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COMPUTING

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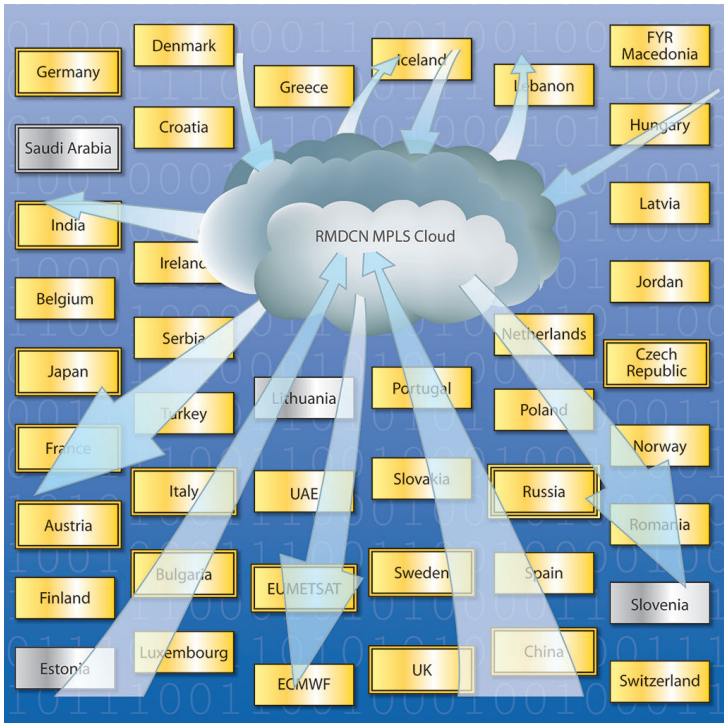

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Improving the Regional Meteorological Data Communications Network (RMDCN)

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Another milestone in the Regional Meteorological Data Communications Network (RMDCN) was reached with the successful migration to a new technology which was completed on 18 June 2007. The migration to an IPVPN (Internet Protocol Virtual Private Network) provides the meteorological community with a state of the art network infrastructure which will give improved service levels and will enable new services to be introduced.

Background

The RMDCN has been in operation since March 2000. It provides a network infrastructure for both the connections between ECMWF and its Member States and most of the GTS connections for WMO Regional Association VI. Over time it has expanded to encompass the Far East with connections to Japan, China and India. Currently there are 42 User Sites connected to it. Orange Business Services (OBS), formerly known as EQUANT, is the provider of this network. ECMWF manages the project and monitors the network on behalf of the connected User Sites following an agreement with WMO.

The initial network was based on a Frame Relay infrastructure using Permanent Virtual Circuits (PVC) between User Sites. There have been regular reviews of the contract which concentrated on pricing issues and also looked at the technology used for the network infrastructure. It was found that networks using Multi Protocol Label Switching (MPLS) were becoming more and more the norm. The RMDCN Operations Committee (ROC) and the ECMWF Technical Advisory Committee (TAC) were regularly updated on the progress of these types of networks, both in terms of reach and reliability and in terms of commercial viability. In 2004 OBS made an offer for a migration of the RMDCN from Frame Relay to an MPLS-based IPVPN (Internet Protocol Virtual Private Network) solution. The main features of the offer from OBS were as follows.

- A doubling of the bandwidth for the network connection for the same charge.
- An improved backup service with the effect that OBS were able to offer improved availability figures (the majority of sites now have 99.9% availability, while Mission Critical sites have 100%). A pre-condition for these improved figures is that the access circuits for both the primary and the backup connection are diversely routed from User Site to OBS Point of Presence.
- The provision of Class of Service (CoS) to allow traffic prioritization.
- Any-to-any connectivity.
- The ability of Sites to choose a reduced service type (Silver service versus Gold).

However some technical trade-offs were made.

- Frame Relay networks provide site-to-site bandwidth guarantees by default, while MPLS-based networks only provide a bandwidth guarantee on the access into the MPLS network (referred to as the cloud).
- In a Frame Relay network the traffic is automatically partitioned by the PVC infrastructure, whereas in an MPLS network the infrastructure is a shared resource and therefore allows for better utilization of the available bandwidth.
- The CoS feature in MPLS networks allows for traffic prioritization and substitutes the end-to-end bandwidth guarantees. Also the network management overhead in a Frame Relay network is quite significant. For an MPLS network this is greatly simplified.

Figures 1 and 2 show the differences between the two network infrastructures, before and after the migration to the MPLS infrastructure.

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The proposal from OBS for the migration of the network was approved by the ECMWF Council in December 2004 and this was also accepted by the other WMO members connected to the RMDCN. Since the new network infrastructure was significantly different the Service Level Agreement had to be revised. Also the implementation plan required detailed discussion with OBS. In order to guarantee an uninterrupted service on the existing Frame Relay network it was decided to implement the new network in parallel with the old network. Following intense negotiations Supplement 4 to the RMDCN contract was signed on 8 May 2006.

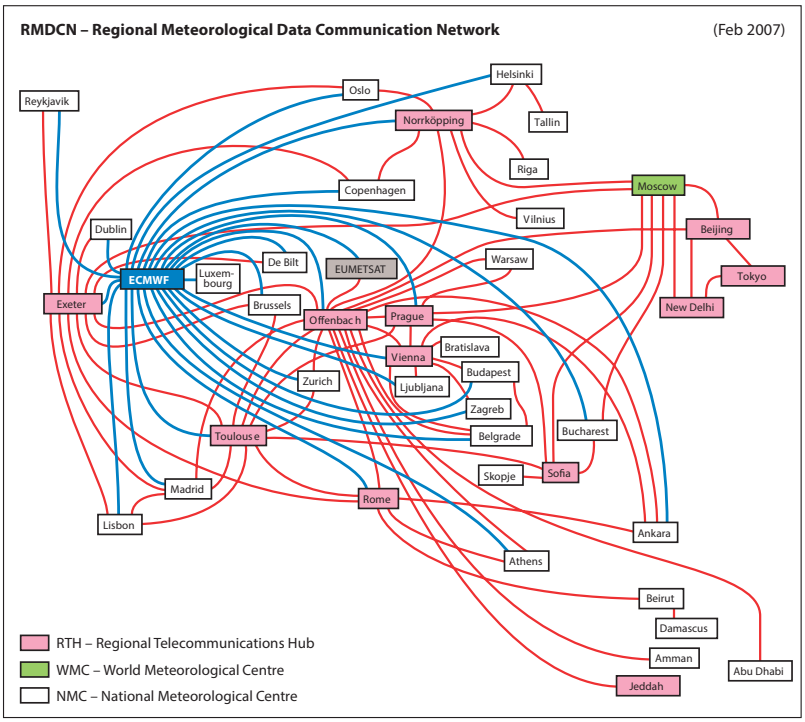

Figure 1 RMDCN Frame Relay network.

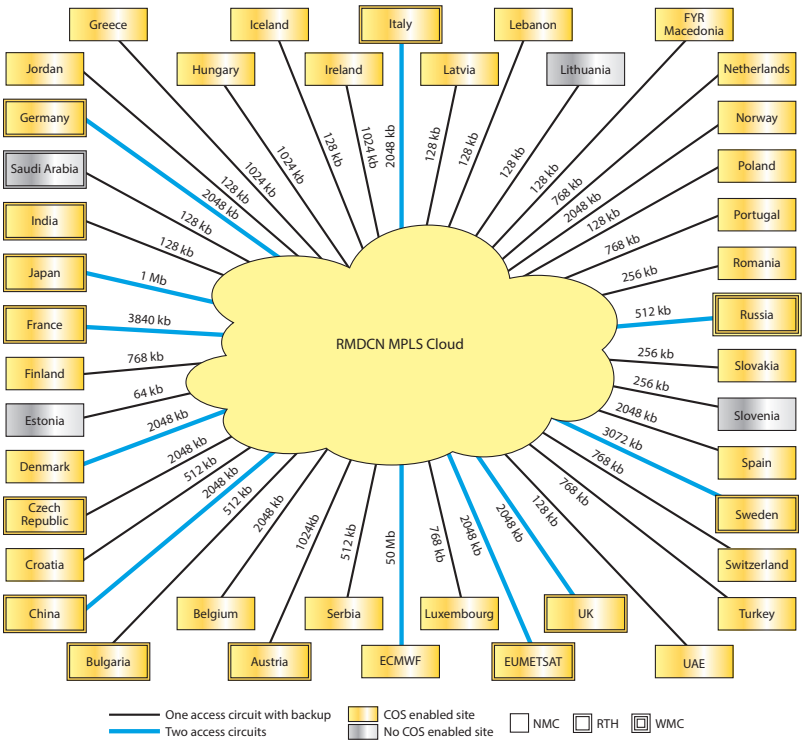

Figure 2 RMDCN MPLS IPVPN network – June 2007.

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From Frame-Relay to MPLS, a technical comparison

The MPLS technology used by the new RMDCN network is different from that of the previous Frame Relay technology. We now consider the differences and the improvements that are provided by the new network.

The Frame-Relay technology

Frame Relay is a relatively old technology which has the following two major characteristics.

- ***Link-based Network:*** In order to be able to exchange data, two sites must share a common dedicated point-to-point circuit. This circuit is deployed by the provider and is called a Permanent Virtual Circuit (PVC). Typically, a site shares several PVCs with all the sites with which it needs to exchange traffic.
- ***Dedicated bandwidth between two sites:*** When a PVC is deployed between two sites, it provides a dedicated bandwidth. This also highlights a limitation, as unused PVC bandwidth can not be (re)used by other PVCs.

For example Figure 3 shows a simplified Frame Relay network. Note that sites B and D cannot exchange data as they do not share a PVC.

The MPLS technology (Multi-Protocol Label Switching)

MPLS is an IP-centric solution that includes significant new features such as CoS (Class of Service) and VPN (Virtual Private Network). It is “Multi Protocol” as it can utilise different network technologies (FR, Ethernet etc.). It performs “Label Switching” since the data packets are switched through the network by virtue of an attached label. The following features characterize an MPLS-based solution.

- ***One access circuit per site:*** In order to exchange data with any of the other sites that are connected to the network, a site needs only one access circuit to the MPLS “cloud”.
- ***Dedicated bandwidth to the network:*** The bandwidth value of the access circuit is the only guaranteed bandwidth for a site.
- ***Traffic prioritisation and CoS (Class of Service):*** Through its traffic engineering mechanisms, MPLS provides a granular way of distinguishing the different traffic flows that cross the network and assign them the appropriate priority. Critical traffic can therefore be allocated a higher bandwidth.

Typically with MPLS a site can exchange data with all of the sites that are connected to the network. In essence, the network acts as a private Internet-like topology. This is known as any-to-any setup (see Figure 4). The lack of dedicated bandwidth between sites is compensated by the CoS configuration that allocates a higher priority the more critical the traffic is.

The new MPLS-based RMDCN network

For the RMDCN community, the two main benefits of an MPLS-based RMDCN network over one based on Frame Relay are the following.

- ***Any-to-any connectivity:*** Without further changes to the existing network, any pair of RMDCN sites can exchange data as soon as they have implemented the necessary routing changes locally.
- ***Class of Service:*** Taking into account that there is no dedicated bandwidth between the different RMDCN sites, the emphasis is on the traffic prioritisation and CoS. It is important that each RMDCN site classifies its traffic properly.

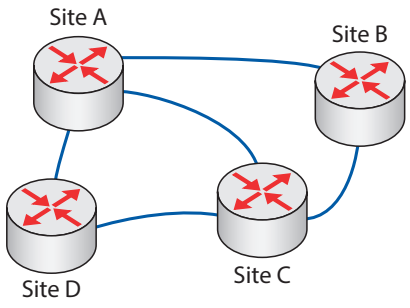

Figure 3 A network based on Frame Relay.

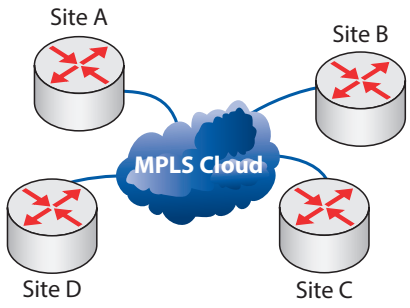

Figure 4 A network based on MPLS.

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The Implementation

The actual migration project commenced following the signature of Supplement 4 of the RMDCN contract on 8 May 2006. Table 1 outlines the major milestones during the migration project. The following phases for the implementation were identified.

Specification of the configuration for each User Site

During this period the final configuration details such as access speed, mission critical setup, backup method, etc. were agreed with all RMDCN Members and the information was passed on to OBS.

Installation of the network

OBS rolled out the new MPLS-based network in parallel with the existing Frame Relay network. ECMWF gathered from all of the RMDCN members the detailed technical information (CoS classification, IP network addresses etc.) which OBS required to configure the network equipment.

Validation of the new network

In order to be confident that the new network was able to meet the operational requirements it had to be validated. This validation was split into two parts.

Firstly there would be a two week User Site Acceptance period during which tests were run to identify any configuration or deployment issues for each User Site on the network. This phase was also used to validate whether or not the traffic on the network was properly classified according to the CoS specifications and that the expected performance levels could be attained. To achieve this, all User Sites were provided with a common set of test software that had been developed by ECMWF.

The second phase of the validation was the Reliability Acceptance Test. Before running any real operational traffic on the network it was necessary to validate the service provided by OBS. During this phase ECMWF duplicated its dissemination traffic that was using the operational network and transmitted this duplicated data over the new network to systems that had been set up for testing by some member sites. Some Regional Telecommunications Hubs did similar tests by transmitting a copy of their operational GTS traffic over the new network to some of their partner sites.

Migration of operational traffic

In order to migrate the 91 PVCs in a controlled manner a detailed time schedule for migrating the operational traffic flows was agreed by all RMDCN Members.

Date	Task
8 May 2006	Signature of Supplement 4 of the RMDCN contract
11 September 2006	Start of installation – roll-out
16 April 2006	Ready for Trial Date – OBS handed over the network
	Start of the User Site Acceptance Tests
19 May 2007	Start of the Reliability Acceptance Test
4 June 2007	Start of the migration of all operational traffic
18 June 2007	Final acceptance of the new network

Table 1 The major milestones during the migration project.

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Conclusion and perspectives

After a process lasting almost three years, the RMDCN has been significantly improved. The new MPLS technology provides a state of the art solution for RMDCN's Managed Virtual Private Network. The network is now ready to face the upcoming challenges:

- Increased traffic flow.
- More versatile exchanges of data between sites.
- The ability of new sites easily to join the network.

Although the backup solution in the new network is a significant improvement compared the one used for the network based on Frame Relay, the limitation in speed is seen as a severe constraint.

In the coming months ECMWF and some volunteer Member States will be testing secure VPN connections over the Internet. This type of connection can be used as a backup connection for the RMDCN with ECMWF acting as a gateway to the RMDCN. A backup of this type will enable faster transfers to take place, as the limit will be the Internet access speed of the User Site. Diverse access of the Internet connection and reliability of the VPN connection are areas that will be part of the investigation. With the improved bandwidth, the current backup solution used by most countries could then be replaced by this new secure Internet VPN based backup solution.

With the migration to the MPLS technology, another major step in the development of the RMDCN has been made. The further evolution of the network, which has been running operationally since March 2000, will have to be addressed by the Steering Committee of the RMDCN in the near future. ECMWF Member States and more generally the WMO community (i.e.the GTS and very soon the WMO Information System (WIS)) will continue to need an improved, managed and reliable network. The MPLS RMDCN is ready to face these new requirements.

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