Motorola Mission Critical LMR Railway Communication System

Raúl Carpio – Latin America Strategy & Business Development

MOTOROLA SOLUTIONS

AGENDA

- [RAILWAY COMMUNICATION REQUIREMENTS](#)

- [MOTOROLA RAILWAY COMMUNICATION SOLUTION](#)

- [MOTOROLA CREDENTIALS AND RAILWAY REFERENCES](#)

- [METRO SAO PAULO](#)

- Q&A

RAILWAY COMMUNICATION REQUIREMENTS

RAILWAY CHALLENGES
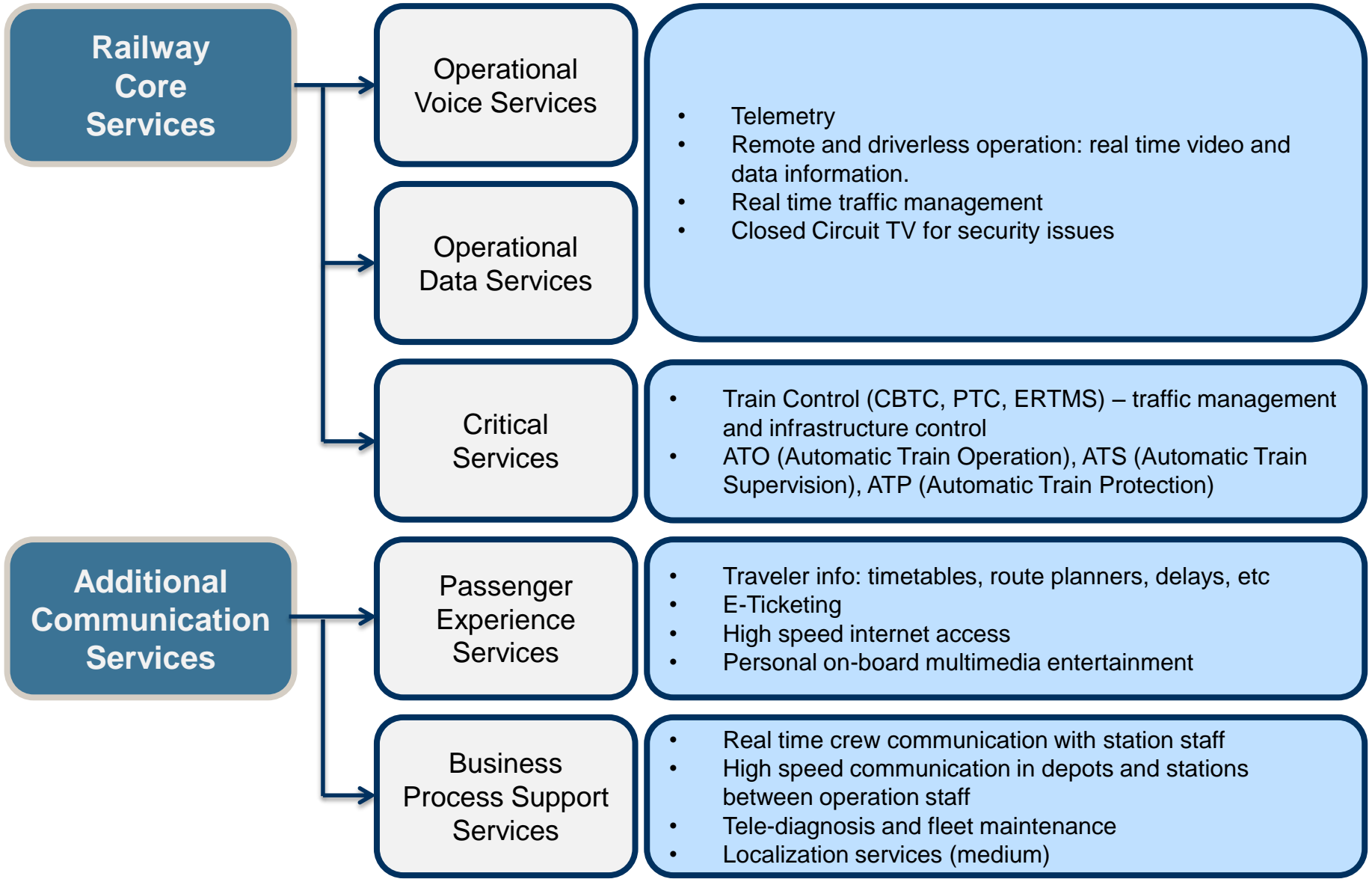
Efficient Train Operation
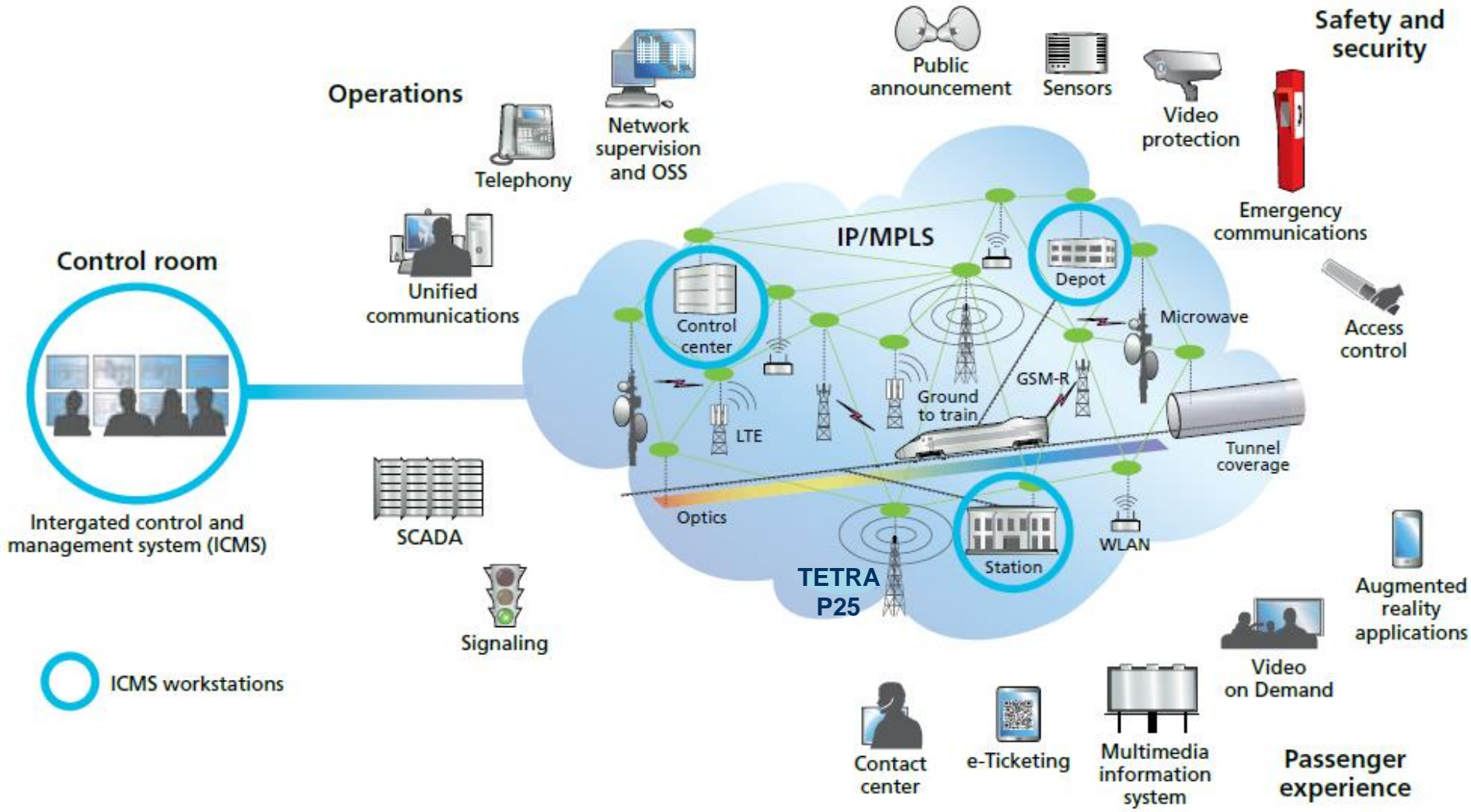
User Satisfaction

Safety & Security Assurance

Cost-Effective Solutions

RAILWAY SERVICES

Railway Core Services

Operational Voice Services

Operational Data Services

- Telemetry
- Remote and driverless operation: real time video and data information.
- Real time traffic management
- Closed Circuit TV for security issues

Critical Services

- Train Control (CBTC, PTC, ERTMS) – traffic management and infrastructure control
- ATO (Automatic Train Operation), ATS (Automatic Train Supervision), ATP (Automatic Train Protection)

Additional Communication Services

Passenger Experience Services

- Traveler info: timetables, route planners, delays, etc
- E-Ticketing
- High speed internet access
- Personal on-board multimedia entertainment

Business Process Support Services

- Real time crew communication with station staff
- High speed communication in depots and stations between operation staff
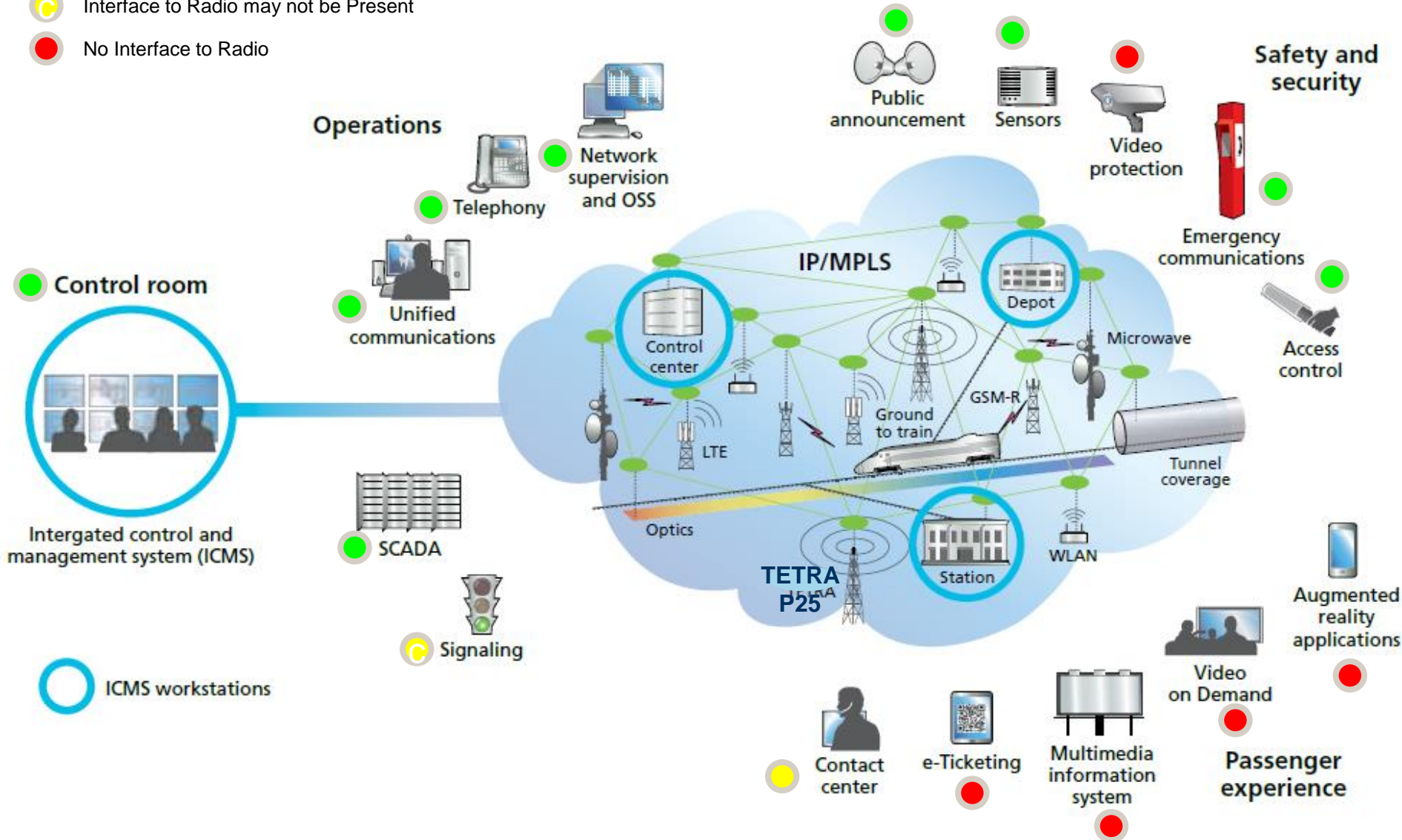- Tele-diagnosis and fleet maintenance
- Localization services (medium)

RAILWAY COMMUNICATION NETWORK TYPICAL SYSTEMS

SYSTEMS WITH INTERFACE TO RADIO

- 🟢 Interface to Radio Present
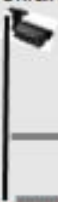- 🟡 Interface to Radio may not be Present
- 🔴 No Interface to Radio

RAILWAY TASKS VIA RADIO

BROADBAND	TETRA / P25	TETRA

	PIS and video surveillance	Train dispatching	Train control
Stations	PIS	Multimedia Trunking	
Railway	Video Surveillance — Railway Video Surveillance	Railway Maintenance	
Train	Carriage Video Surveillance — Carriage PIS	Multimedia Trunking	Train Control

MOTOROLA
RAILWAY COMMUNICATION SOLUTION

RAILWAY TYPICAL RADIO USERS

Train driver, conductor

Control Centre

Station master

Depot, yard

Train-borne equipment

Security / Fire

Engineering & maintenance

RAILWAY COMMUNICATION NEEDS – WIDE AREA VOICE & DATA

Train driver

Train conductor

Control centre

Station master
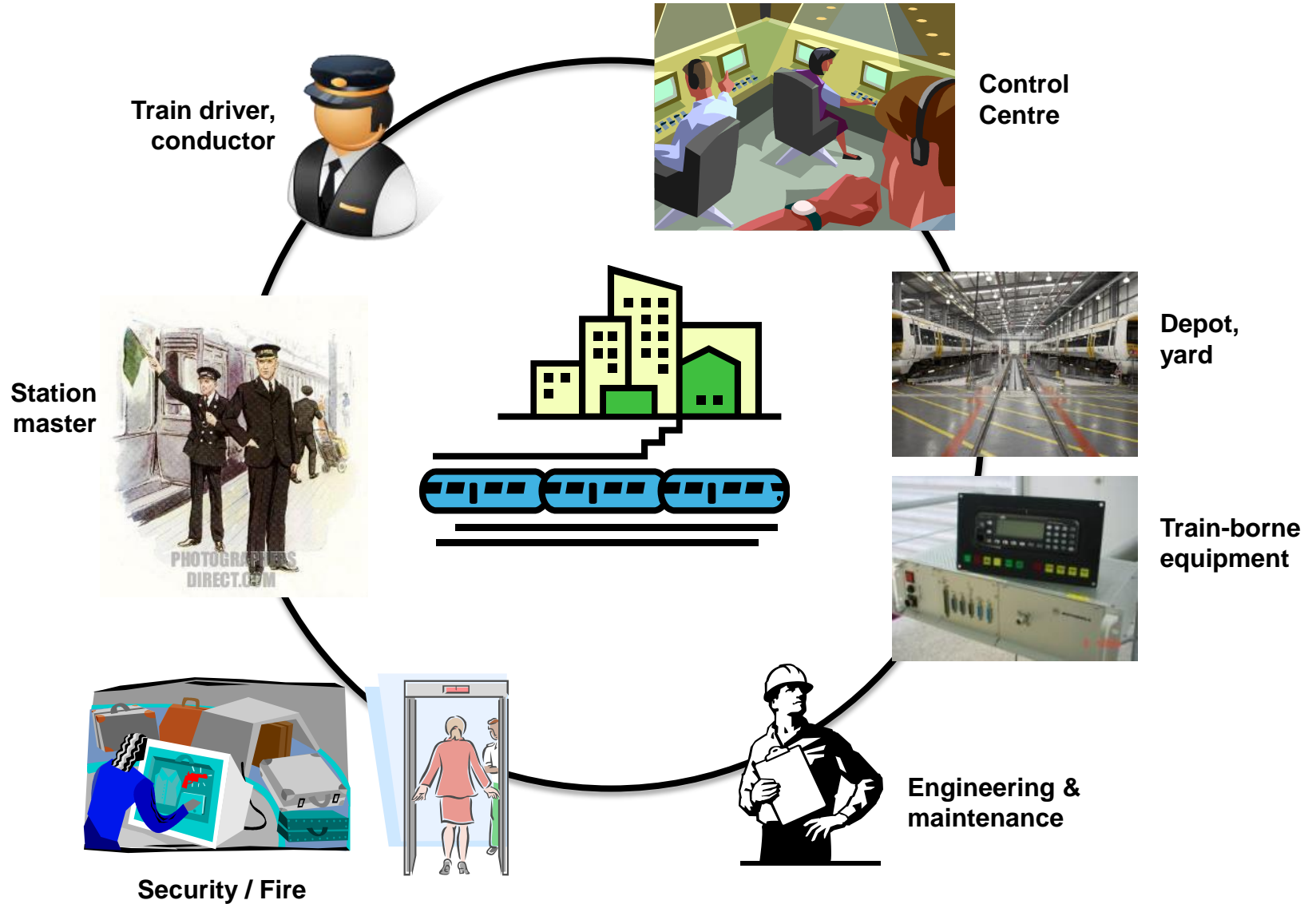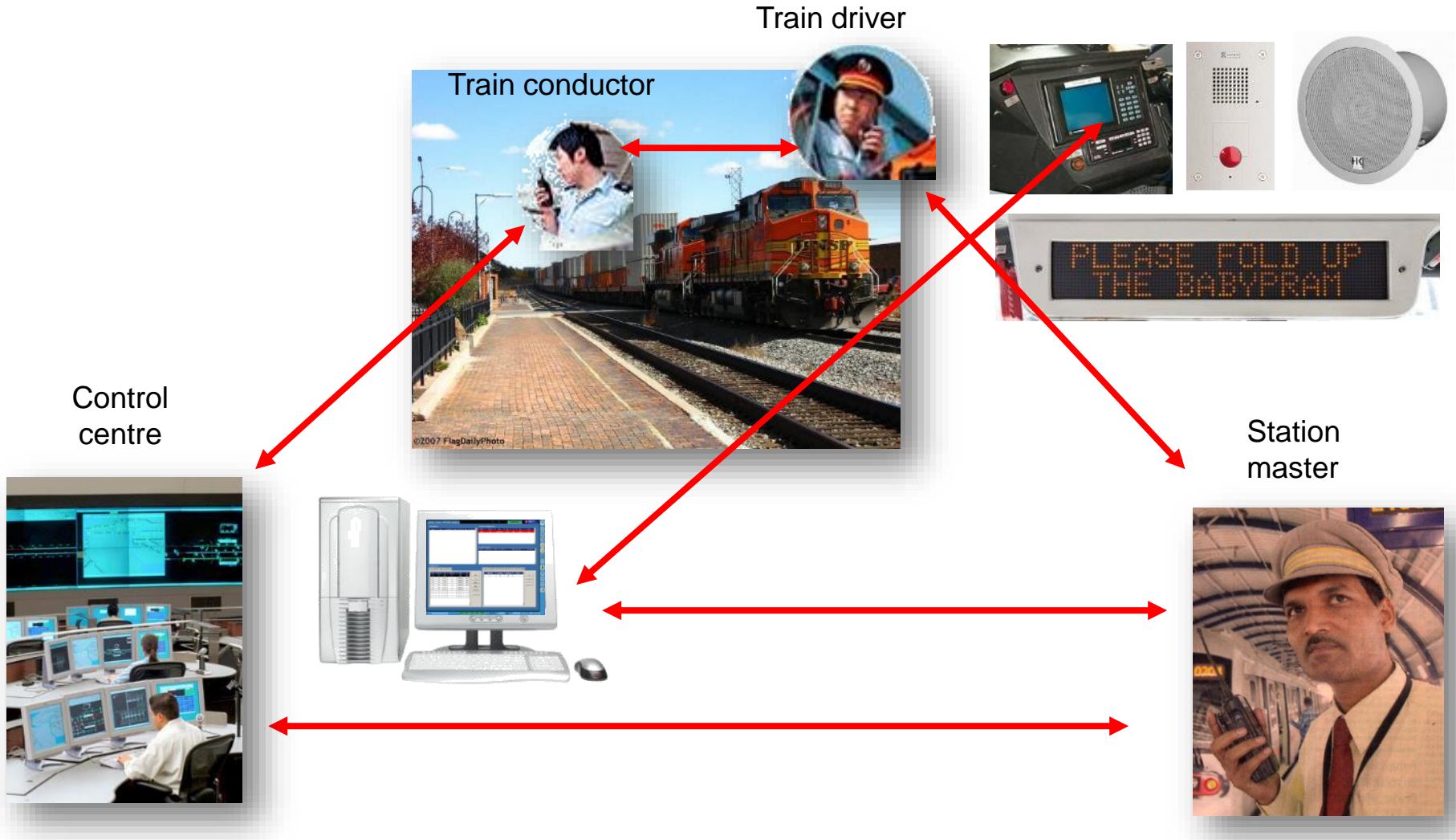
End-to-end Train Radio Solution

CAD & Voice Recording Sub-System

Trainborne Sub-system

API

TETRA

BTS

API

TCI

TRCP

Data

PA

Master Clock

FOTS | **PABX**

PAS | **PIS**

Train Signalling

Other Sub-systems In metro

Other Sub-system

ECB/EHP

Train computer

PIS

Train Controller

TETRA Radio System

Total Train Radio Solution
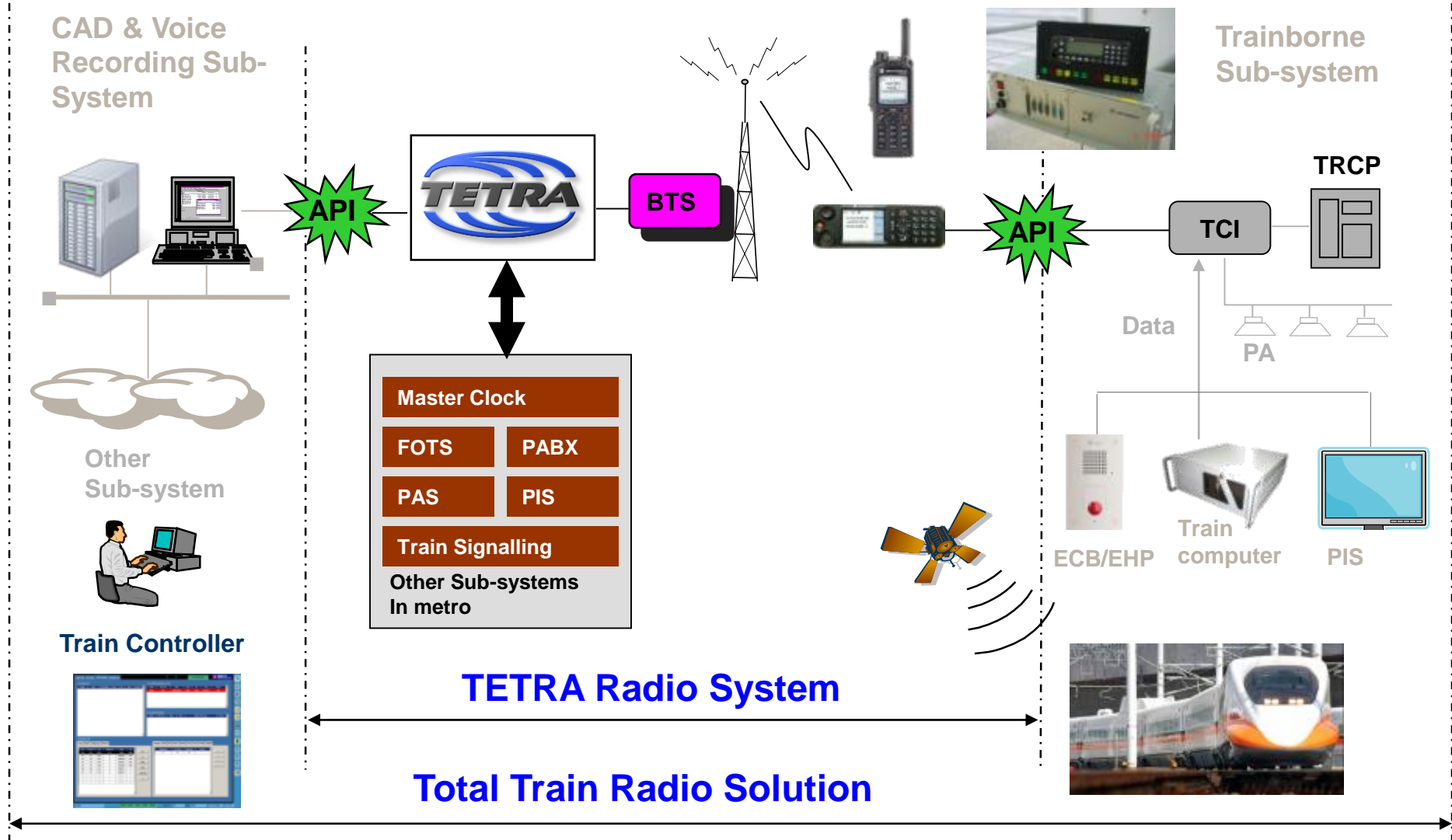
Motorola Dimetra IP

- **Easy Interface to external equipment – comply with industrial standards**
  - Value adding solutions from the applications software community are integrated smoothly and cost effectively

All IP Network Architecture:

Solutions from small local to full nationwide

Scalable for both voice and data

In built resilience

Highly secure

Future proof

Fast nationwide call set-up

Complete Core Network Solution:

IP Network Design

Logging and billing

Call control

Management

Data server

Dispatch

135 cm
IP CORE

Security

Data Services (e.g., WAP)

TETRA 2 High speed data

Base station | Base station | Base station

RAN
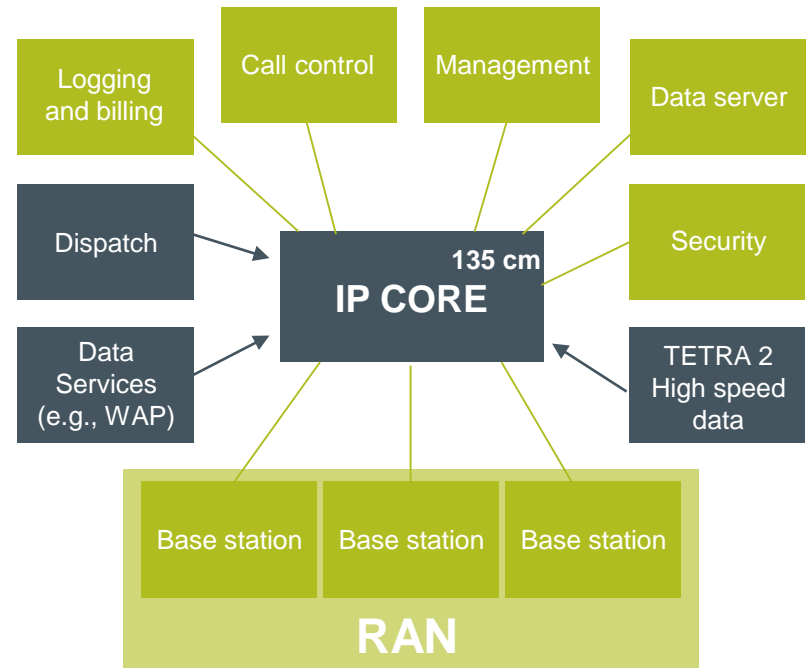
Rail Computer Aided Dispatcher (CAD)

- **Flexible MMI solution customised to suit different customer operations and procedures.**

- **Interface to:**
    - **ATS (Signalling)**
    - **PIDS**
    - **PABX**
    - **Public Address**
    - **Other voice and data sub-systems**

Customised
RailCAD solution

Computer Aided Dispatcher (CAD)
Various CAD GUIs – flexible design

Flexibility in design to help meet individual customer's optimal operating requirements

Motorola's TETRA subscriber radio portfolio

MTP850Ex **MTP850** **MTP3100** **MTP3250** **MTP6550** **MTP6750**

Comprehensive, Proven Feature Set

MTM5200 **MTM5400** **MTM5500**

MTM5000
Rail standards compliant

- **Transceiver Dimension: 45mm x 170mm x 169mm (H x W x D)**

- **Transceiver Weight: 1070g**
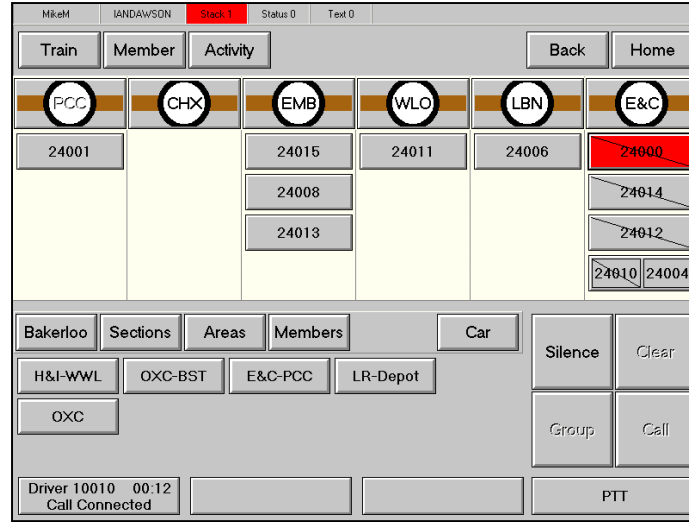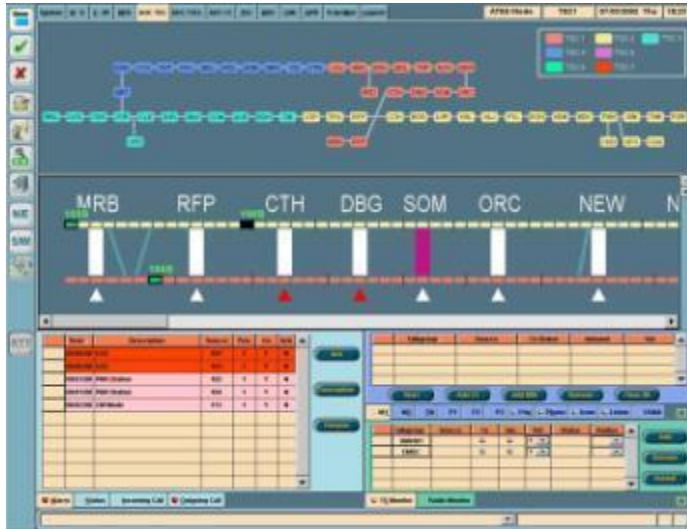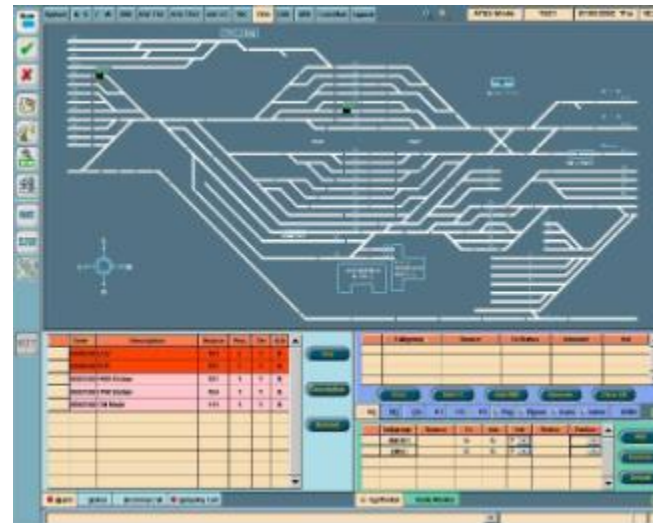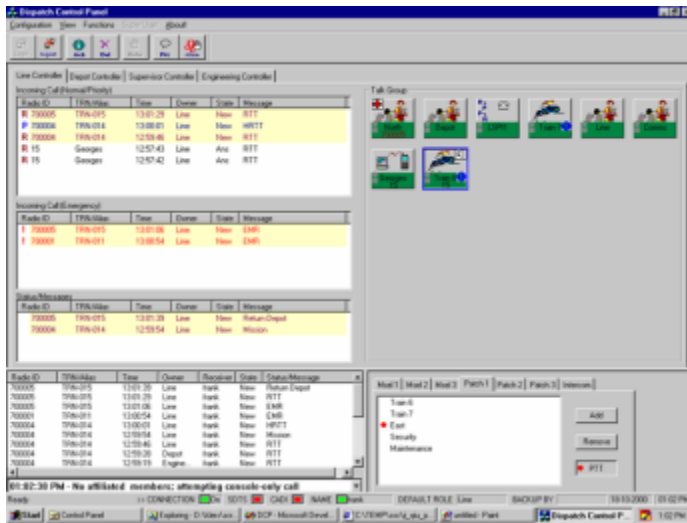
- **Typical Rx RF specification: -116dBm (static), -107dBm (Dynamic)**

- ❏ **Environmental Testing: IEC 60571**

- ❏ **Shock & Vibration: IEC 61373**

- ❏ **EMC compliance: EN 50121, EN 50155**

- ❏ **No additional casing required**

- ❏ **IP54 as per IEC 60529**

- ❏ **Small form factor**

Tetra Subscribers

MTM5x00 / MTM800FuG mobile radio series

MOTOROLA

Declaration of Conformity

Motorola Solutions declares under its sole responsibility that the products, to which this declaration relates, conform to the applicable essential requirements of the following Directive(s) of the Council of the European Community on the approximation of the laws of the Member States:

- 1999/5/EC on Radio Equipment and Telecommunications Terminal Equipment
- ECE Regulation No. 10 for electrical/electronic-subassembly (Automotive Directive)
- 2011/65/EU on RoHS-2 for Restriction of the use of Hazardous Substances

Product:

MTM5200, MTM5400, MTM5500 with Type designator MT953C
MTM800 FuG, MTM800 FuG ET with Type designator MT953CG

Placed on the market by:

Motorola Solutions Germany GmbH, D-13507 Berlin, Germany

Description:

MT953C:
MTM5200   380-430MHz   3W TETRA 1 and 3.16 TEDS TX power,
MTM5400 / MTM5500 380-430MHz, 10W TETRA 1 and 3.16 TEDS TX power,
with Control Heads (Standard/Ethernet), Cables and Accessories.

MT953CG:
MTM800 FuG   380-430MHz, 10W TETRA 1 and 3.16 TEDS TX power,
                 with Standard Control heads, Cables and Accessories.
MTM800 FuG ET 380-430MHz, 380-430MHz, 10W TETRA 1 and 3.16 TEDS TX power
                 with Ethernet Control heads, Cables and Accessories.

Conformity:

Harmonized standards used to demonstrate conformity.

Radio Equipment, Article 3(2)

EN 303 035-1 v1.2.1, EN 303 035-2 v1.2.1, EN 300 394-1 v2.3.1

EMC, Article 3(1)b

EN 301 489-1 v1.9.2, EN 301 489-18 v1.3.1, EN 302 561-1 v1.2.1,
EN 300 394-1 v2.3.1 (rad. emissions)

Safety, Article 3(1)a

EN 60950-1:2006 +A11:2009 +A1:2010 +A12:2011 +AC:2011
ICNIRP(1998) Occupational Controlled Environment,

Year of first application of CE mark: 2010

The essential radio test suites, as defined in the quoted harmonized standards, have been performed.
The product shows compliance with ECE Regulation 10 and is marked with E24 10R 030939
For railway applications the product MT953C shows compliance with following standards:
EMC EN50121-3-2:2006 and Environmental IEC60571 Ed.3.0 / EN50155:2007

Signatures:

Ruediger Maurer
Director of Product Safety and Regulatory Compliance, Motorola Solutions Germany GmbH

Andreas Scheuneman
Managing Director Motorola Solutions Germany GmbH, Am Borsigturm 130, D-13507 Berlin, Germany

Document: Reference: BER-214083-DC-D   28.02.2014
            Keeper: Motorola Solutions Germany GmbH, Am Borsigturm 130, D-13507 Berlin, Germany   DoC form ver 3.1

TRAIN RADIO SYSTEM
SCHEMATIC TRAIN INSTALLATION

TRAIN RADIO SYSTEM - REQUIREMENTS

Functional

- ❑ Call Management by Train Numbers
- ❑ Management of up to Two Control Heads
- ❑ Audio Management (LSP, Telephone Handset, Gooseneck Mic, Portable)
- ❑ Menu Customization
- ❑ Data Interfaces to other On-board Systems
- ❑ Communication to on-board INTERCOM and Public Address Systems
- ❑ I/O ports for Control Functions
- ❑ Shared HW-platform for other On-board Data Applications

Non- Functional

- ❑ Long Product Lifetime
- ❑ High Reliability
- ❑ Railway environmentally tested and CERTIFIED
- ❑ High grade of ingress protection
- ❑ Modular HW & SW expansion
- ❑ Continuous software support
- ❑ Quick Service Response
- ❑ Long term Spare Part Availability

WHY TETRA FOR RAIL OPERATIONS

- **Open standard**
  - Interoperability with open interfaces
  - Price Competitive

- **Frequency availability**
  - Many bands - not enough VHF freq

- **Spectrum efficiency**
- **Good audio quality**
- **Feature rich**
- **Full duplex individual call**
- **Mission critical features – instant group communications, secure, etc.**
- **Integrated / concurrent voice & data**
- **Voice & data interface to other railway sub-systems**
- **High Reliability and Availability**
- **Privacy & security**
- **Future-proof**
- **Rugged durable products**

← **25 kHz** →

| 1 | 2 | 3 | 4 |
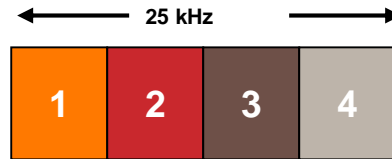
1 TETRA radio channel supports *four simultaneous conversations!*

> *2k contracts across 114 countries*

Contracts by Sector

Installed Systems by sector

- Public Safety 32%
- Utilities 10%
- Confidential 1%
- Business and Industry 5%
- Extraction 5%
- Government 10%
- Military 2%
- PAMR 3%
- Transport 33%
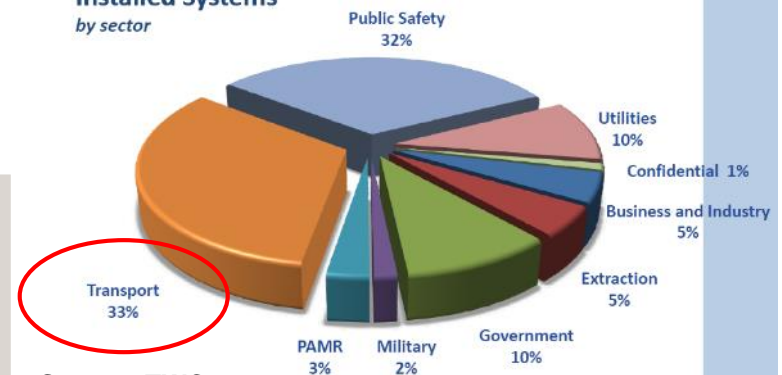
Source: TWC2010

- **TETRA is well suited for rail operations**
- **New subways almost always implement TETRA**
- **Existing subways upgrade from analog to TETRA – e.g. SMRT, MTRC, Beijing, Shanghai, Bangkok, Manila**

MOTOROLA CREDENTIALS & RAILWAY REFERENCES

MOTOROLA SOLUTIONS NO BRASIL

- Há mais de 40 anos presente no Brasil
- Cobertura nacional com sede em São Paulo/SP
- Produção local desde 2000 e em 2014 início da fabricação da linha APX, ideal para comunicação em ambientes críticos
- Mais de 200 engenheiros locais
- Engenharia local, prestando serviços para o Brasil
- Rede autorizada com mais de 300 revendas
- Serviço Autorizado Motorola em todo o país

300

MOTOROLA

COLLABORATING WITH CUSTOMERS FOR >80 YEARS AROUND THE WORLD TO MEET THEIR UNIQUE COMMUNICATION NEEDS ENABLING THEM TO BE THEIR BEST IN THE MOMENTS THAT MATTER

DESIGNED FOR
LAW
ENFORCEMENT

DESIGNED FOR
FIRE AND
EMERGENCY
MEDICAL

DESIGNED FOR
UTILITIES AND
PETRO CHEMICAL

DESIGNED FOR
FEDERAL
GOVERNMENT

DESIGNED FOR
TRANSIT

DESIGNED FOR
MINING

MOTOROLA TETRA SOLUTION RELIABLE & STABLE

WORLD'S LARGEST TETRA SUPPLIER

SINCE 2000…

WE'VE SUPPLIED TETRA SYSTEMS TO A GREAT VARIETY OF USERS IN DIFFERENT VERTICALS AND COUNTRIES.

SYSTEMS: OVER 830

COUNTRIES: OVER 120

NATION-WIDE SYSTEMS: 30

METRO PROJECTS: OVER 100

MSOs: OVER 1,200

BASE STATIONS (SITES):   OVER 26,000

TERMINALS: OVER 2.5 MILLONS

AIRWAVE, UK
3,672 sites, +200,000 users
53 police forces, +300 agencies

NODNETT, NORUEGA
2,100 sites (710 sites TEDS), 40,000 terminals
Control Rooms: 27 (Police), 18 (Fire), 17 (Health)

MOTOROLA P25 SOLUTION RELIABLE & STABLE

WORLD'S LARGEST P25 SUPPLIER

SINCE 2000…

WE'VE SUPPLIED P25 SYSTEMS TO A GREAT VARIETY OF USERS IN DIFFERENT VERTICALS AND COUNTRIES.

SYSTEMS: OVER 550 TRUNKED; OVER 2,000 CONVENTIONAL

COUNTRIES: OVER 90

NATION- & STATE-WIDE SYSTEMS: 34

TERMINALS: OVER 3 MILLONS

MANAGING NETWORKS ACROSS THE GLOBE

Dow Chemical
11 sites
9300 users

Norway
2100 sites
14,000 users

Comm Edison
27 sites
1600 users

Denmark
500 sites
23,000 users

New S. Wales
160 sites
25,000 users

Illinois
274 sites
43,000 users

Maryland
Hosted Core
Federal

Austria
1900 sites
43,000 users

QLD Gas
28 sites
1700 users

Queensland
185 sites
10,000 users

Country Fire
195 sites
2000 users

S. Florida
Hosted Core
21 sites
20,000 Users

S. Carolina
79 sites
45,000 users

Vale
3 sites
399 users

S. Australia
204 sites
15,000 users

Petrobras
Radio Mgmt
35,000 users

Brisbane
65 sites
15,000 users

Chile
15 sites
2,200 users

Australia MMR
100 sites
10,000 users

Rio Tinto
8 sites
500 users

Australia Data
40 sites
1,100 users

20+ GLOBALLY OPERATED NETWORKS
5000+ GLOBALLY OPERATED SITES
300,000+ SUBSCRIBERS ON OPERATED NETWORKS

MOTOROLA RAIL/METRO PROJECTS

Asia Pacific (93)

EUROPE	**7/11**		
Denmark	1		
Ireland	1		
Portugal	1		
Russia	2		
Spain	2		
Turkey	3		
UK	1		

ASIA	**9/93**
China	51
Hong Kong	6
India	12
Korea	10
Macau	1
Malaysia	3
Philippines	1
Singapore	5
Taiwan	4

LATIN AMERICA	**4/4**
Argentina	1
Colombia	1
Mexico	1
Venezuela	1

1. Beijing Light Rail (China)
2. Beijing Airport Express Line (China)
3. Beijing Light Rail (LRT) (China)
4. Beijing Light Rail BaTong (China)
5. Beijing Metro Lines 1
6. Beijing Metro Line 4 (C
7. Beijing Metro Line 5 (C
8. Beijing Metro L6 (Chin
9. Beijing Metro Line 7 (C
10. Beijing Metro Line 8 (C
11. Beijing Metro Line 9 (C
12. Beijing Metro Line 10
13. Beijing Metro Line 10
14. Beijing Metro Line 14
15. Beijing Metro Line 15
16. Beijing Metro Line 15
17. Beijing Metro Fangsha
18. Beijing Metro Yizhuan
19. Beijing Metro Changp
20. Changchun LRT (Chin
21. Changsha Metro L2 (C
22. Chengdu Metro Line 1
23. Chengdu Metro Line 2
24. Chongqing Metro Line
25. Chongqing Metro LRT
26. Chongqing Metro Line 6 (China)
27. Dongguan Metro L2 (China)
28. Guangzhou Metro Line 2 (China)
29. Guangzhou Metro Line 3 (China)
30. Guangzhou Metro Lines 5 & 6 (China)
31. Guangzhou Metro L6 – ph 2 (China)
32. Guangzhou-FoShan Metro (China)
33. Hangzhou Metro Line 1 (China)
34. Harbin Metro L1 (China)
35. Kunming Metro L1,2 (China) + Metro police
36. Kunming Metro L6 (China)
37. Nanjing Metro Line 2 (China)
38. Nanjing Metro L3 (China)
39. Shanghai Metro L1 - 13 (China)
40. Shanghai Metro exp – 5 new lines (China)
41. Shanghai Metro Police (China)
42. Suzhou Metro Line 1 (China)
43. Suzhou Metro L2 (China)
44. Tianjin Light Rail (LRT) (China)
45. Tianjin Metro Line 1 (China)
46. Tianjin Metro Line 2 & 3 (China)
47. Wuhan Metro Line 4 (China)
48. Wuxi Metro L1,2 (China)
49. Xian Metro Line 1 (China)
50. Xian Metro Line 2 (China)
51. XinChang Railway MOR (China)
   West Rail + KSL extension (HKG, China)
   sney Resort Line (Hong Kong, China)
   uth Island Line (Hong Kong, China)
   L – stations (Hong Kong, China)
   KP railway district remote sites) (HKG)
   atin Central Link (Hong Kong, China)
   RT (Macau, China)
   Metro (India)
   Metro (India)
   o Railway Corp Line 1 & 2 (India)
   o Railway Corp Line 3 (India)
   o Railway Corp Phase 2 – Lines 1,2,3
   s + Lines 4,5,6 (India)
   o Railway Corp Phase 3 (India)
   rt Metro Express Line (India)
   Metro (India)
   d Metro (India)
   etro (India)
   Central Railway (India)
   Metro One (India)
   ban Transit Authority L3 + Ext (Korea)
72. Bansong Line (Korea)
73. Busan-Gimhae LRT (Korea)
74. Daegu Metro (Korea)
75. Incheon International Airport Rail Corp (Korea)
76. Seoul Metro Line 9 (Korea)
77. Ui Sinseol LRT (Korea)
78. KRNA Phase 2 (Korea)
79. KRNA Honam Line (Korea)
80. New Bundang Line (Korea)
81. Express Rail Link (Malaysia)
82. Express Rail Link – upgrade + KLIA2 ext (MYS)
83. Klang Valley MRT – SBK Line (Malaysia)
84. Manila LRT Line 1 (Philippines)
85. NSEW Line (Singapore)
86. NSEW Line - BLE extension (Singapore)
87. NSEW Line – upgrade + JEMP,TWE ext (SGP)
88. Downtown Line (Singapore)
89. Sengkang-Punggol LRT (Singapore)
90. Taoyuan Airport MRT (Taiwan)
91. Kaohsiung MRT (Taiwan)
92. Taiwan Railway Administration (Taiwan)
93. Taiwan High Speed Rail (Taiwan)

Being FIRST!!

- **FIRST operational TETRA system for rail in the world**
  - Malaysia ERL – radio solution supplied by Motorola.

- **FIRST TETRA contract for a high speed railway (speed up to 350 Km/h) in the world**
  - Taiwan High Speed Railway – radio solution supplied by Motorola.

- **FIRST APCO 25 system serving one of Australia's longest private freight railway**
  - Western Australia – radio solution supplied by Motorola.

- **FIRST APCO 25 contract for a high speed rail**
  - South Korea High Speed Rail – radio solution supplied by Motorola

- **Longest passenger railway in the world**
  - Taiwan Railway Administration – radio solution supplied by Motorola.

- **Leading Driverless Metros with TETRA**
  - Copenhagen Metro, Shanghai Metro Line 10, Hong Kong Disney Resort Line – radio solution supplied by Motorola

Light Rail & Trams **Long Haul Rail** **High Speed Rail** **Metro** **Airport Express**

LONDON UNDERGROUND – THE TUBE

❑ One of the **Largest Metros** in the world
- Opened 1863
- Over 3 million customer journeys per day
- 450 trains operating 20 hours/day
- 390 Km of tunnels (402 Km total)
- Surface area coverage >1,000 km^2
- 11 lines, 270 stations

❑ **Largest Mass Transit TETRA Network**
- 5 zones, 290 base stations (sites)
- 200+ consoles
- 7000+ portables
- 1,400 train mobiles
- 740 Km radiating cable

❑ **Single Fully Integrated TETRA Network**
Current Motorola TETRA network replaced the separate analogue systems, serving staff on trains, stations and depots for each of the eleven operating lines, improving efficiency and safety.

❑ **Public Safety Integration**:
It is designed to provide voice and data services to police, fire and ambulance dealing with emergencies in the Tube.

❑ **Superb Coverage**:
More than 700 Km of radiating cable were installed to ensure extremely high levels of coverage.

❑ Railway Dispatcher Operation
- Mimic Presentation
- Location by Station

❑ Train Running Number
- Manual and Automatic Input
- Train and fixed Mobile

❑ Train interfaces
- Train Management Computer
- Alarm systems

❑ Railway Mobiles
- Simple Calls
- Dedicated HMI

❑ Routing of calls based on location

MTR, HONG KONG – CONTROL ROOM

METRO SAO PAULO
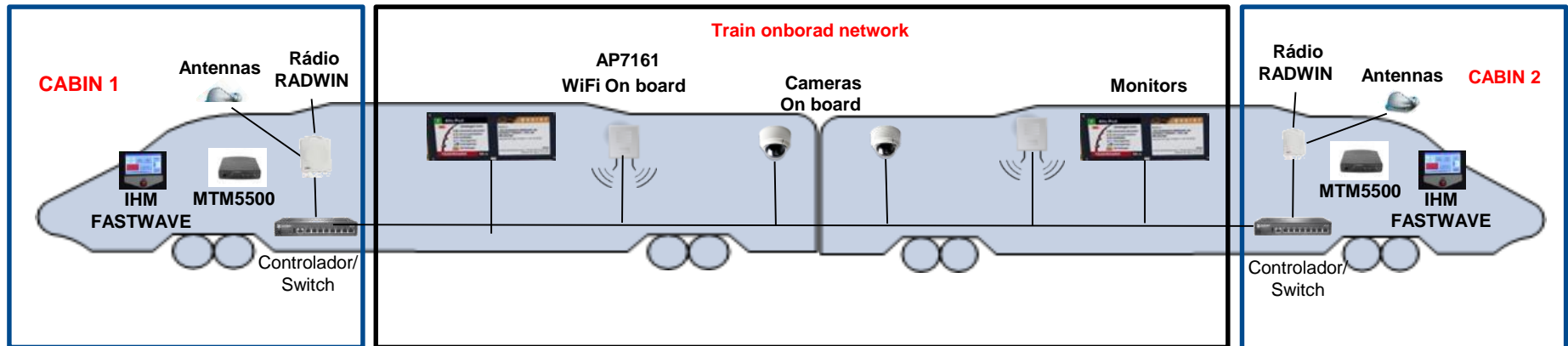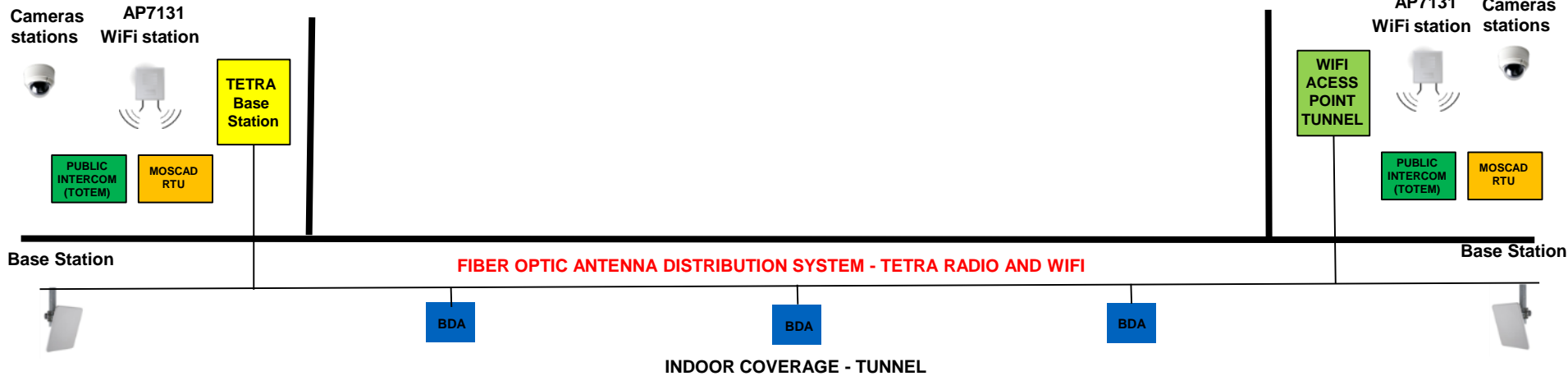
METRO – TOPOLOGIA SCMVD

COMMAND & CONTROL CENTER

RTVVC – REAL TIME VIDEO & VOICE CONTROL

Radio Dispatch Voice MCC7500	VoIP Dispatch Voice WAVE	Train Dispatch Voice SDS Commander	Passanger Annoucement & Multimedia Services	Public Annoucement	VoIP PBX Totem Interc	ACCESS CONTROL	CCTV VMS	CENTRAL SCADA INFRA SYSTEM

STATION A

Cameras stations

AP7131 WiFi station

TETRA Base Station

PUBLIC INTERCOM (TOTEM)

MOSCAD RTU

STATION B

AP7131 WiFi station

Cameras stations

WIFI ACESS POINT TUNNEL

PUBLIC INTERCOM (TOTEM)

MOSCAD RTU

Base Station

FIBER OPTIC ANTENNA DISTRIBUTION SYSTEM - TETRA RADIO AND WIFI

Base Station

BDA **BDA** **BDA**

INDOOR COVERAGE - TUNNEL

Train onborad network

CABIN 1

Antennas **Rádio RADWIN**

AP7161 WiFi On board

Cameras On board

Monitors

Rádio RADWIN Antennas **CABIN 2**

IHM FASTWAVE **MTM5500**

MTM5500 **IHM FASTWAVE**

Controlador/ Switch

Controlador/ Switch

Nome do Trabalho – usar várias linhas se necessário

Nome e e-mail do(s) apresentador(es)

Obrigado