Full migration towards ERTMS

The Danish Signalling programme

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Presented at CCRCC by Chief Engineer Jens Holst Møller

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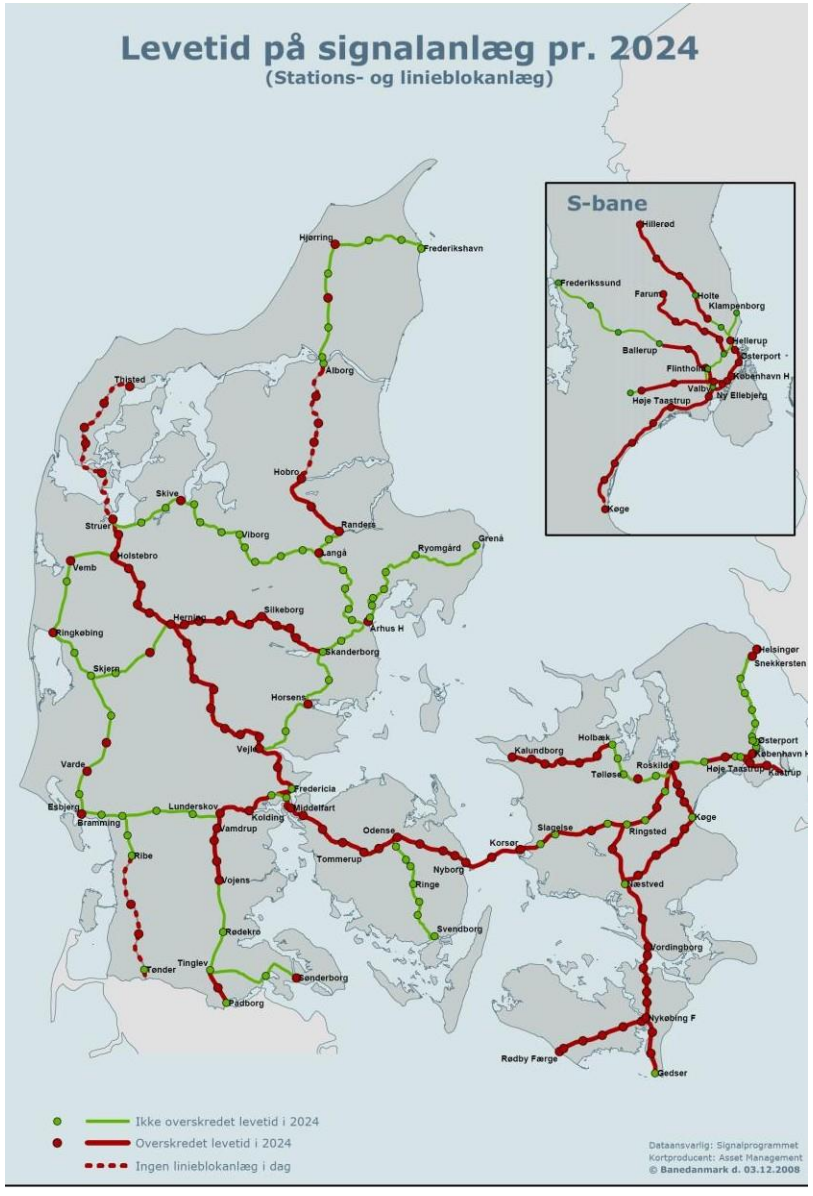
Background (2008)

- 60 pct. of all signaling will have exceeded their useful life in 2024
- Core competencies regarding legacy signaling going on pension
- 50 pct. of all train delays caused by signalling related errors
- Interoperability not economically feasible within frame of legacy signalling
- Conventional renewal not economically advantageous nor feasible as method to remove renewal backlog
- Benefits associated with radio based signalling (CBTC and ETCS L2)



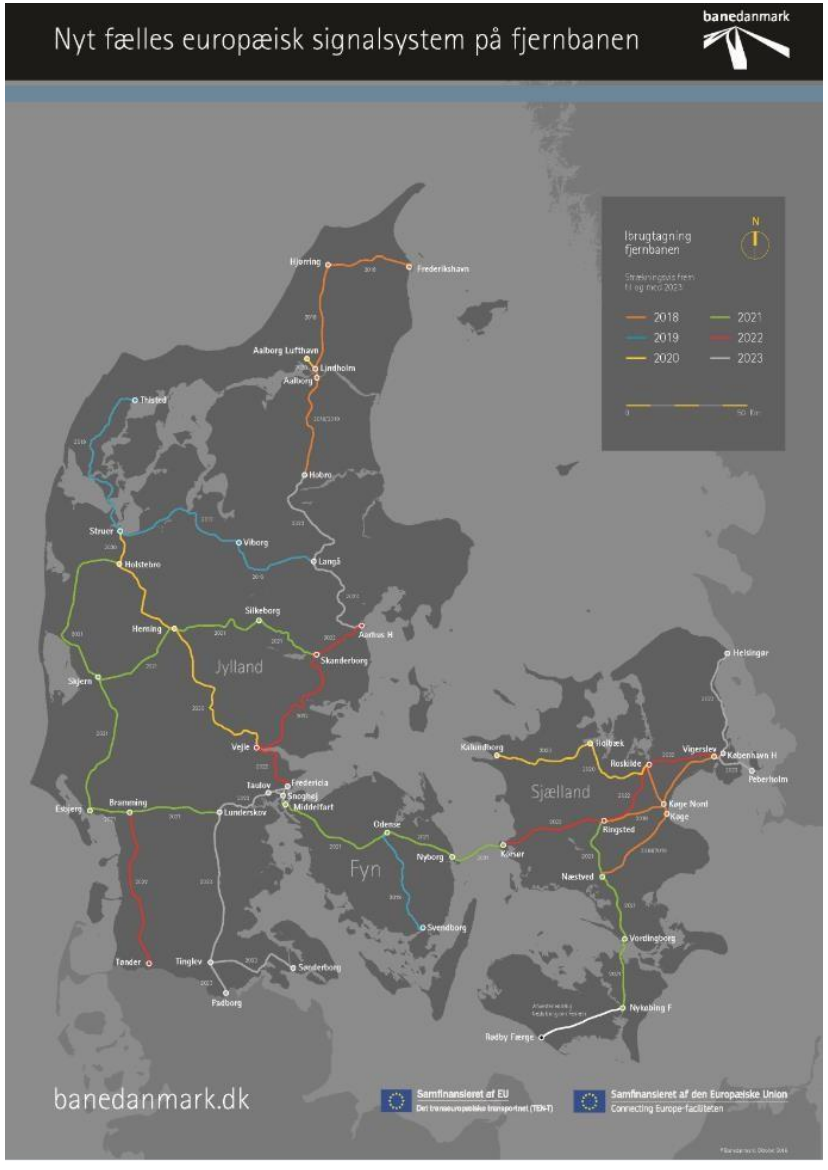
Danish Signalling programme

Radio based signalling as an enabler for open marked renewal

- National deployment of ERTMS level 2 and deployment of CBTC on S-bane, decided 2009, main contracts in 2011/2012.
  - East Denmark, Alstom
  - West Denmark, Thales-Strukton
  - Onboard, Alstom
  - STM, Siemens
  - GSM-R, Nokia
  - S-bane infra&onboard Siemens

- ETCS Baseline 3
  - Online Key management
  - ETCS over GPRS
  - Level crossings
  - Braking curves for conventional trains
  - Interoperability consolidation (+400 CR)

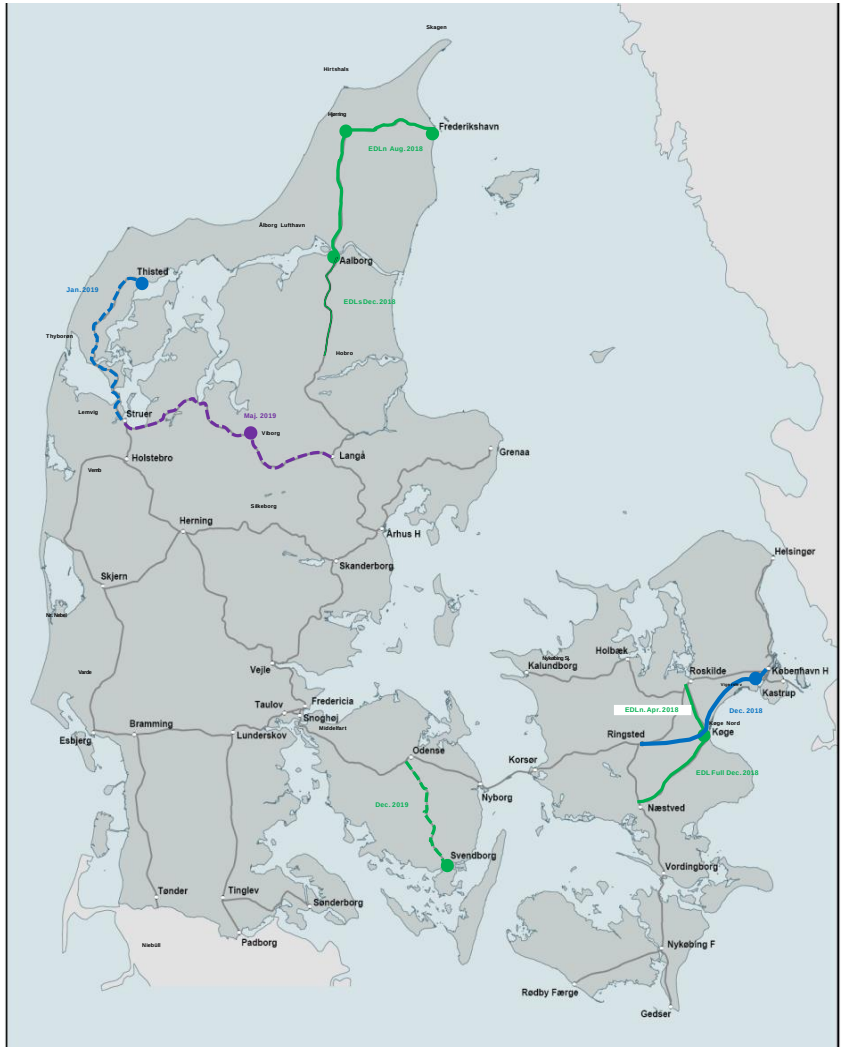
- S-bane high capacity CBTC
  - Moving block (70 sec technical headway)
  - ATO (GoA2 in operation, GoA4 ready)



Status

First ERTMS lines under test

- Early Deployment line West in test (81 km single track, 120 km/h) target Q3 2018
- Early Deployment line East in test (67 km single track, 120 km/h) target Q4 2018
- New line Copenhagen-Ringsted in installation (60 km double track, 250 km/h), test starting januar/february 2018(commissioning dec 2018)
- Odense-Svendborg in engineering (47 km single track)
- Struer-Thisted in installation (73 km single track)
- Struer-Langå in engineering (102 km single track)
- Replanning end 2016 switched sequence of lines to do secondary lines before main lines and extended time plan 2 years, due to **delayed design** from suppliers.
- Both TCCs (and obviously the Joint Test Lab) are delivered and in use.
- First CBTC line on S-bane in stable operation



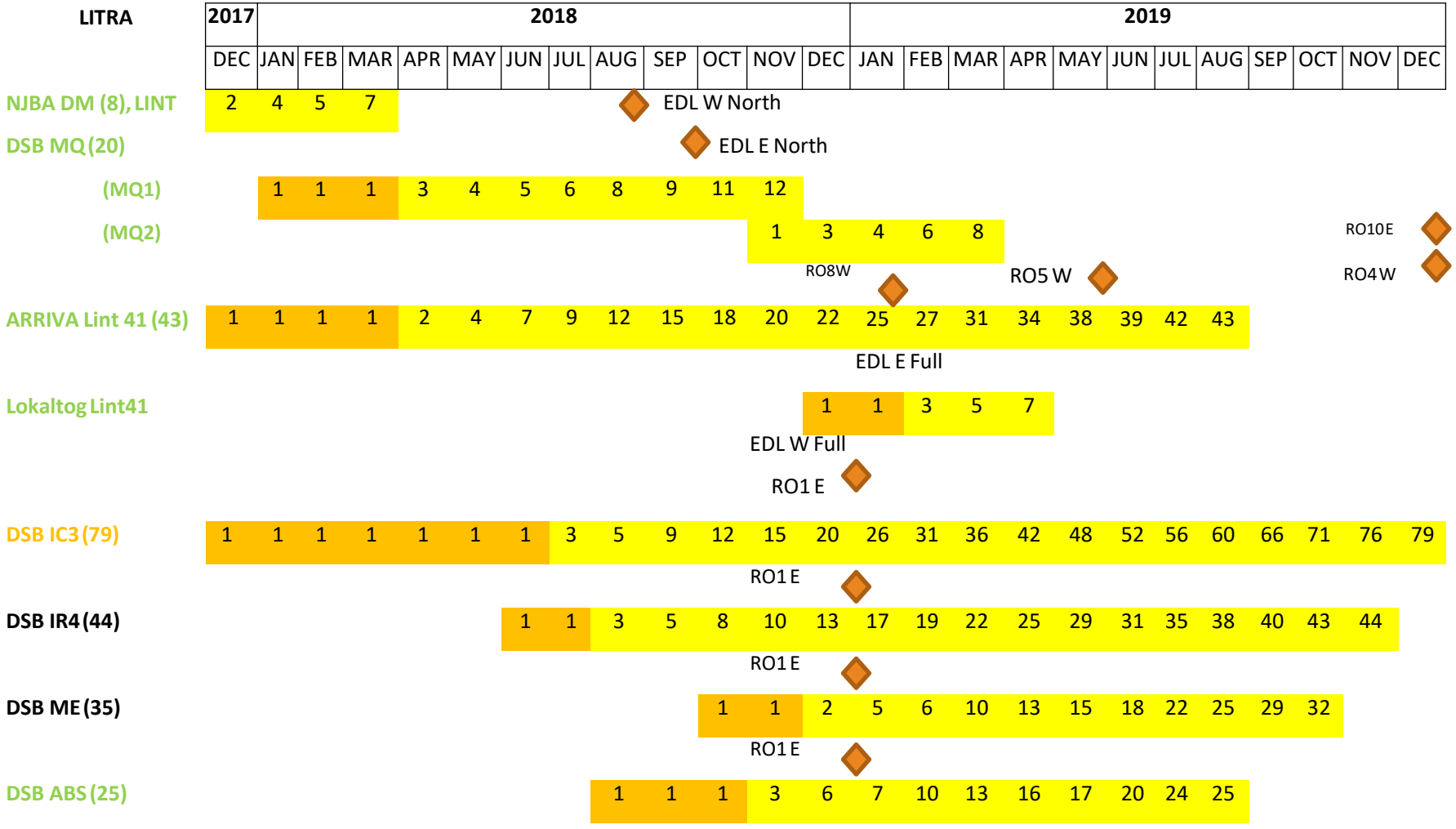
Current focuspoints for the ERTMS deployment

- Commissioning of first ERMTS lines are our highest priority.

- Onboard fitment delays is pushing commissioning dates for trackside deployment, in depth analysis and replanning based on onboard fitment ongoing.
  - Alignment with DSB and ministry regarding expected traffic on the lines.
  - Variance analysis on robustness of onboard fitment plans
  - Initiatives to increase robustness of onboard design and fitment plans

- Next update regarding the plan will be in December 2017.

Onboard overview for 2018-2019 ** DRAFT **



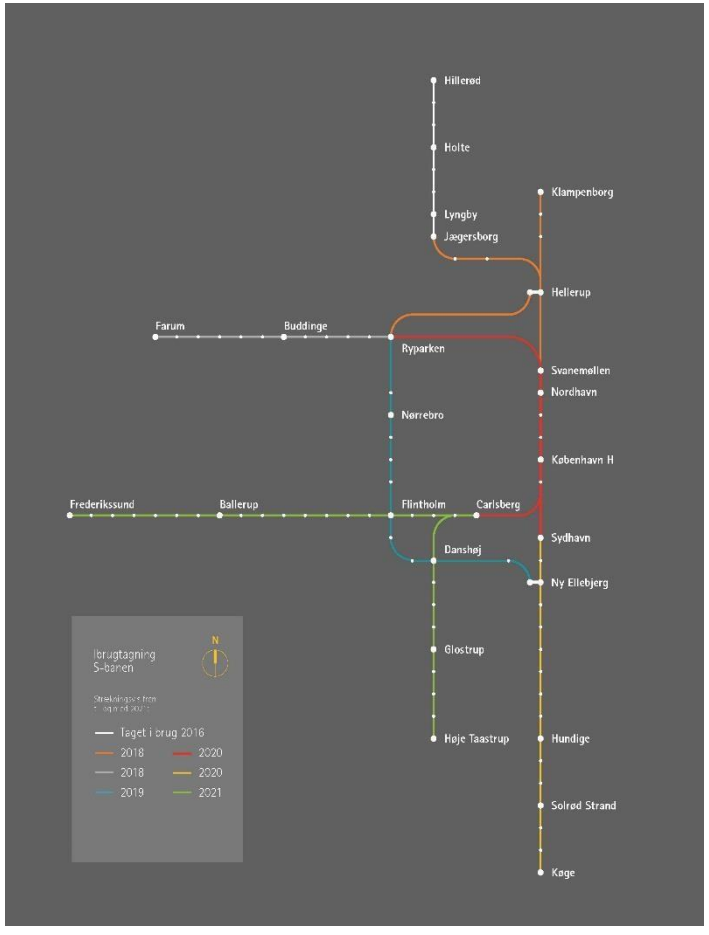
CBTC on Copenhagen S-bane

- Early deployment line in service for 1½ year
- Teething issues have been the cause of delays and even cancellations of service.

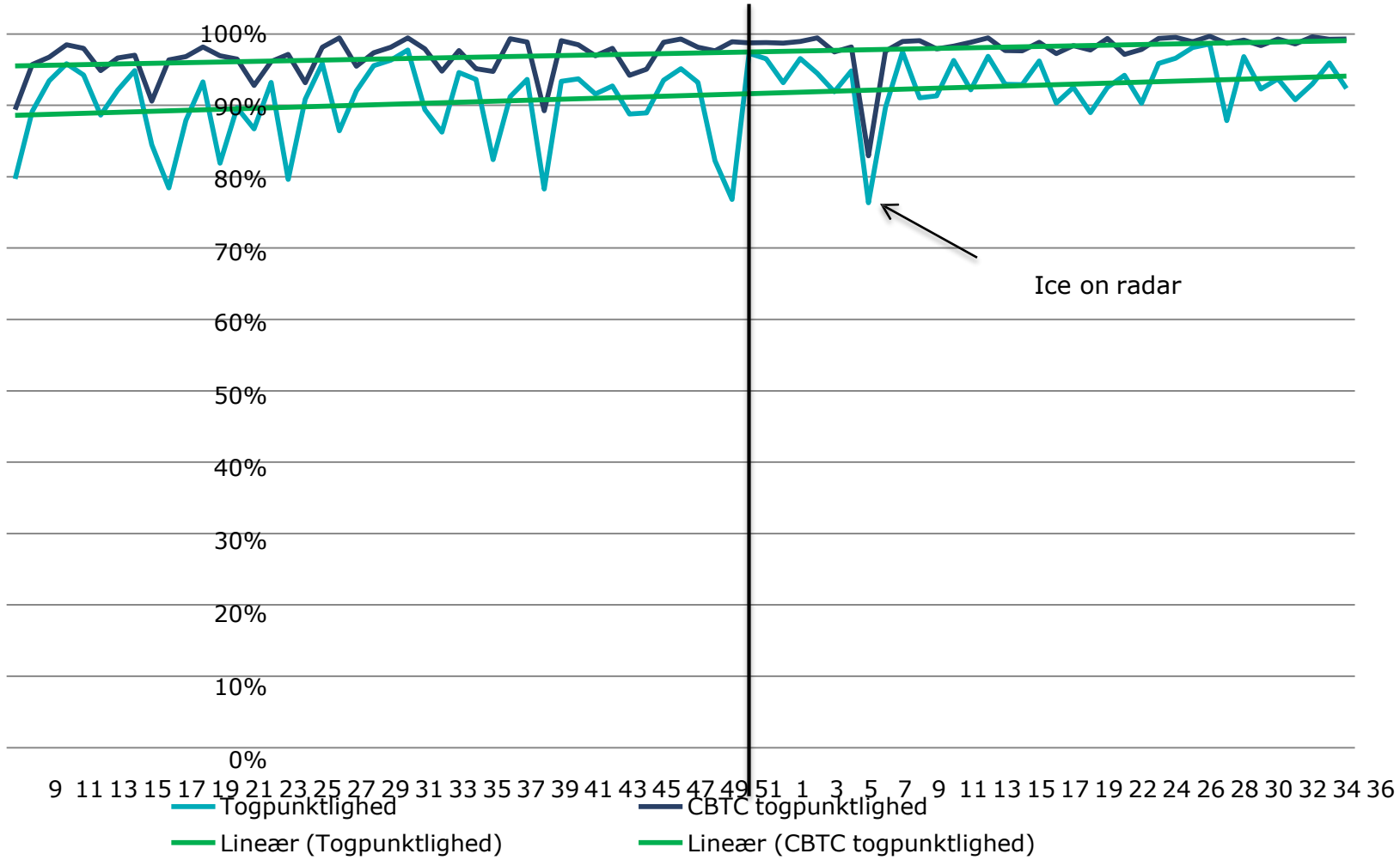
- EDL planned to be upgraded to full feature primo 2018
- Target is to remove remaining issues before larger scale deployment.

- Next line Svanemøllen/Ryparken-Klampenborg/Jægersborg commissioning summer 2018

- Last line expected to be commissioned year end 2021



Punctuality on S-bane since commissioning of CBTC (ultimo february 2016)



ERTMS & CBTC learnings

Product and process maturity growth

- ERTMS B3 products are available both trackside and onboard.
- The integration tests in lab and on lines are going well -building confidence that the systems will work in operation.

However:

- The design phase has been longer than planned both for CBTC and ERTMS (but especially for ERTMS onboard)
- The onboard product and installation process maturity has been a big challenge
- Marked barriers hamper the onboard installation process (train documentation)
- The current onboard product offers are incomplete with respect to software management.

Future steps

Before 2023

- Introduction of B3R2 including ETCS over GPRS in onboard

After 2023

- Improvement of braking curves
- Infrastructure support for ATO (GoA2)
- Driver Advisory Systems or ATO (GoA2) in new trains
- Increased capacity for trainsets through Level 3 on main corridors.
- Migration from GSM-R to next generation radio