Networking at LVNL

Air Traffic Control The Nederlands

Agenda

- Intro
  - Speaker
  - Air Traffic Control the Nederlands
  - Networks in ATC
- Technical environment
  - Networks @LVNL
  - Applications
- How do we do it
  - Requirements / choices / tradeoffs
  - Evolution vs revolution
- Future
  - Next steps

Intro spreaker

Speaker

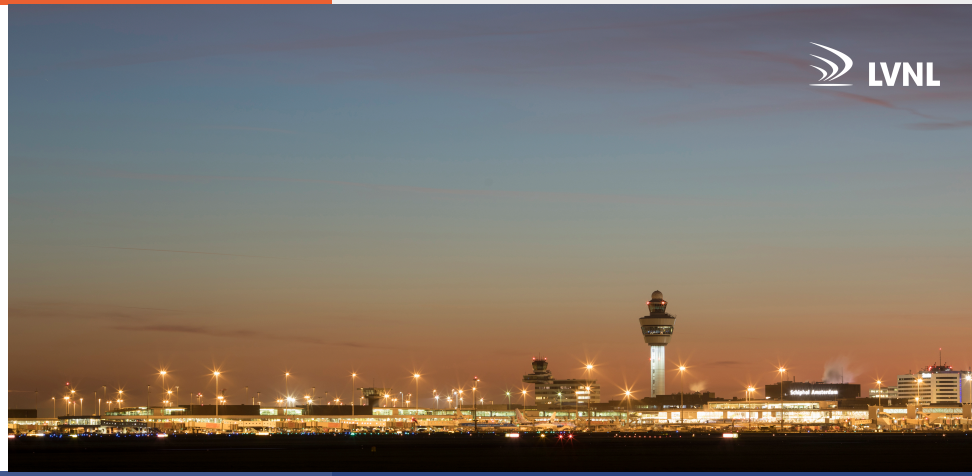
Rudi van Drunen

- Network Engineer
- 1.5 yrs of LVNL history
- Hardware – Systems – Software – Networking
- Loves the lower parts of the stack
- NLUUG Chairman of the Board, Ham radio, photography

Air Traffic Control the Nederlands

Organization

- “Zelfstandig Bestuursorgaan” (sinds 1993)
- Income from levies



1000

colleagues

350

Ops colleagues

250

Air Traffic Controllers

2019

614.396

'transit (airspace)'

499.446

Schiphol

71.000.000

Passengers @Schiphol

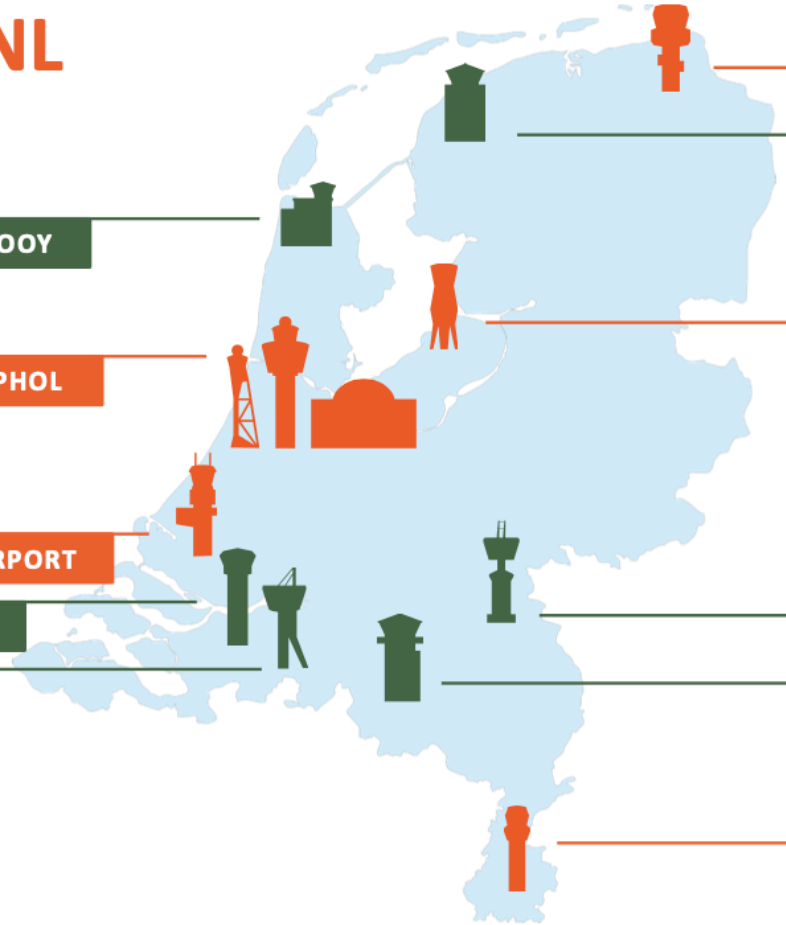
2022

488.904

416.455

71.000.000

Locaties LVNL



GRONINGEN AIRPORT EELDE

VLIEGBASIS LEEUWARDEN

MARITIEM VLIEGKAMP DE KOOY

LELYSTAD AIRPORT

AMSTERDAM AIRPORT SCHIPHOL

TOWER CENTER

TOWER WEST

OPERATIONAL ROOM; RADAR

ROTTERDAM THE HAGUE AIRPORT

VLIEGBASIS WOENSDRECHT

VLIEGBASIS VOLKEL

VLIEGBASIS GILZE-RIJEN

VLIEGBASIS EINDHOVEN

MAASTRICHT AACHEN AIRPORT

Location Schiphol

- Area Control
- Approach
- Tower

Schiphol Oost Headquarters

Schiphol Tower Center

Units LVNL

3. AREA CONTROL
TOT 7,5 KM
2. APPROACH CONTROL
VERTREKKEND & NADEREND
1. TOWER
LOKAAL

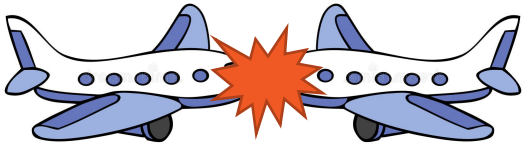
Our Networks facilitating ATC

What is ATC ?

- Separation of Aircraft in “controlled airspace”
- How?
  - Radar
  - Radio comms

System Failure

- No radar image:
  - Location of aircraft not visible.
- Voice comms:
  - No possibility to separate aircraft.



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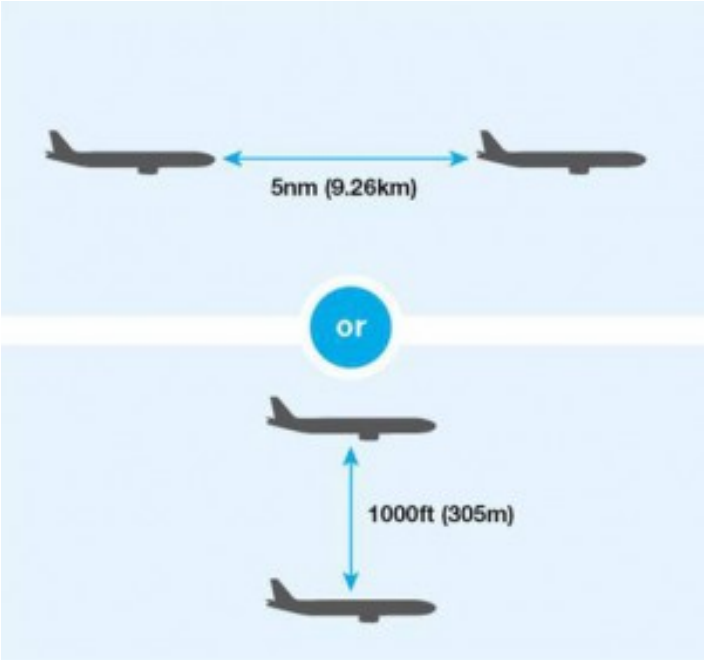
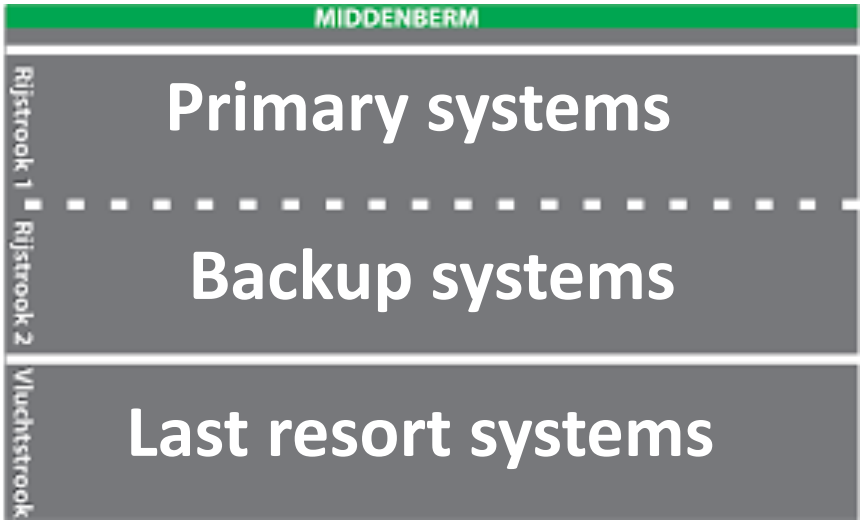


Three lane principle

- Functionality for ATC is “a system”.

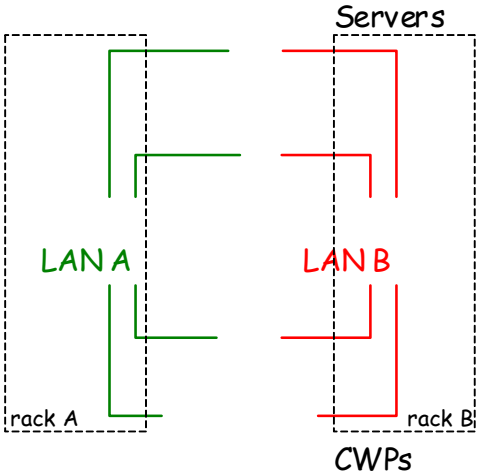
- Critical systems: 3-lane principle:
  - Radar screen (eyes).
  - Air-ground voice comms (primary means of communication between cotroler and pilot).



“Systems on multiple networks”

- A mumber of critical systems are connected to a duplicate LAN network environment:
  - Data is duped on both networks.
  - Switching between networks is up to the application.
  - Almost no interruption in service when switching networks.

Example:



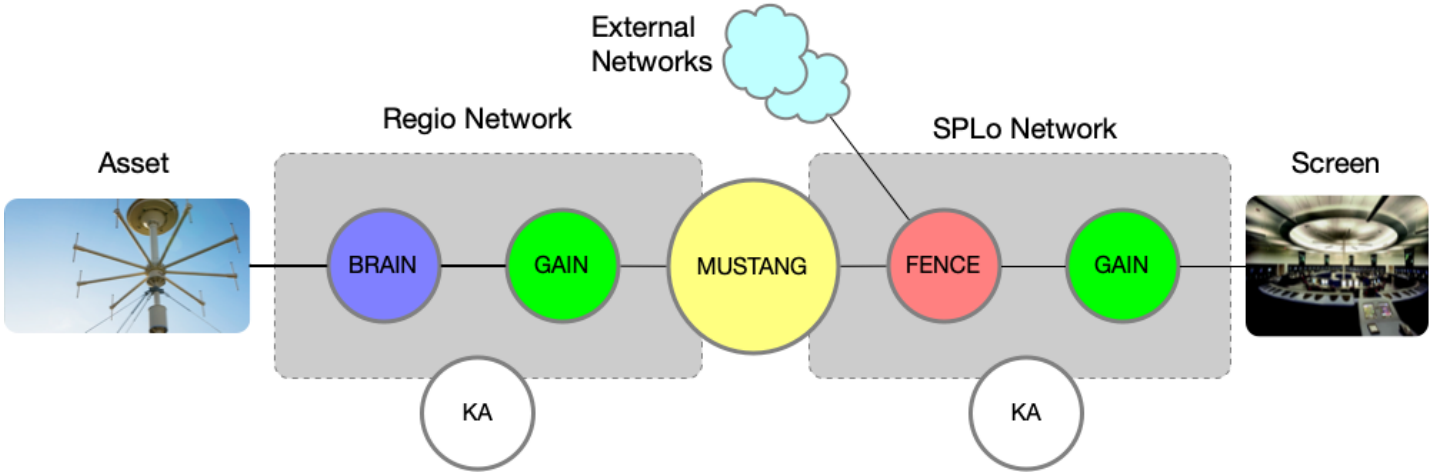
Our Networks

Applications on the LVNL networks (OPS)

- Systems for
  - Pilots
  - ATC.
- Radar screen:
  - Air traffic situation picture (RADAR screen, VDF)
- Voice comms:
  - Ground-Ground voice communication
  - Ground-Air voice communication
- Aux systems:
  - Flightplan data exchange
  - Meteorological data exchange
  - Recording data
  - Monitoring and control
  - Aircraft Navigation data (VOR/DME beacons, ILS at runways)

The Networks

KA network, NON OPS:
- Office
- Support network
- Cisco

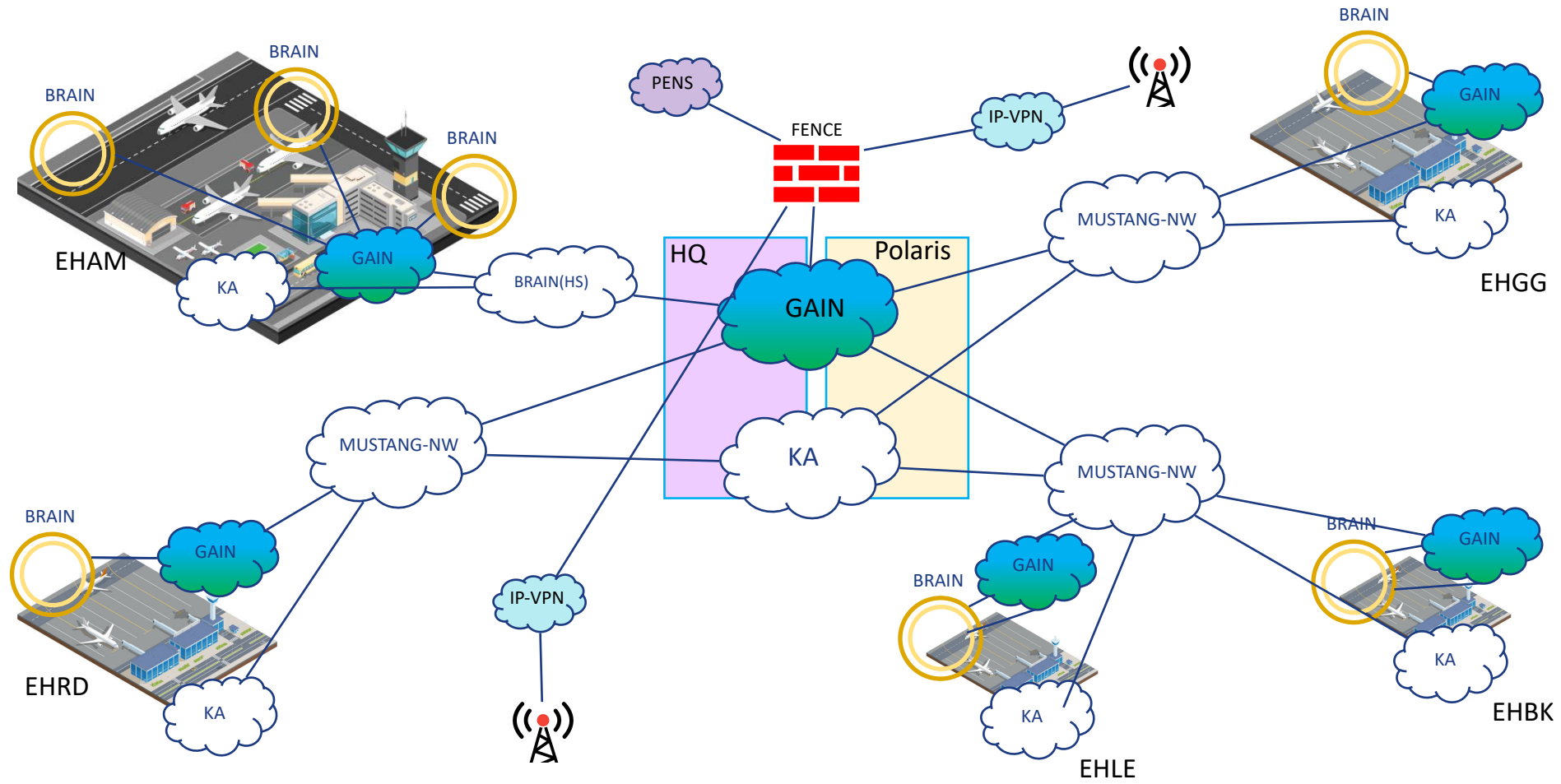


BRAIN Networks:
- Around Airfields
- Sensors (eg. KNMI)
- Ring network
- Cisco

MUSTANG Networks:
- Nation Wide
- Transport
- Cisco

GAIN Networks:
- MAIN ATC LAN
- All systems @ SPLo / reg
- MPLS
- Cisco

FENCE Firewall Infra:
- Networking Security
- Multilayer
- Not disclosed


BRAIN
BRAIN
BRAIN
EHAM
KA
GAIN
BRAIN(HS)
PENS
FENCE
IP-VPN
HQ
Polaris
GAIN
KA
MUSTANG-NW
MUSTANG-NW
MUSTANG-NW
BRAIN
GAIN
KA
EHGG
BRAIN
GAIN
KA
EHRD
IP-VPN
BRAIN
GAIN
KA
EHLE
BRAIN
GAIN
KA
EHBK

LVNL networks

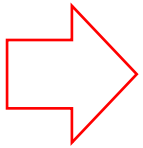
- History
  - Evolution vs Revolution
  - We do not live in an IP-only environment (yet)
- Life cycle
  - Slow development (on end-systems)
  - Long life (30+yrs)
- Criticalness
  - Uptime
  - Safety

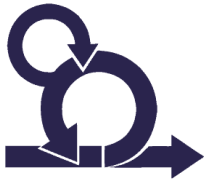
- Complexity
  - Interfaces
  - Redundancy
  - Interconnects
  - Physical
  - Technology
  - Environments
    - DTAE (NON OPS)
    - P (OPS)

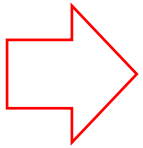
How to get this done ?

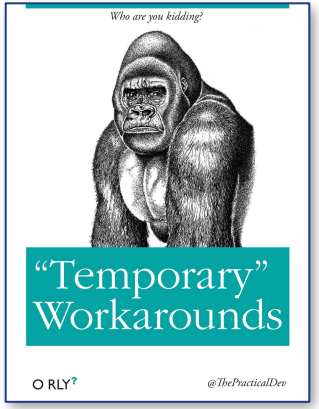
Continuous Transformations

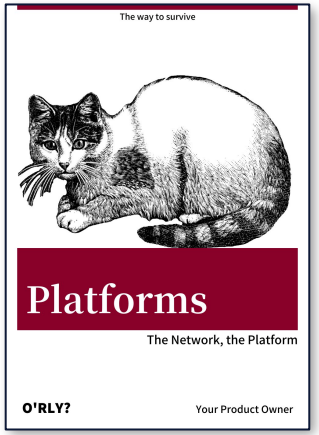
- Previous situation
  - Product groups (NAV, SUR, AAA, TOWER)
    - Servers
    - Network
    - Infra
- Moving to
  - A LVNL wide
    - Server
    - Network
    - INFRA
- Standardize !
- And here we are….
  - Somebody should do something …











Standardization while

- Integrating 400 + “silo” (legacy) networks
- Supporting loads of projects
  - Building new systems
  - Integrating military fields
- Doing our own LCM
- Act on changing environments
  - 3rd party Infra
  - Regulations and other external factors.
- Optimization of the operation
  - Enhancing Safety
  - New Systems / innovation

But: we are running a 24x7 safety company

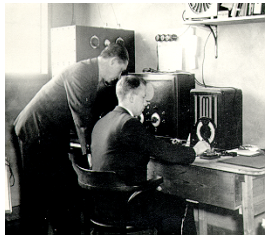
- Regulations
  - When, what
- Procedures
  - How, why, backup
- Continuously running operation
  - No time to “close down airspace”

- We need to fix and enhance / replace the plane in mid air!
  - Otherwise, we cannot land anymore

  - Challenges of doing Innovation in a risk aversive organization
    - Communication
    - Planning
    - Understanding each others needs and fears
    - Calculated risk vs risk aversive

(Back to) the Future

Evolution of the Controller Working Position (data driven, all digital, AI)



"Luchtverkeersbeveiliging" (1940)

SARP II (1978)

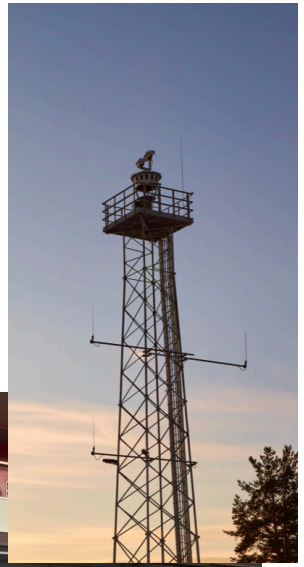
AAA (1992)

2026+: iCAS

Cooperation with DFS
Product of INDRA, Spain
Polaris building @ Schiphol Oost
On the NL-IT top 5 list

Centralised Base / remote tower

- Remote Air traffic control from Schiphol (TWR-W, Eelde, Beek)
- SAAB development
- In use at London City and Norway



(Tower) Sims

- Educational
- Business critical

1ATM

- Integration of military air traffic control org and systems
- @military airbases LVNL ATC .
- Integration
  - Technical
  - Organization

Questions ??

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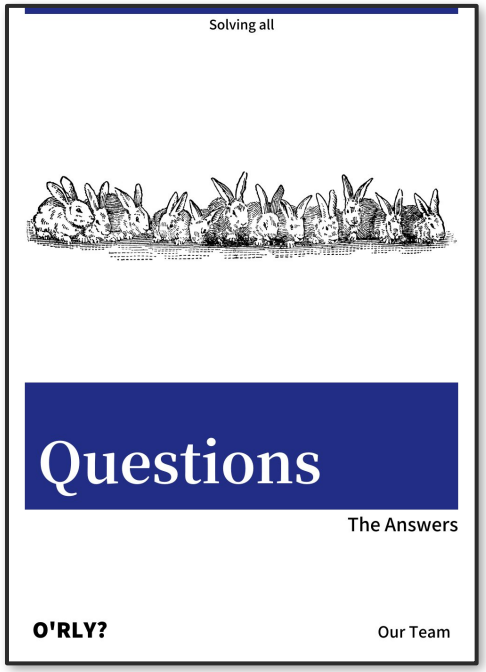

How can you help ?

- Do you like to:
    - Architecture
    - Design
    - Build
    - Maintain
- One of the most complex and critical network environments in NL ?
- There are lots of possibilities for cooperation.