that it is only a temporary shift of control.

Conclusions

1. Greater cooperation between the civil and system elements will enable wastage and re-work reductions, the timing of design freeze is critical to achieve best integration.
2. Every element of equipment that is eliminated saves CAPEX, maintenance, replacement and energy.
3. Optimisation of lighting saves energy now and for ever.
4. There is local data available which can be used to refine the design specification guidelines contained within the applied standards.

Flipping the Switch

1. More access to existing operational data to enable reduced OPEX.
2. Energy saving and reduction requirements to be included in the Scheme Design.
3. More detail in the civil to systems interface.
4. Reassessment of Scope strategy to mitigate interface conflicts and duplications.
5. Bidders required to declare their equipment power consumption based on their BoQ.
6. System (energy) running costs become an influential element of the evaluation criteria.

Should you wish for any clarifications or further explanations, please contact Rod at rodanders900@yahoo.co.uk

Lights Out !