GARR, SWITCH, and GÉANT deploy an advanced multi-domain connection between ECMWF and CSCS

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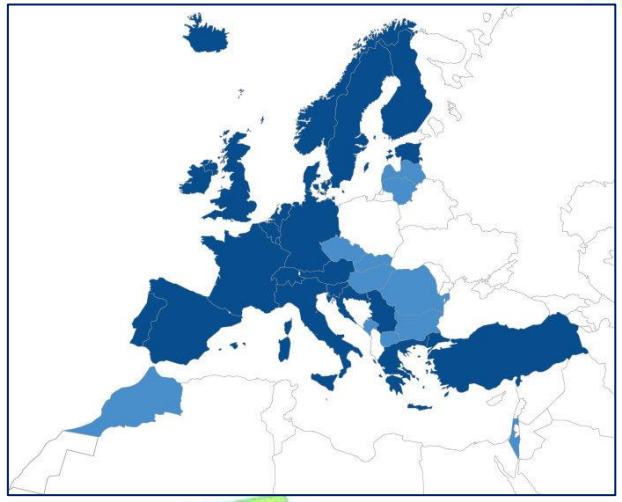
ECMWF

Introduction – ECMWF activities

European Centre for Medium-Range Weather Forecasts

- A research institute and a 24/7 operational service
- Produces global Numerical Weather Predictions (NWP)
- Has one of the largest supercomputing facilities and meteorological data archives in the world **(~500 Petabytes**)
- Key player in Copernicus, the Earth Observation component of the EU's Space programme
- Around 530 members of staff
  - Reading, UK: HQ ~295 staff
  - Bologna, Italy: data centre ~45 staff
  - Bonn, Germany: offices ~190 staff



Introduction – ECMWF activities

Core mission

- Produce daily operational numerical weather forecasts and monitor the Earth system
- Carry out scientific and technical research to improve forecast skill
- **Maintain an archive of meteorological data**
- ECMWF also provides advanced training to scientific staff in our Member and Cooperating States

Introduction – SwissTwins project

CSCS – Centro Svizzero di Calcolo Scientifico

- A service and research unit based in **Lugano**, develops and promotes technical and scientific services for the Swiss research community in the field of high-performance computing (HPC)
- CSCS facilitates top-level research by developing, operating and supporting supercomputing systems on the basis of cutting-edge and innovative technologies
- CSCS hosts the MeteoSwiss weather prediction model
- CSCS hosts and runs the **Alps** HPC system

Introduction – SwissTwins project

SwissTwins

- An international collaboration to facilitate, among other things, access to ECMWF forecast products and meteorological archive for the training of Artificial Intelligence (AI) and Machine Learning (ML) models that run on the Alps HPC system
- A dedicated Data Hypercube —a high-performance storage and data processing cluster— was deployed at ECMWF's data centre in Bologna and connected to the CSCS Alps data centre infrastructure in Lugano
- This cluster will support data access with **low latency** and the extraction of specific datasets to train AI and ML models for the benefits of the Swiss and international numerical weather and climate prediction community

Introduction – SwissTwins project

Goals

- Pilot phase: demonstrate the possibility of transferring an entire ensemble forecast dataset **in less than one hour** between ECMWF and CSCS
- Subsequent phases: multiple AI/ML models in the weather and climate domain will be consuming data from the Data Hypercube simultaneously
  - There will be an increase of the total aggregate throughput from 100Gbps to 400Gbps

A dedicated multi-domain service

WAN Requirements

- 100Gbps end-to-end, ultra-large bandwidth infrastructure that enables massive data transfers from ECMWF to CSCS
- Resilience, reliability, security, and direct user access to the optical infrastructure

Solution: a dedicated multi-domain service

- State-of-the-art, ultra-large bandwidth dedicated connection that seamlessly traverses the network domains of GARR, SWITCH and GÉANT
- Two diverse and dedicated **100 Gbps links**, independently managed by the three operators

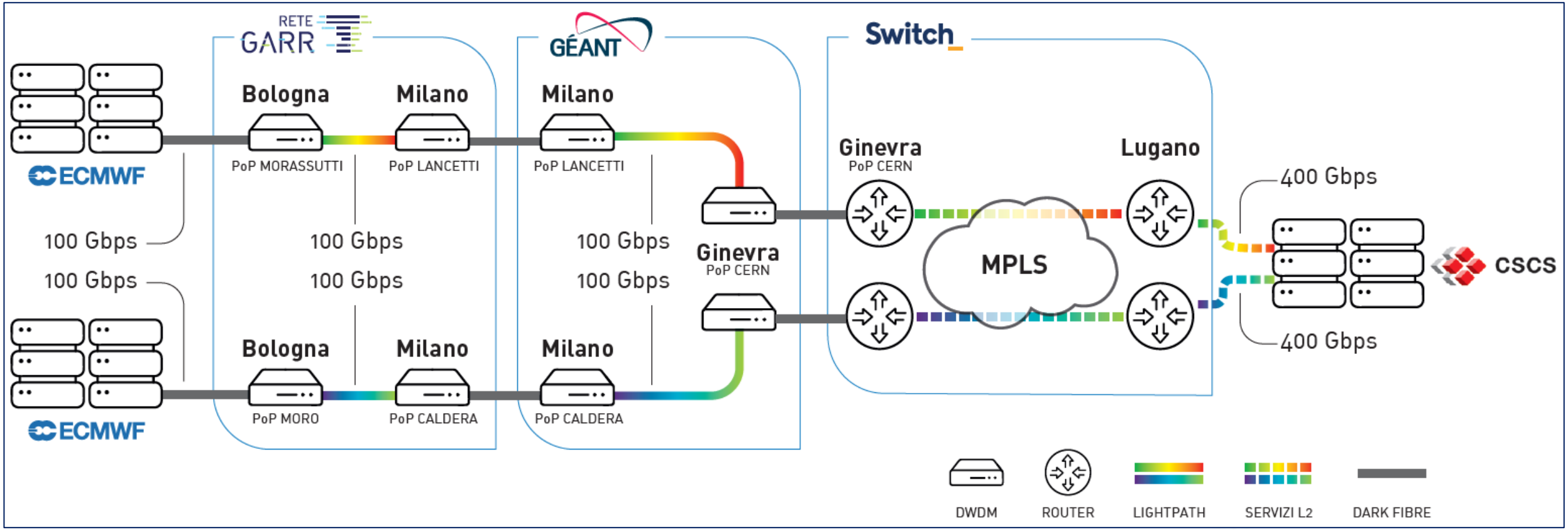
A dedicated multi-domain service

Solution – A dedicated multi-domain service (cont)

- On ECMWF side, new resources have been deployed: two new fibre links have been installed by Lepida to access the backbone
- From there, the two optical light paths have been configured to reach GARR PoPs in Milan, where the Italian network connects with the GÉANT network, which carries the traffic to its POP located at CERN in Geneva
- From Geneva, SWITCH takes over and delivers the data to its final destination at CSCS in Lugano
- The implementation methods differ between the networks:
  - GARR and GÉANT have chosen an optical domain approach
  - SWITCH uses a Layer 2 Ethernet-over-MPLS service

A dedicated multi-domain service

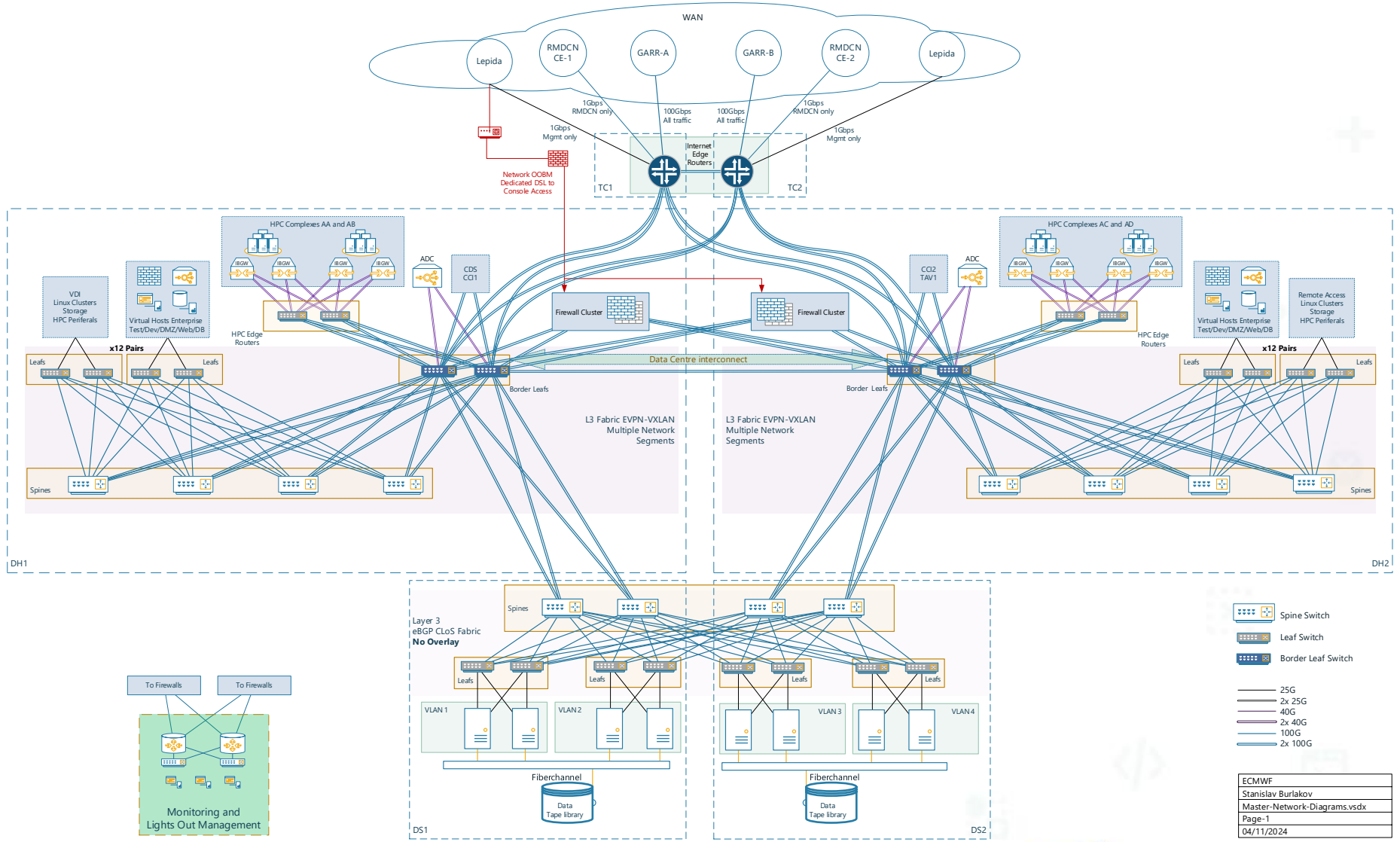
Solution – A dedicated multi-domain service (cont)



SwissTwins – LAN and other aspects

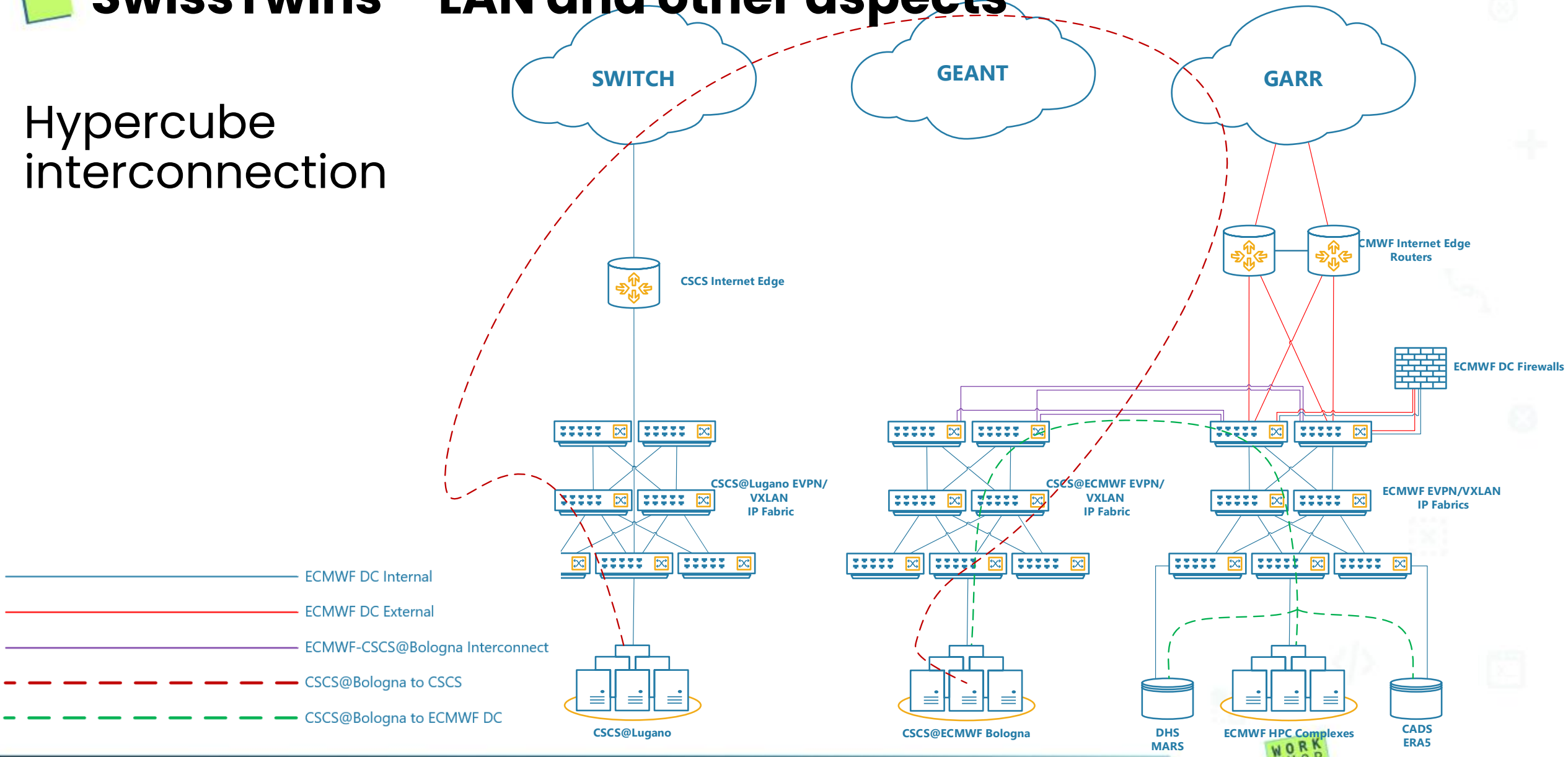
ECMWF network

- 3 x IP Fabrics
- Security zones



SwissTwins – LAN and other aspects

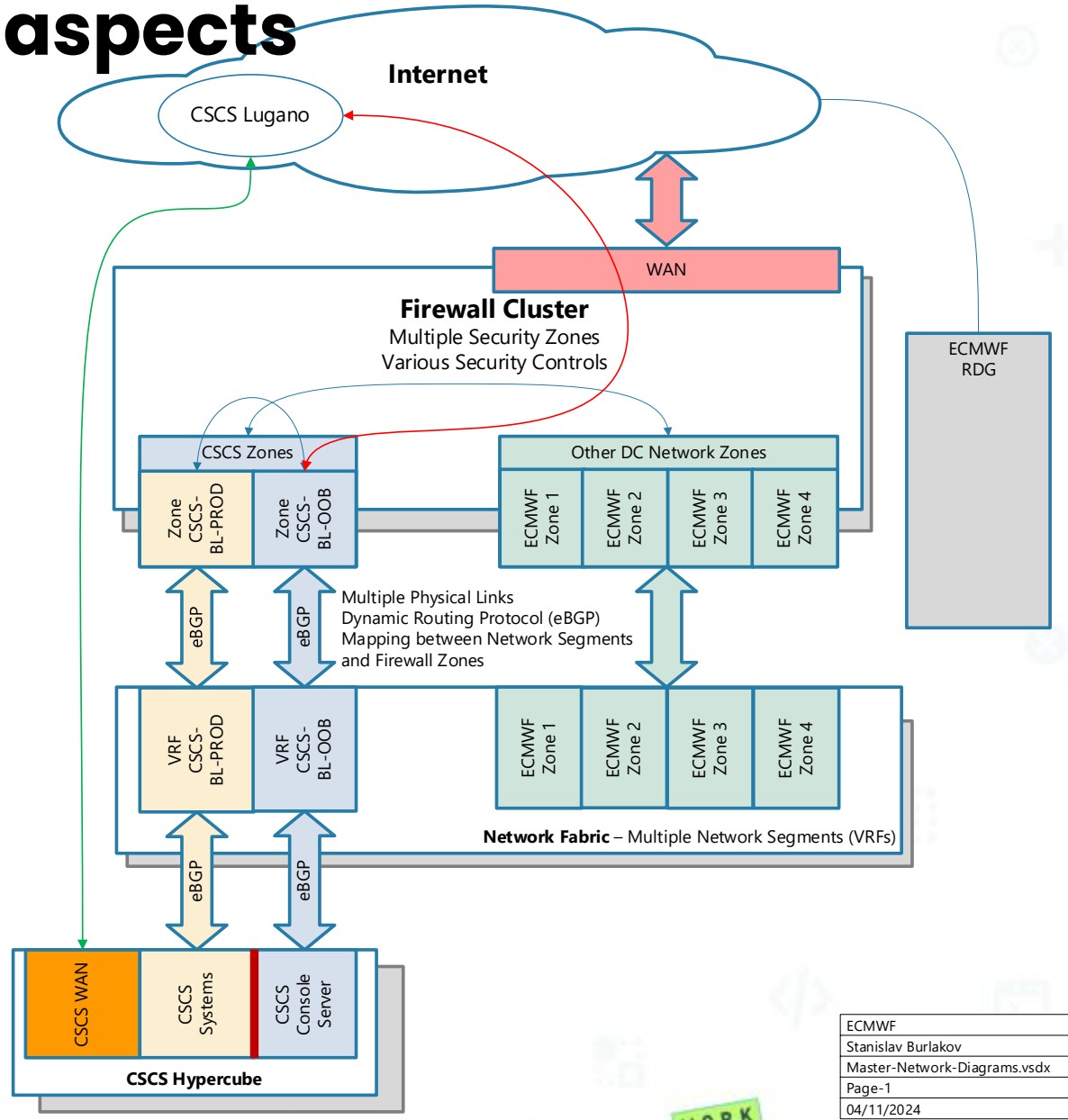
Hypercube interconnection



SwissTwins – LAN and other aspects

Security zones

- Network segmentation/defense in depth
  - User-facing services
  - Management/admin traffic
- Solution: multiple VRFs+ security zones



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Return on experience… so far

WAN aspects

- High level of collaboration and trust among operators and would not be possible outside the research networks ecosystem
  - Commercial operators are confined to their domains of competence
- Leverage the capabilities of the new next-generation GARR-T network for optical infrastructure access

Other aspects

- The end-to-end service “physically” terminates directly into the Hypercube cluster
  - New paradigm for ECMWF
  - Monitoring and operational support challenges

To be continued...

Grazie per l'attenzione

Domande?

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