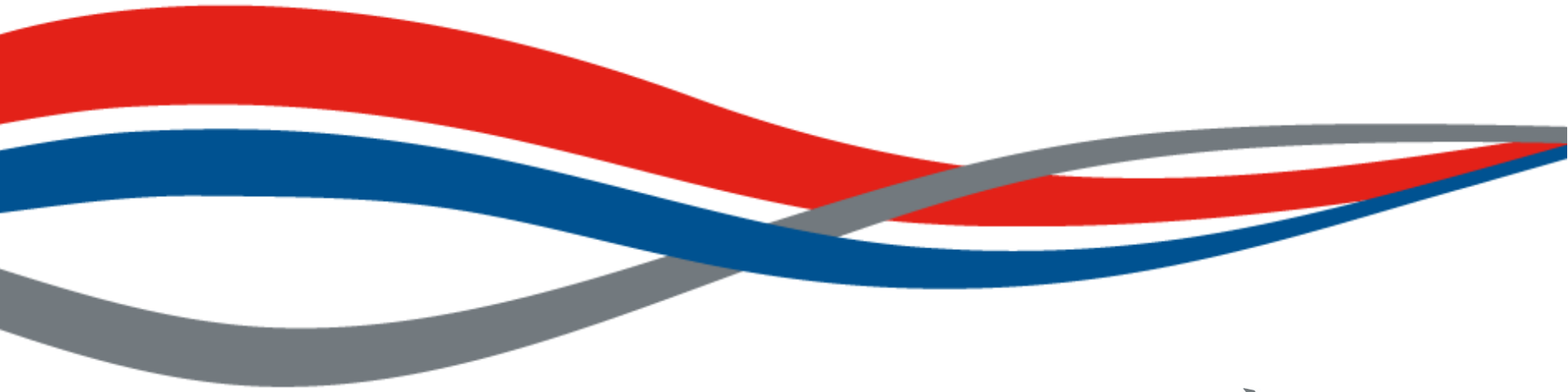
COMBINED SE-DK ATP SYSTEM FOR ØRESUND LINK



TOPICS

BACKGROUND
- History
- Characteristics Swedish ATP – Danish ATP
- Strategic Considerations
- Decision

PRINCIPLES
- Combined ATP
- Automatic Switch-Over
- Scenarios
- Units

CONCLUSIONS
- Experience
- The future

HISTORY

SWEDISH ATP

- Introduced late 70’s
- Updated ‘ATC2’ early 90’s
- Wayside equipment supplied by Bombardier (Ebicab 700 ~98%) and Ansaldo (L10000 ~2%)
- Onboard equipment supplied by Bombardier (Ebicab 700 ~10%) and Ansaldo (L10000 ~90%)
- Full brake profile monitoring, based on the train’s individual braking characteristics

DANISH ATP

- Introduced late 80’s
- Wayside equipment supplied by Siemens (ZUB123 100%)
- Onboard equipment supplied ny Siemens (ZUB123 100%)
- Full brake profile monitoring, based on the train’s individual braking characteristics

SYSTEM CHARACTERISTICS

SWEDISH ATP

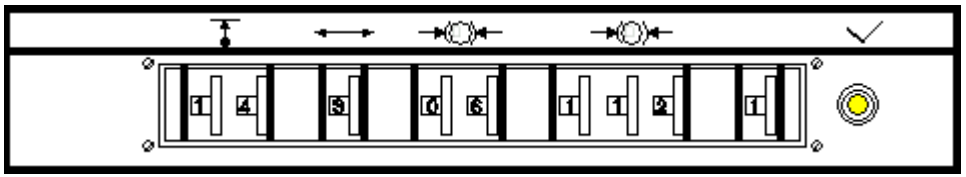
- Balises located between rails
- Minimum two balises at one location (balise group)
- Signal info and civil speeds from separate groups
- Frequency range 27 / 4.5 MHz
- Digital DMI display without speedometer

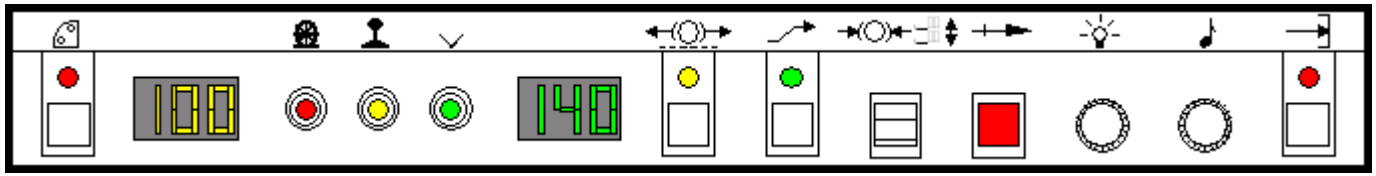
DANISH ATP

- Balises located on the right hand side of running rails
- Only one balise at a location
- Signal info and civil speeds from same balise
- Frequency range 100 / 850 kHz
- Analogue and digital DMI display with speedometer

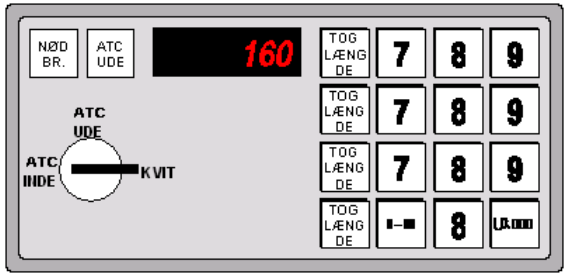
DMI

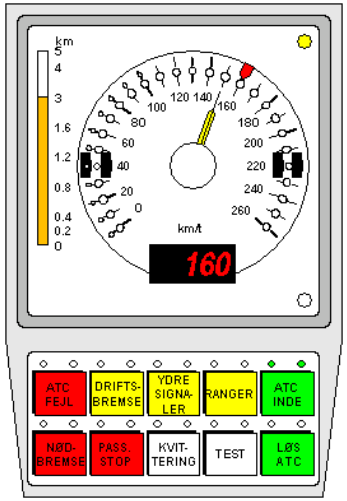
SWEDISH ATP





DANISH ATP





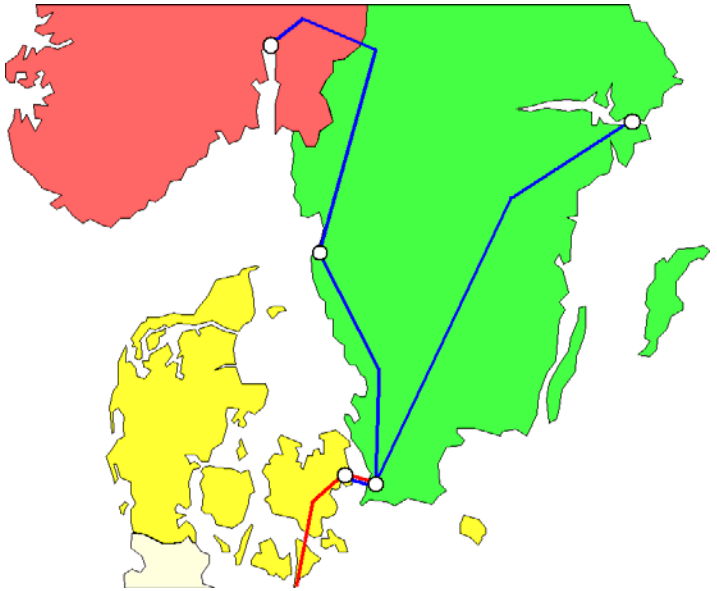
CONSIDERATIONS

A. ERTMS?

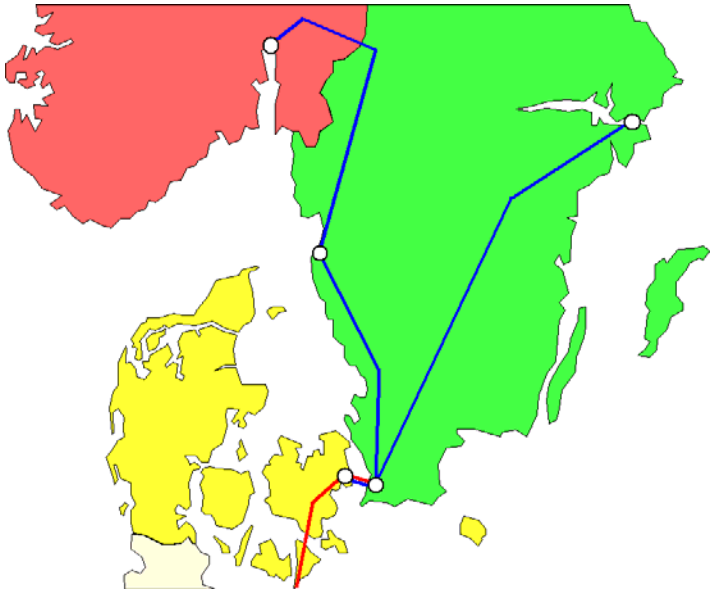
B. DUAL WAYSIDE?

C. DUAL ON-BOARD SYSTEMS?

D. DUAL WAYSIDE / DUAL ON-BOARD?



CONSIDERATIONS



A. ERTMS?

- Not a mature system 1997
- No STM:s available

B. DUAL WAYSIDE?

- Requires whole section to be fitted with both systems

C. DUAL ON-BOARD SYSTEMS?

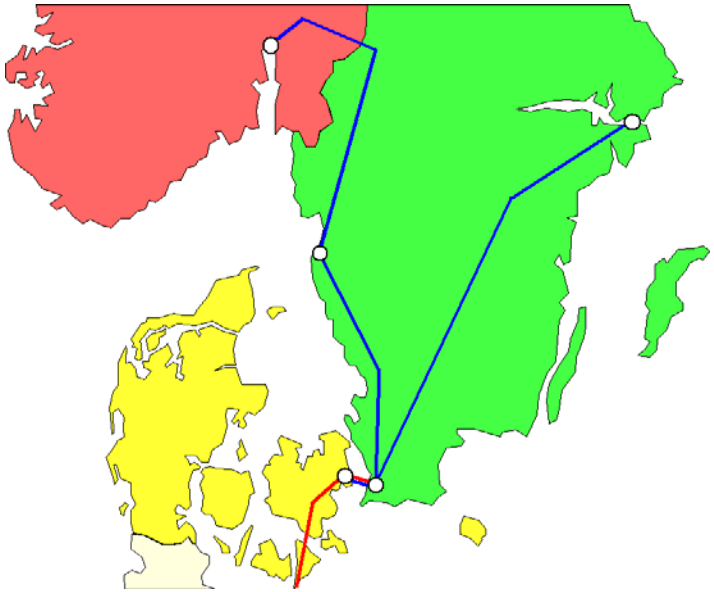
- Requires all trains on the link to be fitted with combined ATP

D. DUAL WAYSIDE / DUAL ON-BOARD?

- Same as C, but with the possibility for future upgrade to dual wayside
- Requires some means of system selection when in ‘dual wayside’ area

DECISION

D. DUAL WAYSIDE / DUAL ON-BOARD!

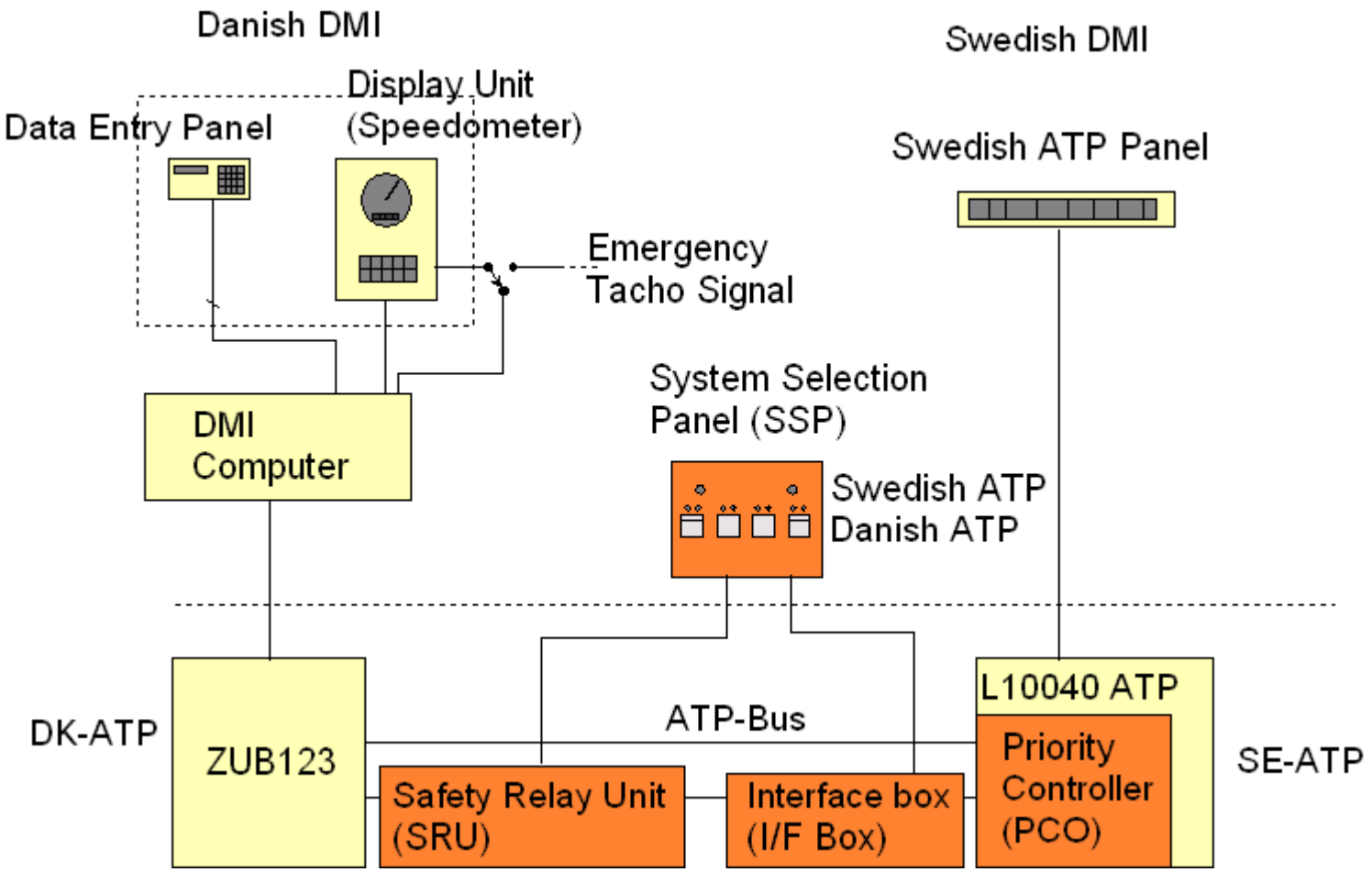


- Initially, all trains operating on the link will be fitted with a dual system
- In the future, the link Copenhagen-Malmö *can* be fitted with both systems
- Once this step has been taken, then trains fitted with Swedish ATP can operate to Copenhagen and trains fitted with Danish ATP can operate to Malmö
- Trains fitted with the dual system can operate beyond these without constraints

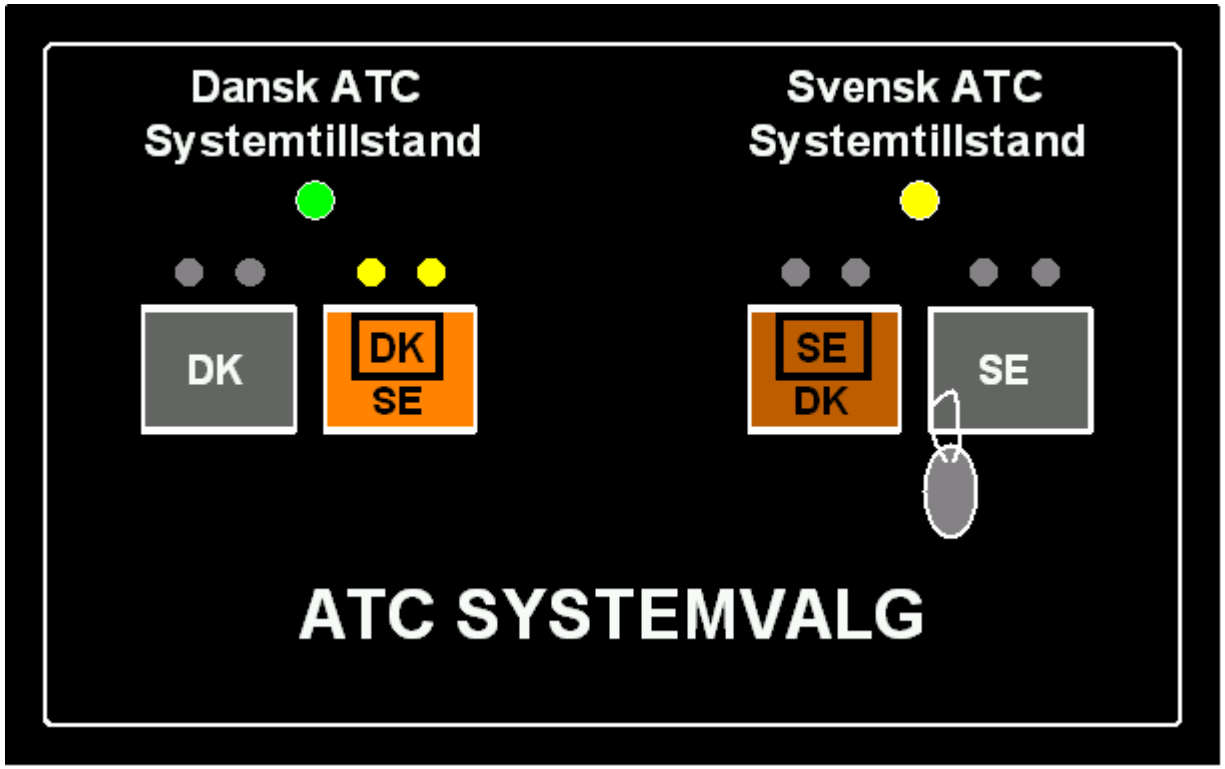
REQUIREMENTS

- Capable of operating on Danish lines without constraints
- Capable of operating on Swedish lines without constraints
- Capable of operating on a line equipped with both ATP systems
- Capable of switching from one mode of operation to the other at speeds up to 200 km/h

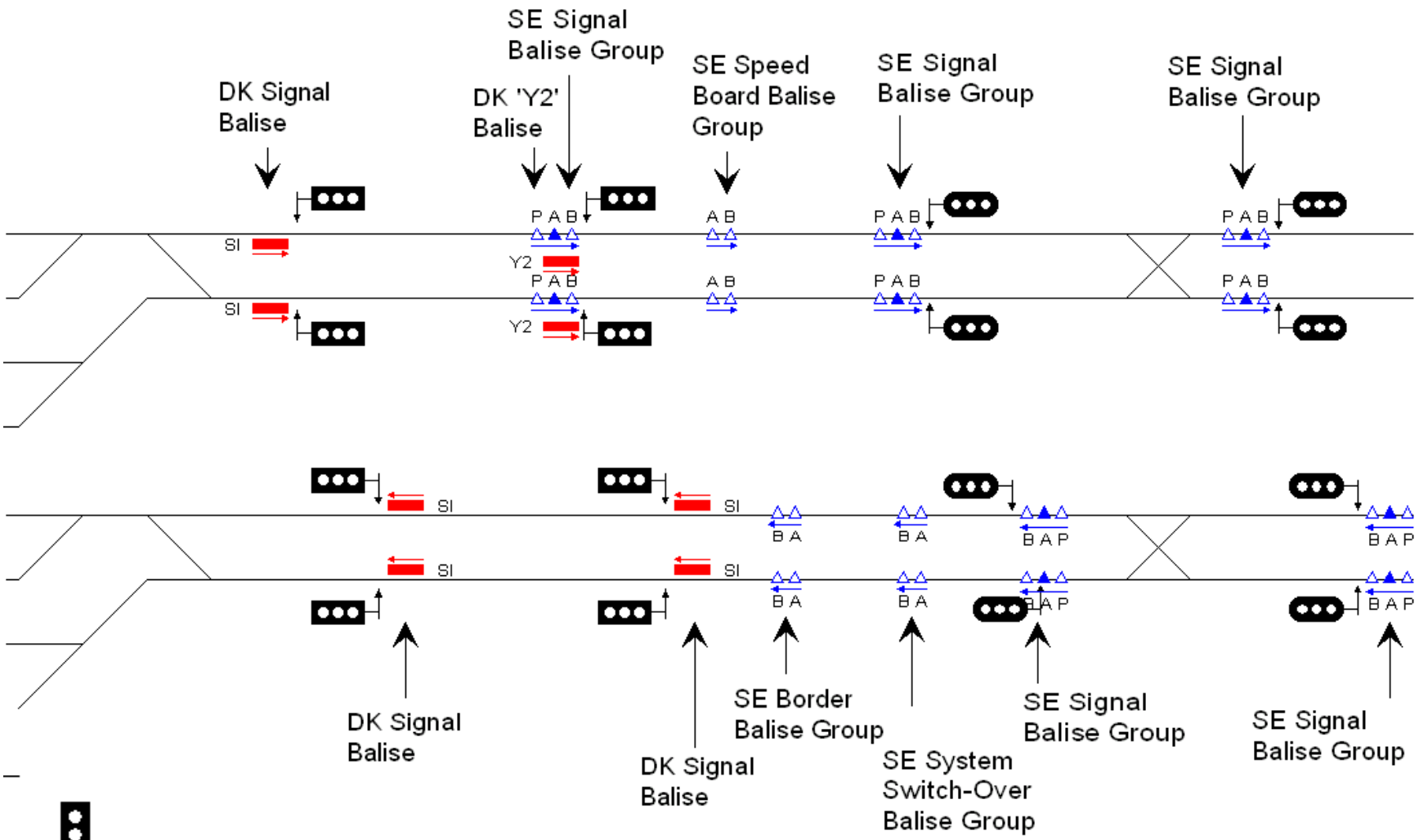
BLOCK DIAGRAM



SYSTEM SELECTION PANEL (SSP)



TRACK LAYOUT



Danish Signal

Swedish Signal

AnsaldoSTS

SCENARIOS

- DRIVING FROM SWEDEN TO DENMARK
- DRIVING FROM DENMARK TO SWEDEN
- CHANGING PRIORITY
- SELECTING DANISH ATP EXCLUSIVELY
- SELECTING SWEDISH ATP EXCLUSIVELY

SCENARIO — SE > DK

DRIVING FROM SWEDEN TO DENMARK (Startup)

- Activate Cab
- Both systems startup
- Self test and enter train data in both systems
- Both Systems start supervising default startup conditions
- SSP: Indicates priority
- SE ATP reads first signal balises and speed board balises
- Drive train length
- SE DMI will light up and SE ATP will commence full supervision
- SE ATP sends ‘Supervising’ flag to DK-ATP
- DK ATP extinguishes all displays and ‘Max Speed’ indicator is set to zero
- DK ATP ceases supervision and enters ‘F’ state
- SSP: DK ‘state’ lamp will change green > yellow

SCENARIO — SE > DK

DRIVING FROM SWEDEN TO DENMARK (Switch-over)

- DK ATP reads first DK balise
- DK ATP lights up and starts monitoring
- SSP: DK ‘state’ lamp will change yellow > green
- DK ATP sends ‘Supervising’ flag to SE ATP
- SE ATP will extinguish all displays
- SE ATP ceases supervision and enters ‘F’ state
- SSP: SE ‘state’ lamp will change green > yellow
- SE ATP reads ‘system switch-over’ balises and ‘border’ balises (ignored, because SE ATP is now in ‘F’ state)

NB: The changeover is slightly different, pending which system is prioritized

SCENARIO — DK > SE

DRIVING FROM DENMARK TO SWEDEN (Startup)

- Activate Cab
- Both systems startup
- Self test and enter train data in both systems
- Both Systems start supervising default startup conditions
- SSP: Indicates priority
- DK ATP reads first balise
- DK DMI will light up and DK ATP will commence full supervision
- DK ATP sends ‘Supervising’ flag to SE-ATP
- SE ATP extinguishes all displays
- SE ATP ceases supervision and enters ‘F’ state
- SSP: SE ‘state’ lamp will change green > yellow

SCENARIO — DK > SE

DRIVING FROM DENMARK TO SWEDEN (Switch-over)

- DK ATP reads last DK balise, which includes information on the upcoming system switch-over
- SE ATP reads first SE signal balises and speed board balises
- Drive train length
- SE ATP lights up and starts monitoring
- SSP: SE ‘state’ lamp will change yellow > green
- SE ATP sends ‘Supervising’ flag to DK ATP
- DK ATP will extinguish all displays and ‘Max Speed’ indicator is set to zero
- DK ATP ceases supervision and enters ‘F’ state
- SSP: DK ‘state’ lamp will change green > yellow

NB: The changeover is slightly different, pending which system is prioritized

SCENARIO — CHANGING PRIORITY

FROM PRIORITY SWEDISH ATP TO PRIORITY DANISH ATP

- Both systems have information for full supervision
- SE ATP is prioritized
- SSP: ‘Priority SE’ illuminated
- SSP: Press ‘Priority DK’ button until it illuminates
- SSP: ‘Priority SE’ is extinguished
- DK ATP illuminates and starts monitoring
- SSP: DK ‘state’ lamp will change yellow > green
- DK ATP sends ‘Supervising’ flag to SE ATP
- SE ATP ceases supervision and enters ‘F’ state
- SSP: SE ‘state’ lamp will change green > yellow

NB: Changing priority from Danish ATP to Swedish ATP follows a similar procedure

SCENARIO — SELECTING EXCLUSIVE ATP

SELECTING DANISH ATP

- This procedure may only be undertaken at standstill
- Danish ATP must not be selected when the train is in an area not fitted with Danish ATP
- SSP: Press ‘DK’ button until it illuminates
- SSP: Other buttons are extinguished
- DK ATP illuminates and starts monitoring
- SSP: DK ‘state’ lamp will change yellow > green
- DK ATP isolates SE ATP
- SE ‘state’ lamp is extinguished

NB: Selecting SE ATP follows a similar procedure, but requires breaking a seal.

SIGNAL EQUIPPED WITH BOTH ATP SYSTEMS

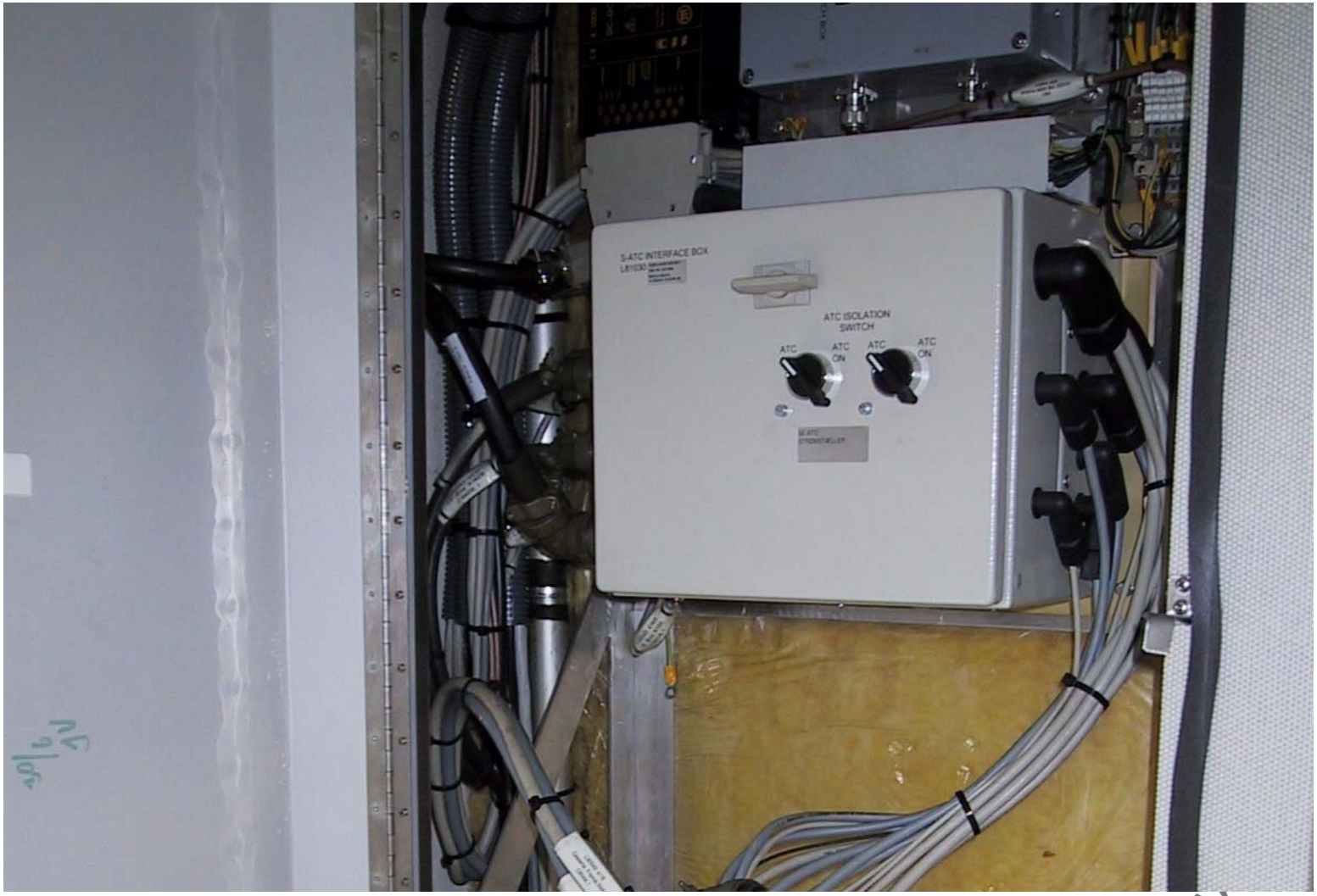
DRIVER'S CAB EMU

DRIVER'S CAB FREIGHT LOCO

SYSTEM SELECTION PANEL

ATP CABINET

INTERFACE BOX



CONCLUSIONS

- The combined SE – DK ATP system has now been in service since 2000
- Over 200 systems supplied
- Very reliable, including safe switch-over up to 200 km/h
- Can be upgraded to dual wayside, should the need arise
- Will most probably be replaced by ERTMS in the future

THANK YOU FOR YOUR ATTENTION