THALES | PARSONS

# Dubai Metro Experience

## Design and construction of the Dubai Metro, the longest fully automated driverless metro network in the world

**Wednesday, April 5, 2017**
**AQTr (Association Québécoise des transport): 52e Congrès**

Steven LaRocco, Parsons
Norman Chong, Thales

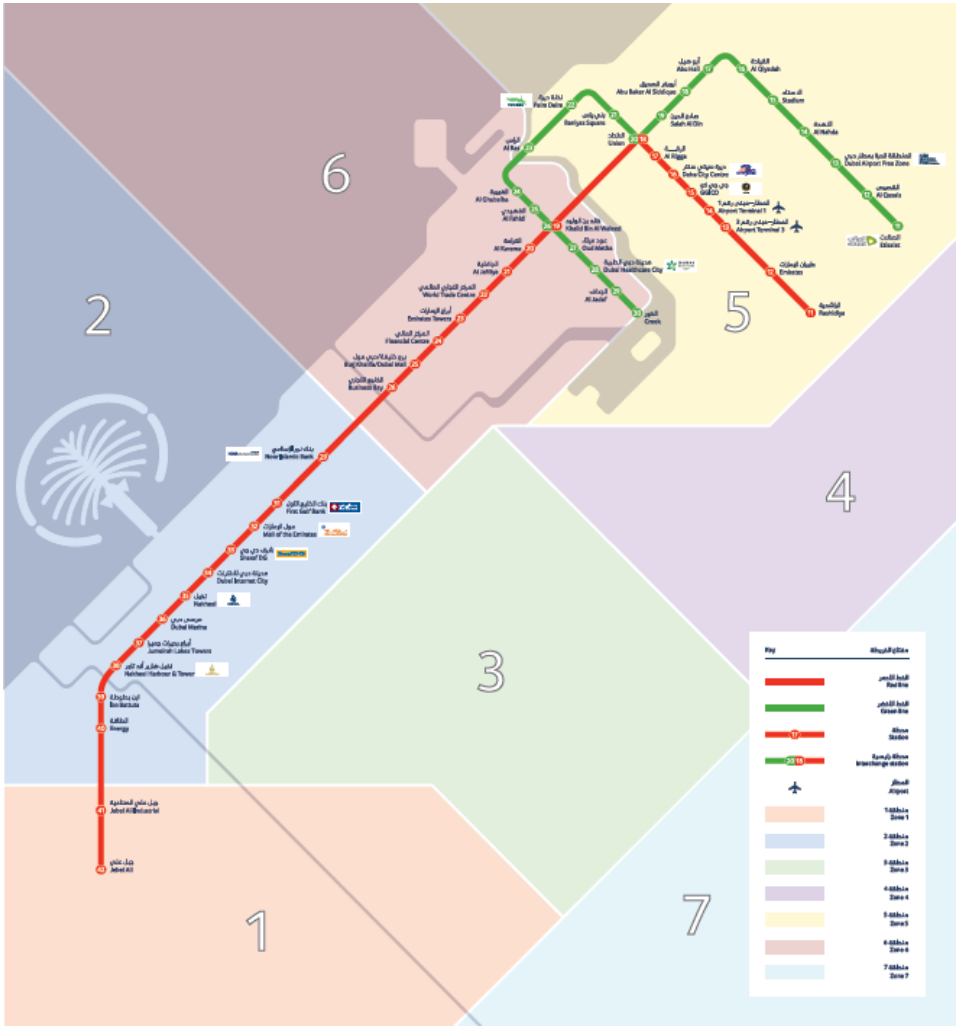
delivering a better world SM

# Dubai Metro – Context and Objectives

- **Objective to become the region's prime business and leisure destination**
  - Manage mobility of a growing population
  - Reduce use of automobiles
- **Decision made to build an efficient urban rail system using world-leading, proven, advanced technology**
  - Largest fully automatic driverless metro system in the world
  - Public transport backbone of Dubai
  - Integration with developments
  - Bus feeder routes
  - Rail Designed for people with Special Needs
  - Real time passenger information system
  - Smart card ticketing system,
  - Mobile phone coverage underground
  - State of the art advertising

# Dubai Metro – Network Summary

- **75km total length**
  - 2 lines (Red & Green)
  - 47 stations + 3 depots
- **52km Red Line** (opened 09/09/09)
  - 5.7km underground tunnels
  - 42.8km elevated viaduct
  - 3.5km at grade
  - 27 stations + 2 shared interchanges
  - 2 depots
- **23km Green Line** (opened 09/09/11)
  - 8.3km underground tunnels
  - 14.7km elevated viaduct
  - 18 stations + 2 shared interchanges
  - 1 depot



# Dubai Metro – Network Summary

## Design & Build contract awarded in July 2005

### Client
Roads and Transport Authority (then Dubai Municipality)

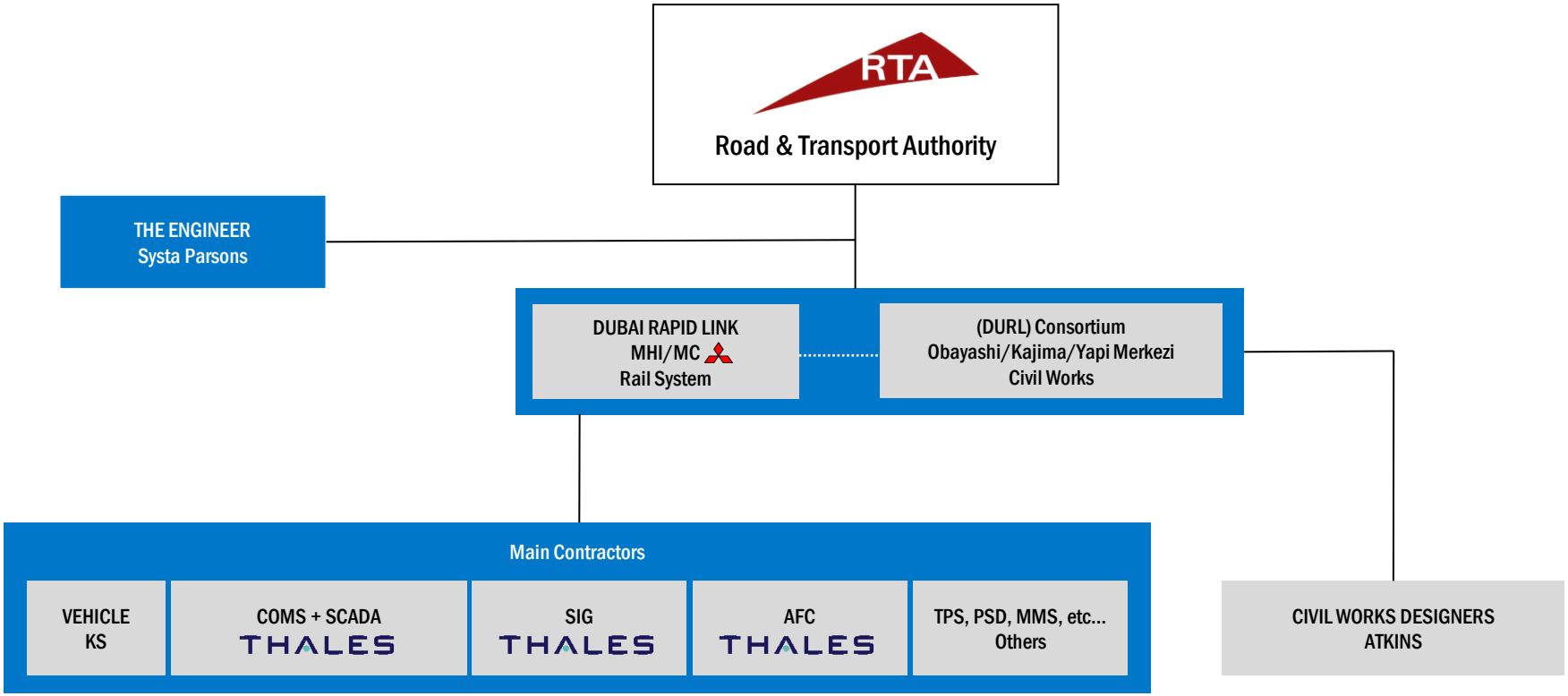
### Consultant
The Engineer (Parsons Systra Joint Venture)

### Contractor
Dubai Rapid Link Consortium (DURL) Joint Venture of:

- Mitsubishi Heavy Industries, Tokyo, Japan
- Mitsubishi Corporation, Tokyo, Japan
- Obayashi Corporation, Tokyo, Japan
- Kajima Corporation, Tokyo, Japan
- Yapi Merkezi Insaat Ve Sanayi, Istanbul, Turkey

### Designer
Atkins (Architectural Design – Aedas; Interior Design – KCA International)

# Organization Chart



# Dubai Metro – Parsons Program-Wide Role

## Program Management

Developed and monitored the project's budget, analyzed the project schedule, claims management and contract modifications, as well as leading all quality initiatives.

## Construction Management

Monitored the Contractor's day-to-day activities to ensure that the execution of all site works (civil and systems) were completed in accordance with the approved designs, technical specifications, applicable standards and regulations, and all health & safety, quality assurance and environmental rules.

## Design Reviews

Technical and functional assessments of the contractor's design and drawings to independently verify that contract requirements and RTA's expectations were met.

*At peak Parsons had more than 250 management, technical, and supervision staff overseeing the works of the project's design-build Contractor, verifying integration & contract compliance to ensure timely project delivery in a safe environment*

# Dubai Metro – Architectural Context

**World class architecture a key objective**

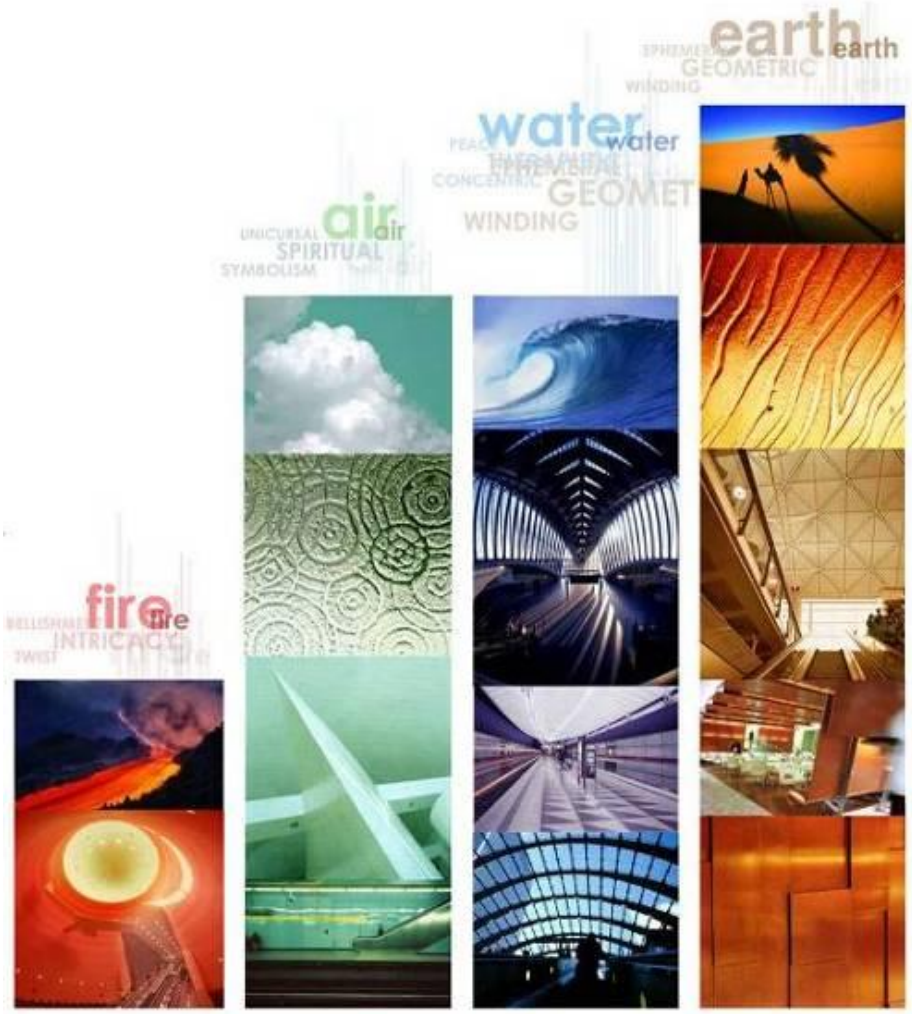
**Four main themes with distinctive colors**

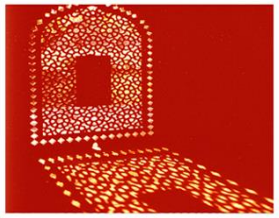
- Fire – red themes
- Water – blue themes
- Earth – brown themes
- Air – green themes

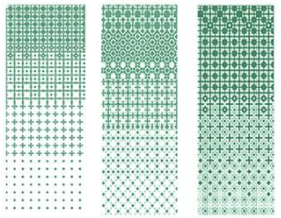
**Other key influences** were the historic and physical context to ensure stations sit well in their respective environment;

- Ultra modern 'clam shell' designs in new Dubai
- Heritage themes in old town

# Station Interior Design Themes by KCA





FIRE

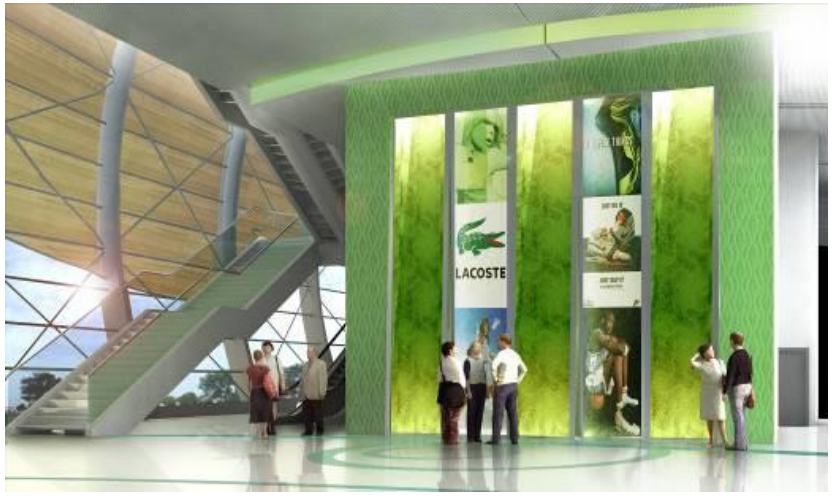
AIR

WATER

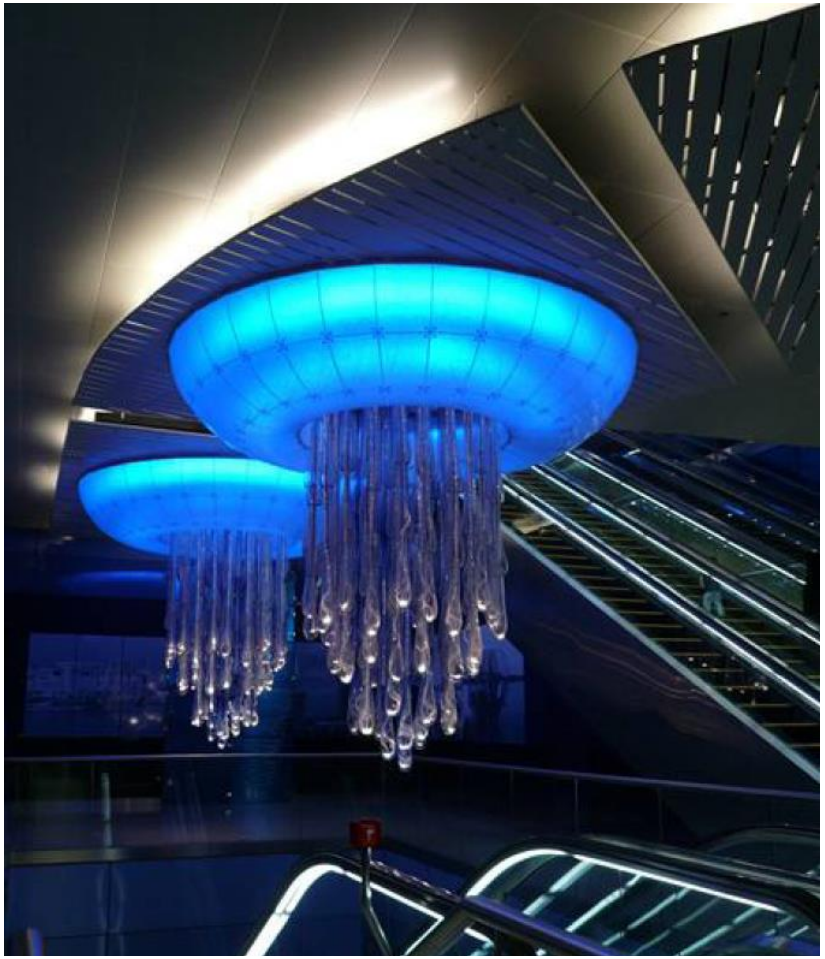
EARTH

# Fire Theme Design


# Air Theme Design



# Water Theme Design



# Earth Theme Design


# Change the Fabric of Dubai

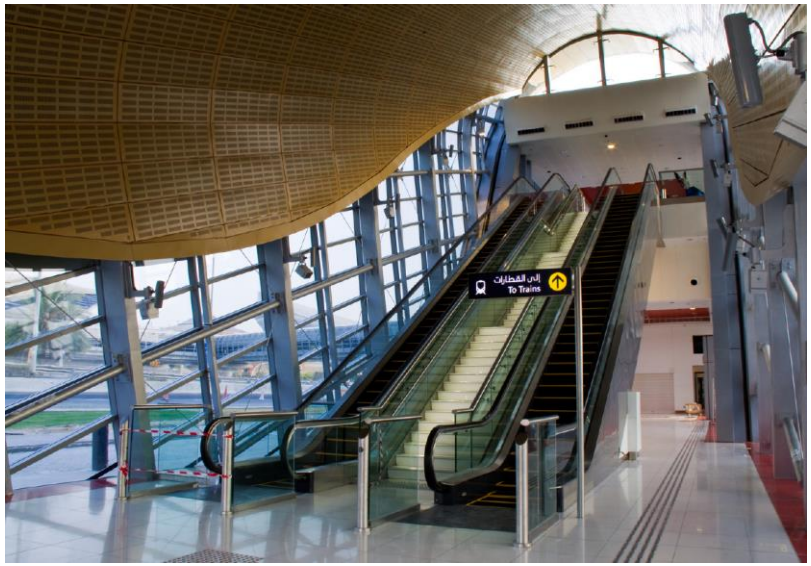
## 95 Entrance Pods
Integrated Bus Waiting Facility

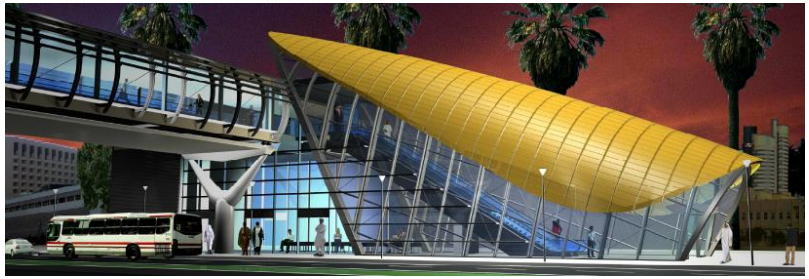
## 58 Footbridges
Connecting to Metro and other side of major road

## 10 Type-1 Extensions
With integrated Bus waiting facilities

## 3 Car Parks
Integrated Bus Station and/or bus waiting facilities

## Road & Highways Improvements
Encourage safe, easy and comfortable pedestrian movements between modes of transportation



# Dubai Metro – Massive Civil Engineering Works

## Extensive civil engineering works including:

- **Tunneling:** TBM and cut and cover construction methods utilized

- **Station structures:** including underground diaphragm wall construction, overground extensive complex structural steelwork

- **Viaduct and pier construction:** over 50km of viaduct with more than 4000 piers

# Dubai Metro – Stations

## 47 stations

- 37 overground
- 10 underground

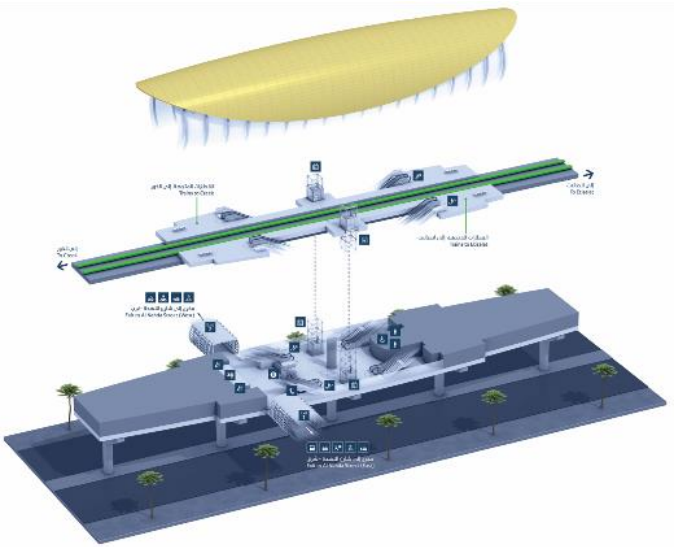
## Overground Stations – 3 Types

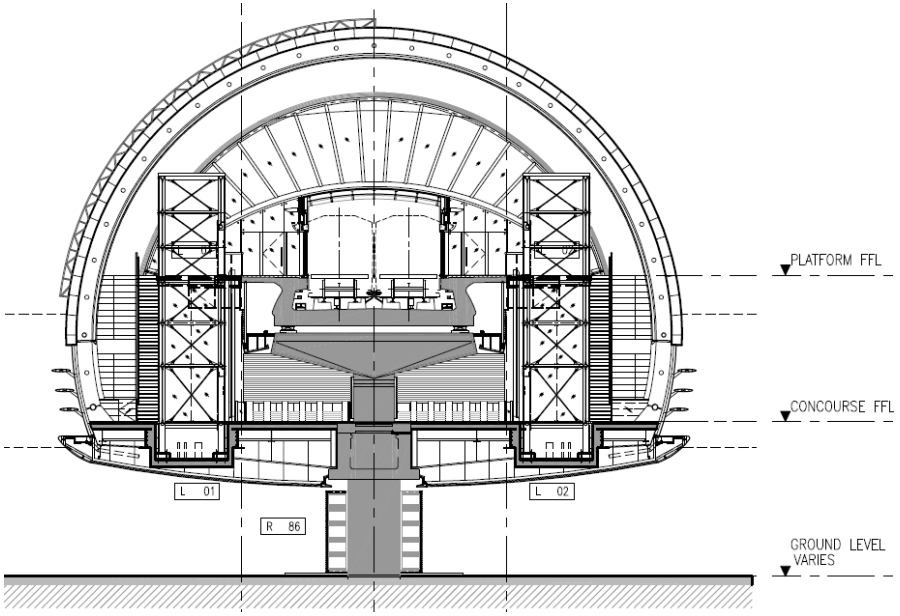
- **Type 1**: concourse at ground level, raised platform
- **Type 2**: concourse & platform raised 5m, access by entrance pods and footbridges
- **Type 3**: as type 1 but inclusion of ‘pocket track’ for expanded operations

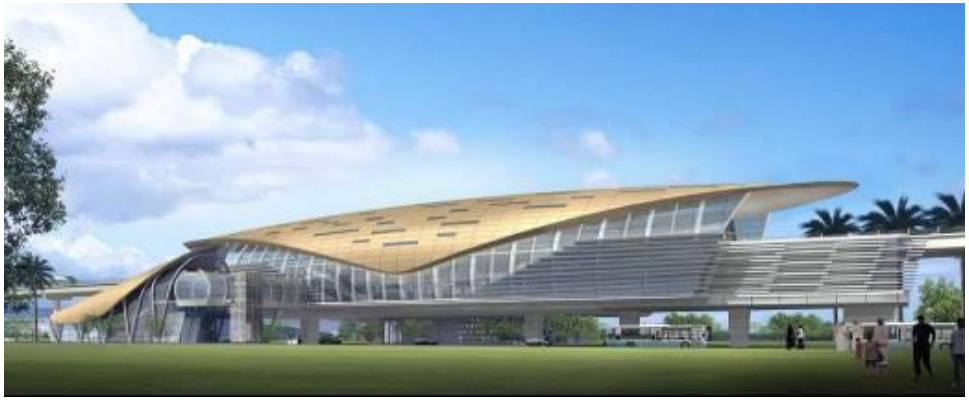
## Underground Stations

- four on the Red Line
- eight on the Green Line
- two shared interchange stations

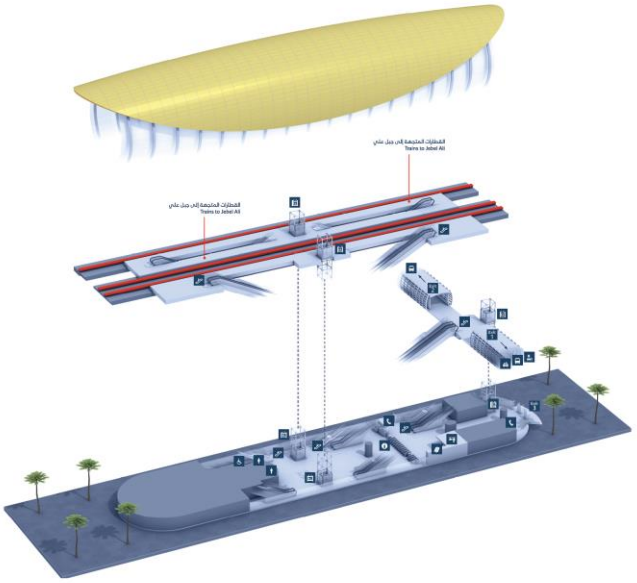
# Typical Type-2 Station

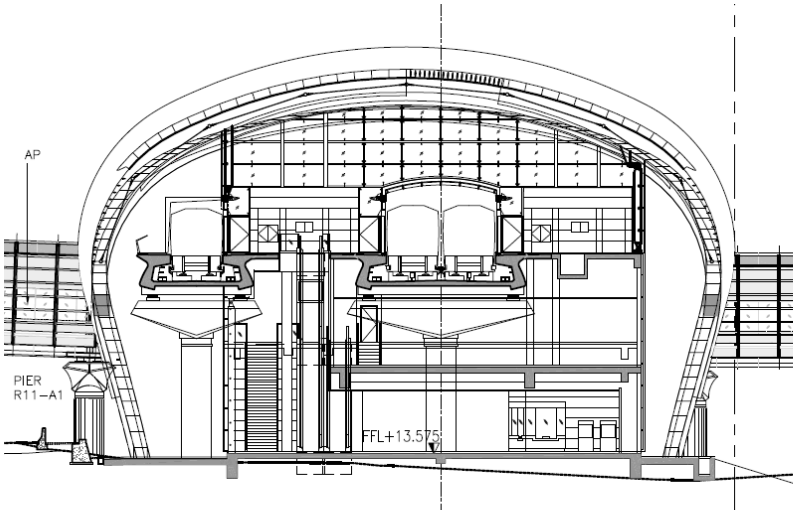


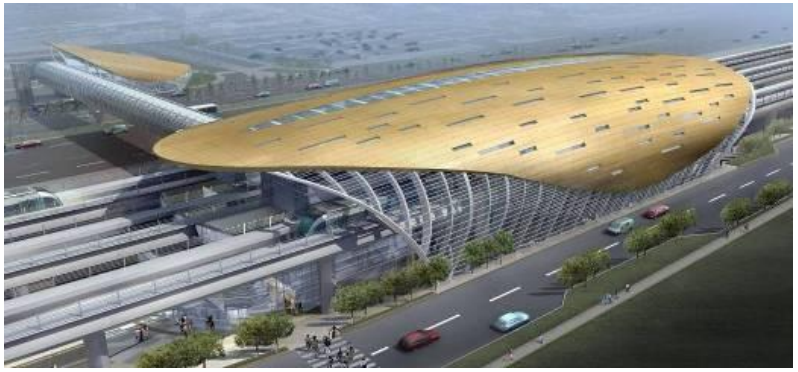


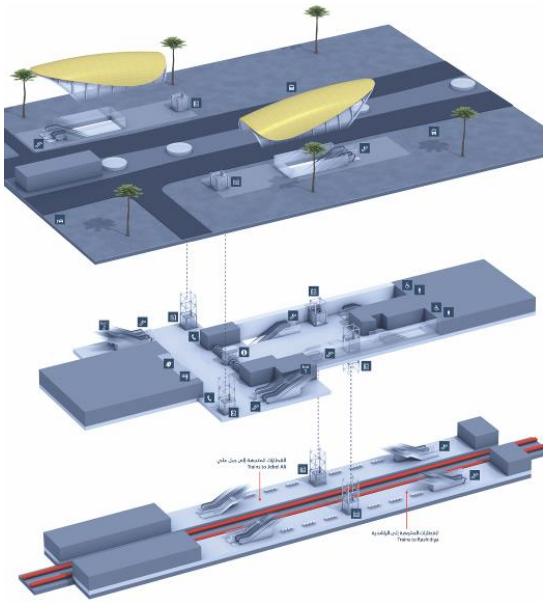
# Type-3 Station

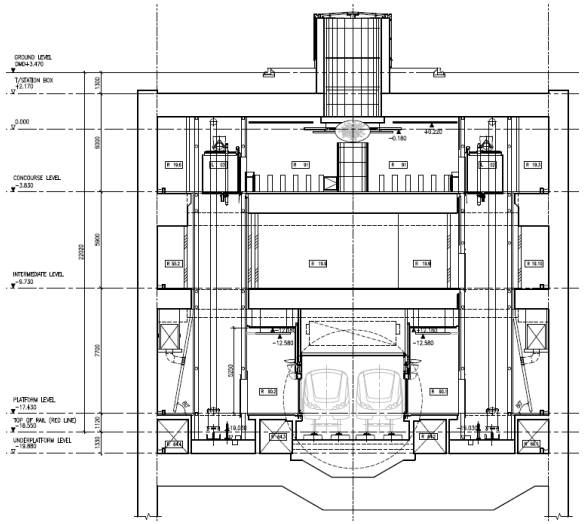


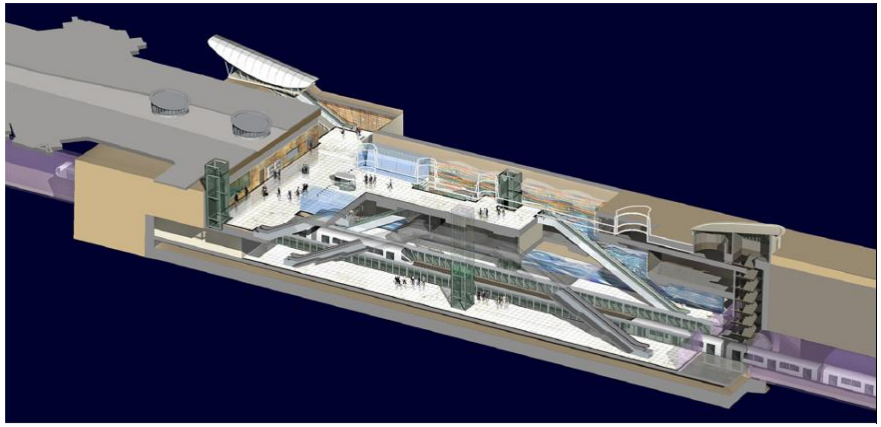


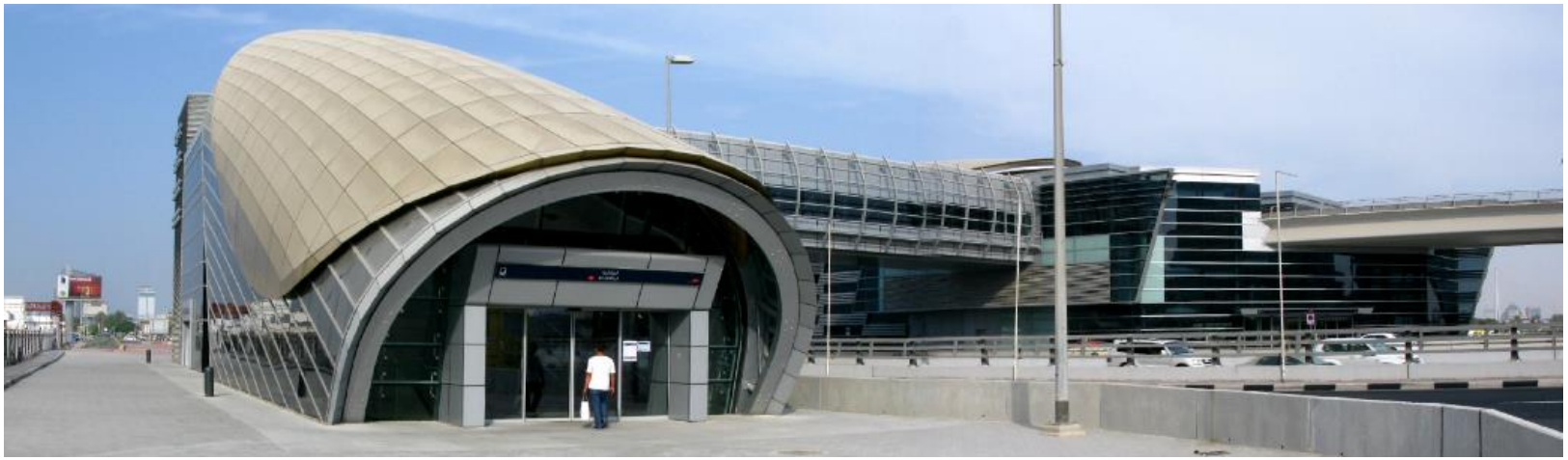
# Typical UG Station





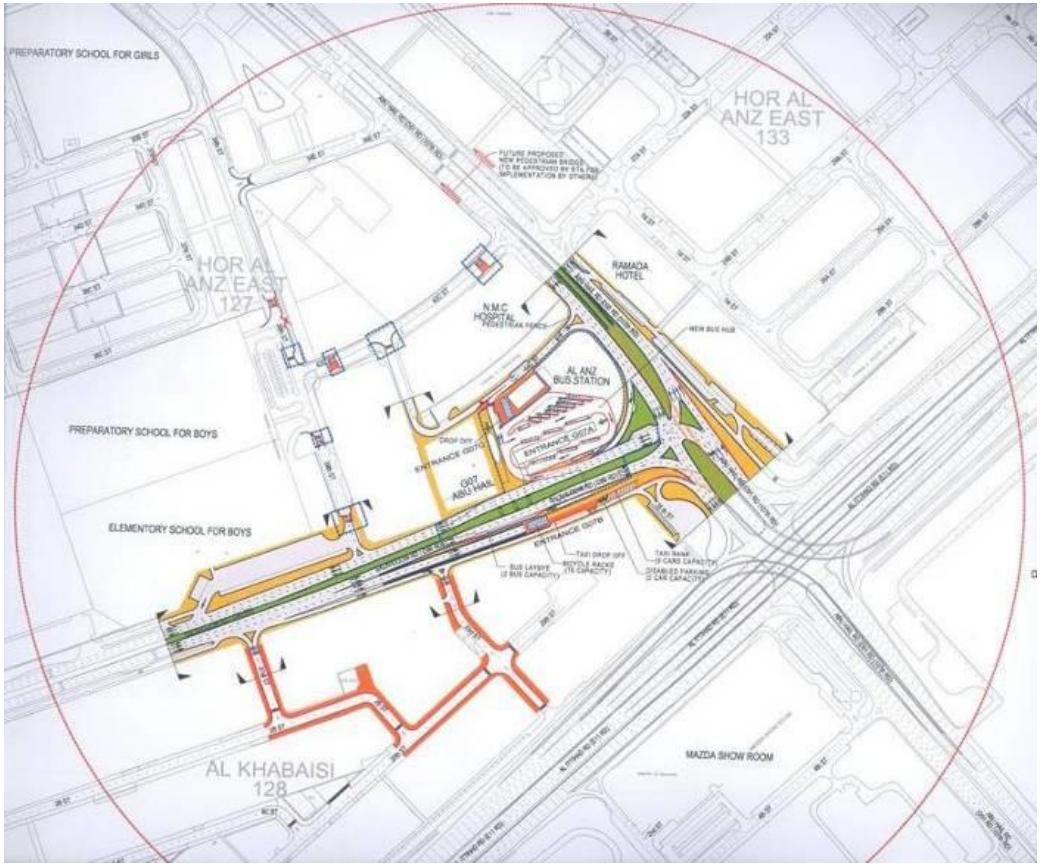



# Station Context Planning Components



# Interconnectivity of Road, Rail and Water Transport

- The area of 500m radius surrounding Metro Station is improved.
- Work includes constructing new roads, Footpath, Cycle track, Bus Stop / Bus Stand, Taxi Bays, Parking area etc.




Abu Hail Station in Green Line
Lay out showing Bus station, Taxi Bays, Parking areas etc.

# Dubai Metro – MEP systems

## Dedicated power distribution system

- Three main power stations
- 132kV system with 33kV ring main

## Massive HVAC systems provided

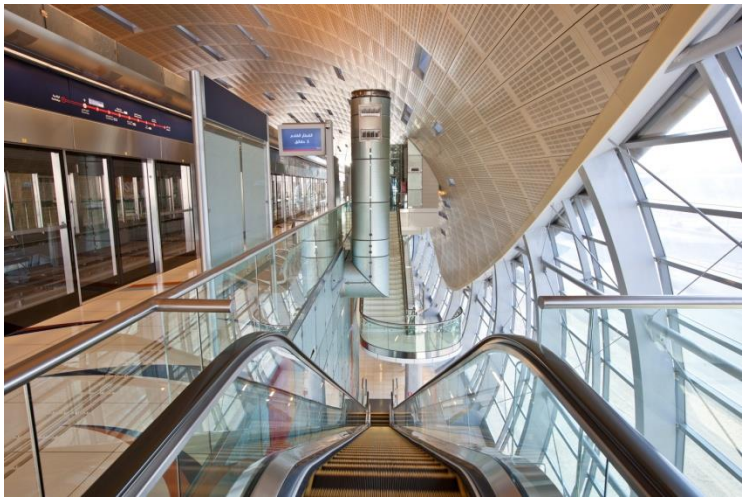
- extensive system design and installation to meet temperature control requirements

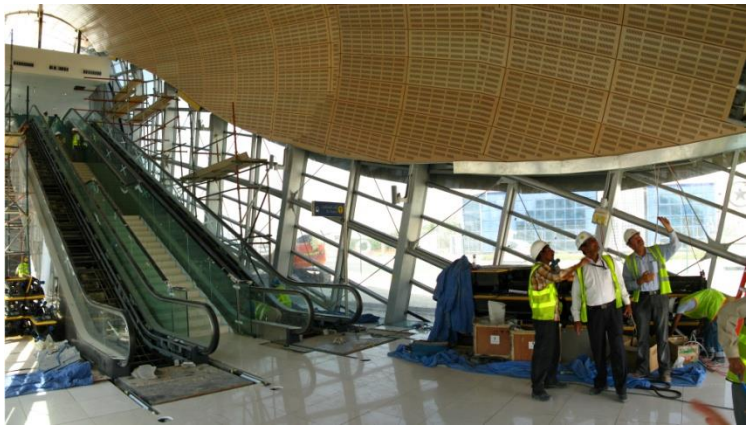
## Passenger mobility systems

- extensive escalators, elevators & travelators through stations, footbridges and entrance pods

## Environmental Control System (ECS)

- critical to provide integration to the rail systems (via the Operational Control System)
- all MEP systems monitored and/or controlled using the ECS and OCS interface





# Dubai Metro – rail systems

## Operating Control System (OCS)

Interface to the MEP systems via the ECS
All rail systems monitored and/or controlled using OCS with main control at the designated Operational Control Centre

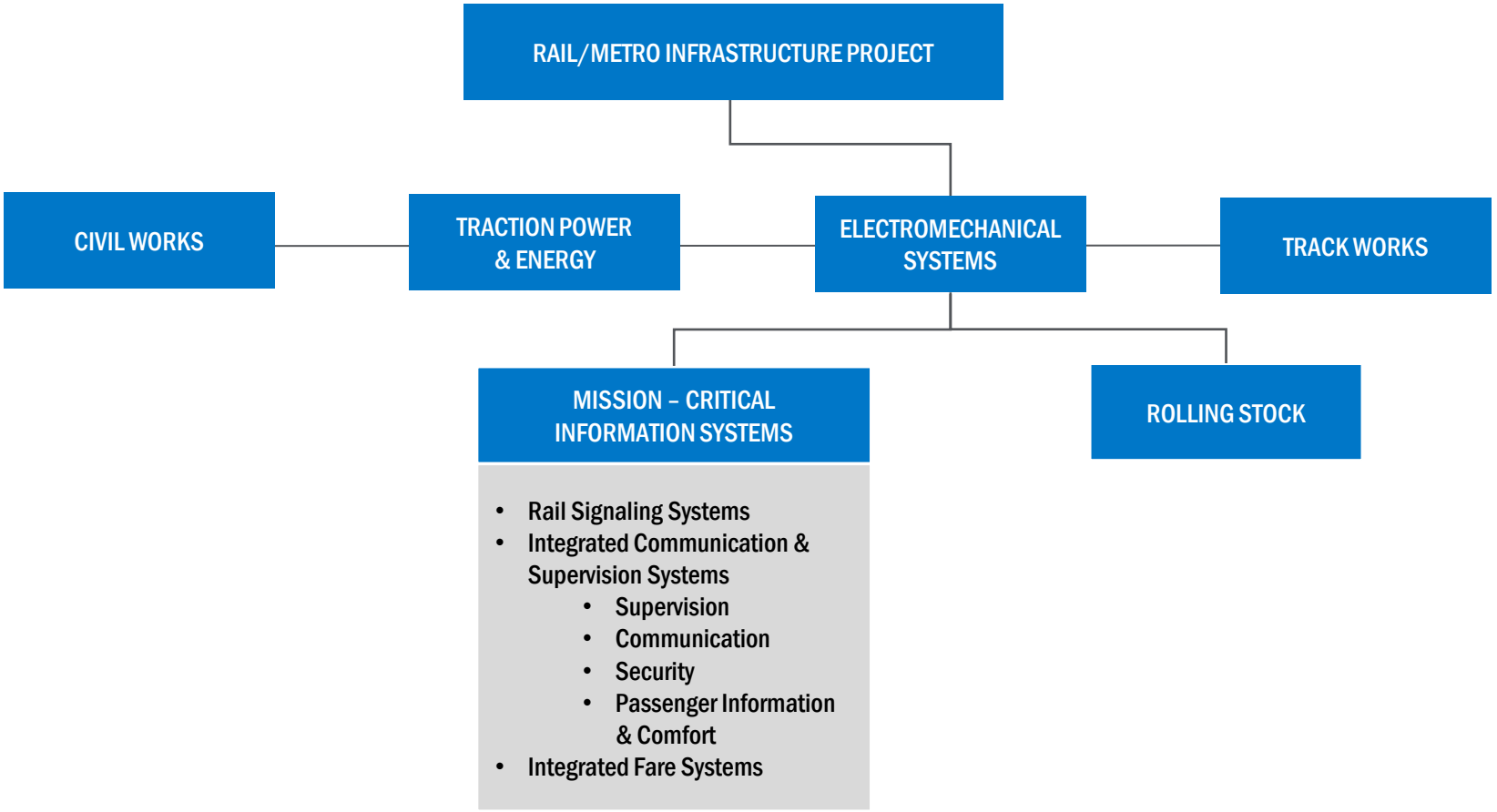
## Operational Control Centre (OCC)

Network centre for management of all integrated communication and control systems to maximize network efficiency

## Driverless Train Systems

Automated rolling stock management via the OCC, with safety assurance via the Automated Train Control (ATC) and supporting communication systems

# Mission Critical Information Systems



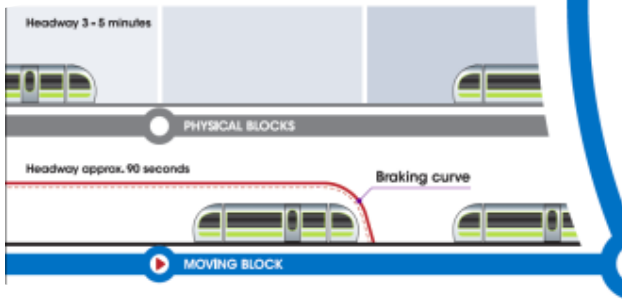
# CBTC Architecture

## Sub-Systems

Continuous train location

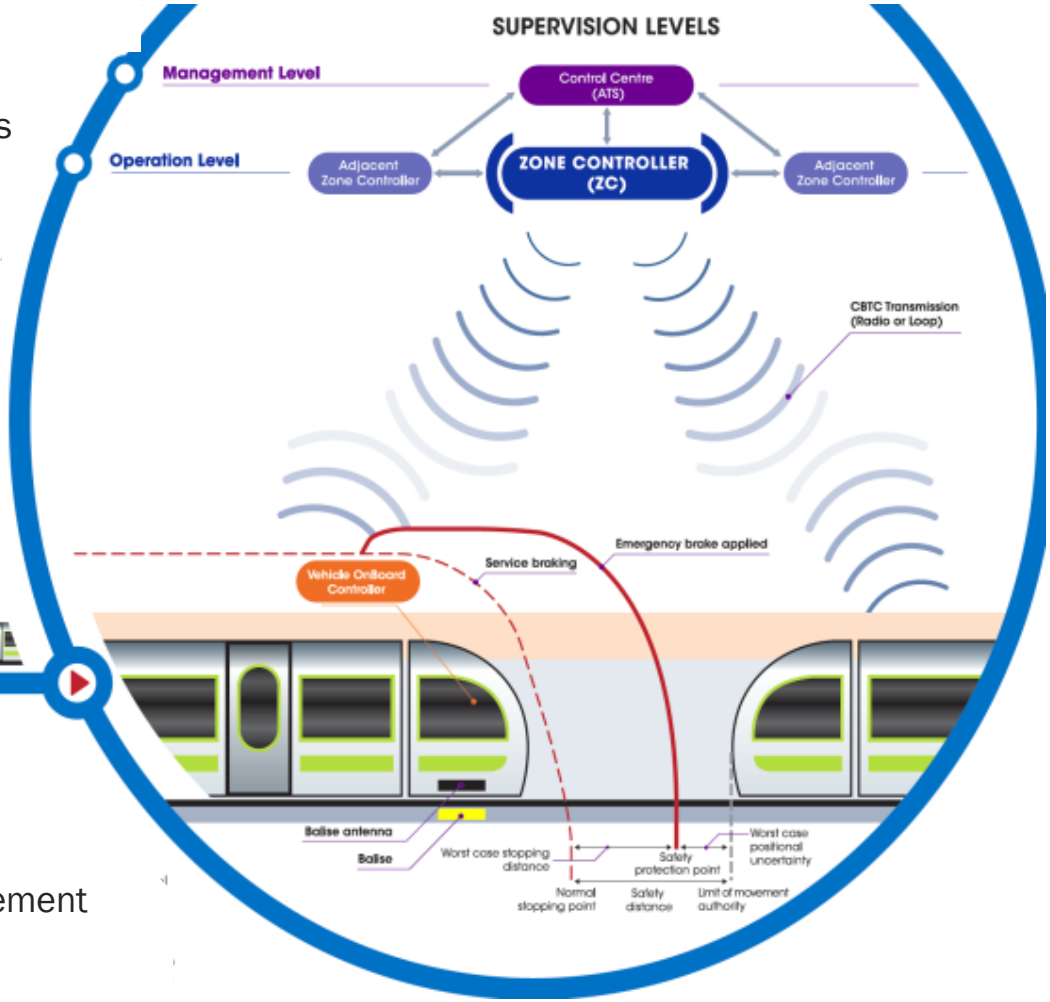
Zone Controller to vitally monitor train positions & issue movement authorities

On-Board Equipment to supervise the speed & automatically control the train (ATP/ATO)




Communication System to communicate with trains and network between all sub-systems

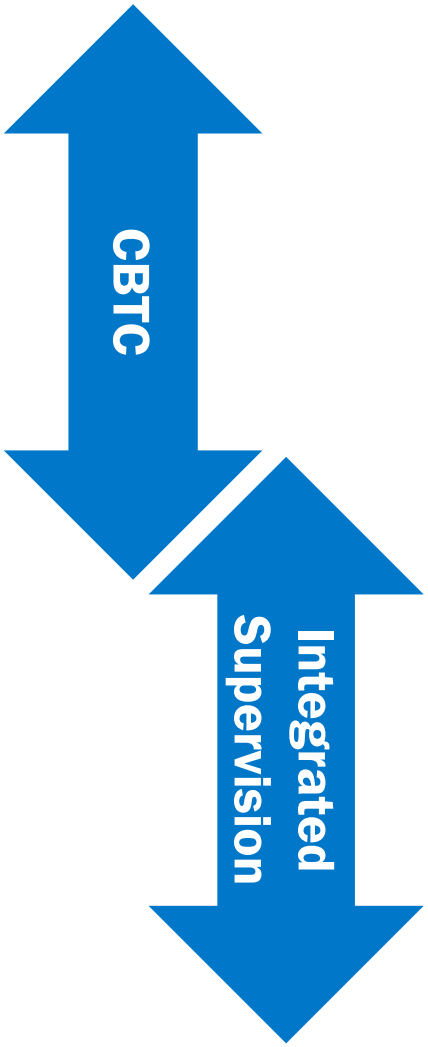
Automatic Train Supervision (ATS) and management of the overall line



# What Customers Want

## Intelligent, Safe, Reliable Systems

- **The Basics**
  - A safe system, compliant to operational requirements
  - Delivered on time & budget
- **Operations & Long Term Objectives**
  - Flexibility
    - To respond to customer loads, traffic incident management, 24 hour operations)
  - Save operating costs
    - Energy, maintenance, staff
  - Provide added value services to passengers
  - Manage capacity (near and long term)
  - Optimize capital investment costs (civil, train sets)
  - Increased security
  - Decision aid and crisis management tools

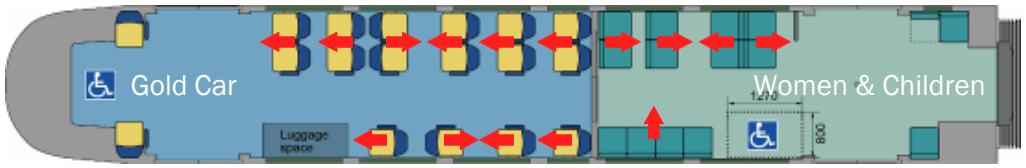


# The Implementation Challenge

## Murphy's Law always applies – be prepared to deal with the unexpected

- **Opening for Special Events**
  - Has to happen by a specific date – no matter what
    - Political mandate
    - Public event or festival
- **Short Schedule**
  - Can you go live in 14 months?
- **Dealing with realities of projects**
  - Interfaces with and dependencies on civil & other works
  - Changing requirements
  - Train control is close to last on the implementation chain
    - But necessary to enter revenue operations

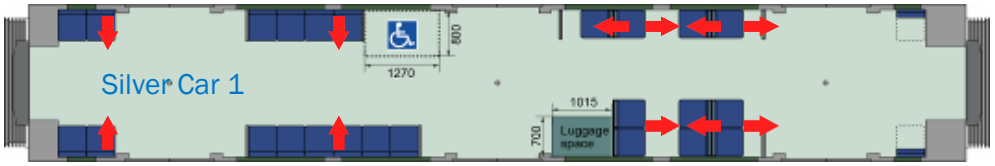
DM1 car




**Gold Car Seating: 19 + 1WC**

| | |
|---|---|
| W&C Seating: | 15 + 1WC |
| Standing: | 42 (AW2) |
| | 63 (AW3) |
| | 85 (AW4) |

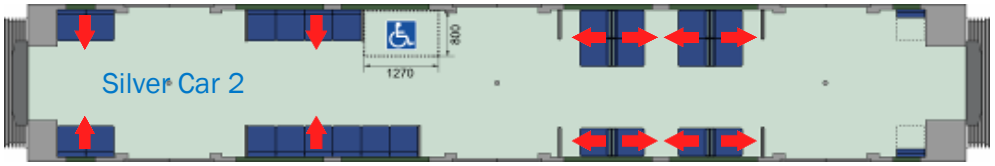
T car




**Silver Car 1 Seating 25 + 1WC**

| | |
|---|---|
| Standing: | 117 (AW2) |
| | 175 (AW3) |
| | 235 (AW4) |

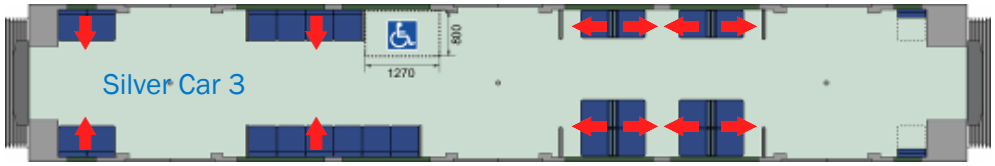
M car




**Silver Car 2 Seating 27 + 1WC**

| | |
|---|---|
| Standing: | 118 (AW2) |
| | 176 (AW3) |
| | 236 (AW4) |

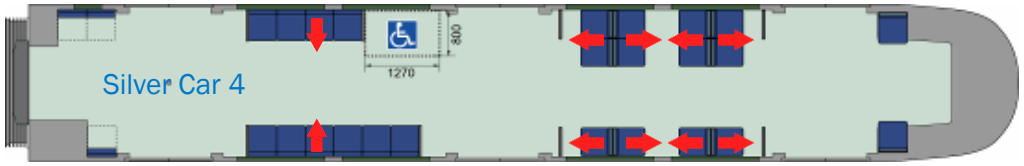
T car




**Silver Car 3 Seating 27 + 1WC**

| | |
|---|---|
| Standing: | 118 (AW2) |
| | 176 (AW3) |
| | 236 (AW4) |

DM2 car




**Silver Car 4 Seating 25 + 1WC**

| | |
|---|---|
| Standing: | 112 (AW2) |
| | 170 (AW3) |
| | 230 (AW4) |

**TOTAL Capacity (AW1 138) (AW2 507) (AW3 760) (AW4 1022)**

# Train Interior

# Train Interiors – Silver Class

# Dubai Metro – Project Challenges

1. Demanding Schedule for a project of such magnitude
2. **Fast track construction**
3. **Contractor**; new joint venture, none of which had experience in the market.
4. Introduction of a new technology for the first transit rail project in the Middle East area
5. High expectations from RTA who wanted a Signature Project for the Dubai Area
6. **Major utilities diversions (**impacting 80% of Dubai's utilities)
7. **Major variations**; management and execution of major variations throughout the construction period.
8. **Procurement**; project initiation and first three years were during global and local/regional construction boom, followed by massive downturn.

- **Project Achievement**
  - Single largest fully automatic UTO system in the world (75kms)
  - Opening on accelerated schedule “9-9-9” in full UTO with safety case for a railway where not all stations were initially opened
- **Satisfied Customer**


Thank you!