Multi-Vendor Router Networks
Nestec S.A.

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Company Overview
Nestec S.A. is a research and administration company providing services for the Nestle group. They are structured in an administration headquarters based in Vevey, Switzerland (hereafter HQ), a generic research center (hereafter CRN) dedicated to fundamental research based in Lausanne, Switzerland, and diverse product specific research sites (hereafter RECOs) in Switzerland and all over the world.

A few years ago, the RECOs and the CRN decided to unify their environment and to start electronic communication within their community. They selected the HP 3000 platform and are using HP’s network services and HP DeskManager to provide peer-to-peer communication over X.25 networks. The RECOs and the CRN were also installing and rapidly deploying Ethernet PC LANs built upon Microsoft LAN Manager and TCP/IP.

The Nestle corporation also selected Infonet as the global carrier to provide the basic infrastructure to link all the sites together, on a worldwide basis. Thus, the RECOs and the CRN used X.25 technology for backbone access with HP Model 45 concentrators where appropriate. The HP 3000 provided the gateway functions between the LAN and the WAN.

The HQ is using an IBM mainframe with SNA and Token Ring networks and a host-based E-mail system. It also has directly dependent remote sites spread across the country and internationally. Years ago HQ started the deployment of a Novell network with centralized and decentralized PC servers.

The heterogeneous E-Mail systems talk together using an IBM host centralized gateway, located in the USA and managed by Infonet. This gateway links all messaging technologies through a software package from Softswitch, Inc.

Due to the Nestle company structure, all Nestec S.A. entities are autonomous in terms of management and supplier choice, following the corporate guidelines and recommendations.

Business Need
Recent decisions in the company, such as centralization of applications, brought up the need for strengthening the inter-site communication, especially in Switzerland. The Swiss RECOs were asked to interactively access applications residing on the HQ mainframe, and the business required information access to any server in the country.

Furthermore, Nestec S.A. wanted to exchange information with universities and other research companies, and to access data on public servers. Thus, global access to the Internet was another requirement.

Therefore, the above-mentioned needs dictated building an extended LAN, linking all the sites for peer-to-peer connectivity in a multi-protocol environment.
**Heterogenous Environments**

The HQ had started interconnecting local and remote rings using Wellfleet Communications Inc. routers.

The RECOs and CRN have historically been pleased with HP as an information technology and networking supplier, and as such selected Hewlett-Packard routers to minimize vendors, risks, and support costs.

The third player is a country-based service provider company, called Switch, which supplies commercial and educational Internet access. Switch also provides X.400-to-SMTP (RFC-822) address translation gateway service. As with much of the Internet infrastructure, Switch has built its network using Cisco System Inc. routers.

The above comments and descriptions are meant to help the reader understand the origin and purpose of these three router technologies which caused the multi-vendor data transport network to be a reality at Nestec S.A today.

**Network Requirements and Design Criteria**

Differences in data flow, traffic volume, and protocols did not allow a straightforward design. Hence, the emphasis was on security, redundancy, and overall network cost optimization (leased lines, equipment, Infonet subscription, support, etc.).

The main data flows are summarized below by traffic groups.

**Traffic Group A. Inter-Swiss RECOs (TCP/IP only)**
- Interactive access to custom application modules.
- File transfer.
- Sporadic file server connection.
- Electronic mail (HP DeskManager).

**Traffic Group B. Swiss RECOs - CRN (TCP/IP only)**
- Interactive access to custom application modules.
- File transfer.
- Sporadic file server connection.
- Electronic mail (HP DeskManager).
- General IBM/host spool file distribution.

**Traffic Group C. CRN - Headquarters**
- Interactive access to custom application modules
- Interactive access to IBM common applications (using TN3270 protocol).
- File transfer with HP 3000, UNIX, and IBM system.
- Moderate connection on NetWare file server.
- IBM/host printer emulation (based on HP-SNA/IMF, IBM3270 emulation).
- IBM/host interactive traffic for non-LAN-based remote users.

Group C traffic requires that TCP/IP, SNA and IPX/SPX traffic be merged over the same line. This telecommunication line is further rationalized with TDM multiplexers by integrating router data with voice and X.25 channels.

**Traffic group D. RECOs & CRN - Headquarters**
- Interactive access to IBM common applications (using TN3270 protocol).
- File transfer with HP 3000, UNIX, and IBM systems.
- Moderate connection on NetWare file server.

**Traffic Group E. Swiss RECOs & CRN - Infonet**

Infonet access is primarily required for all international traffic. Therefore X.25 connectivity must be kept for legacy environments such as PAD workgroups, traveling users, and other international RECO’s. The extended LAN must therefore provide an entry and connection to the carrier.

Since the major part of the international traffic is electronic mail batch transfer, a low-cost connection at 9600 b/s was selected.

Note: Infonet E-MAIL traffic is divided into 2 parts:
1. An HP DeskManager connection to the other international RECOs (this traffic directly affects the router network connectivity to Infonet)
2. An HP DeskManager connection to SoftSwitch gateway traffic which uses SNA/NRJE emulation communication on the HP 3000 E-MAIL gateway machine (ARCOM/X.400, Infonet, and Internet mail).

The resulting SNA traffic is later converted to X.25/QLLC into a HP Model 45 concentrator. This concentrator provides connectivity to TELEPAC (the Swiss PSN X.25 network) for public access, PAD users, and X.400 services.

Interactive application maintenance is also done through Infonet.

**Traffic Group F. Swiss RECOs, CRN, and HQ - Internet**

This group of traffic covers all the sporadic Internet access by the entire Swiss Nestec S.A. organization.
Design Criteria

One should note here that the scope of this paper is to concentrate on the HP network design part which covers all the traffic groups described above, along with interconnectivity to other technologies.

The network design criteria were derived with the following objectives in mind:

- Avoid points of failure which would penalize all traffic types
- Homogenize the type of routers (HP EtherTwist family)
- Minimize purchase and maintenance costs
- Optimize interactive performance
- Manageability, security, and redundancy.

We standardized on HP Router/SR only, with the exception of the HQ which required a HP Router/BR for FDDI backbone access. All HP routers are running software version A.07.02.

Network Topology

This paper is not meant to provide all the details of the network, since exhaustive design parameters would produce a document outside the scope of a case study. However, we have concentrated on the driving rationales and other main areas of interest.

The overall topology is made of point-to-point 64 Kbps leased lines going from the Swiss RECOs and the CRN toward the HQ in Vevey. This topology design was mainly dictated by traffic group C & D traffic requirements, which are the most sensitive in terms of delay.

Typical RECO Router Design Principles.

This part is common and reproducible for most RECOs. It features an HP 3000, a PC LAN, and DTCs on a single Ethernet segment connected to the extended LAN. The port WAN1 of the unique router is linked on the PTT telecommunication line for traffic group A transfer, while the WAN2 port is connected on SWISSNET (Swiss ISDN network) with a V.25 bis dial-up terminal adapter. This link provides a redundant path to HQ for the partial traffic group D, which is mission critical. It is automatically activated by the router when the main telecommunication circuit fails. It is configured as an alternate path for TCP/IP and uses static route configuration, while the main circuits rely on OSPF (discussed later) for getting routing table updates. It is worth mentioning that one should assign a lower preference to static route, so that it is not
activated permanently. Figure 1 depicts this basic design.

**CRN Router Design Principles.**

As mentioned earlier, the CRN has more requirements in terms of traffic types, and therefore needs to support more protocols. For cost and convenience reasons, it is also the site chosen for providing the gateway to Infonet and Internet. Therefore, keeping the design criteria in mind, we assigned one router (CRN1 in figure 2) responsible for traffic groups B, C, and part of D, and another (CRN2) to be responsible for traffic groups E and F.

CRN1 basically has the same function as provided for the RECOs, with the exception of SNA encapsulation (synchronous pass-through) capability on WAN3, required for SNA/LU3 printer emulation on an HP 3000. However, in this case the ISDN circuit is configured as a back-up circuit group for providing all redundant services.

**Internet and Infonet Access**

CRN2 functions as the gateway to the international and outside world. It is not mission critical in terms of availability. However, special attention is given to it due to the security issues of public network connectivity.

The CRN2 router talks to the Internet gateway router (Cisco System Inc. AGS+/4, OS version 9.1-7) using the PPP protocol configured on the WAN3 port. A default route has been set up for sending all unknown IP Nestec S.A. addresses over this link. As security is a very hot issue while accessing the Internet, an open secured system acting as a firewall has been implemented. It works in conjunction with a filter on CRN2 which lets only a very few well known IP and PORT addresses come in.

On its WAN1 port, CRN2 also talks X.25 to Infonet through an HP Model 45 switch, which concentrates the TELEPAC and Infonet accesses and performs SNA protocol conversion (SDLC <-> X.25/QLLC) for the HP 3000 mail gateway mentioned earlier. Since the remote nodes are mainly HP 3000 MPE/iX systems (European and US RECOs), CRN2 uses RFC-877 IP encapsulation and static routes.

**HQ Router Design Principles.**

This is a great area of interest. It features the logical link between the Wellfleet Communications Inc. and HP router network technologies. The physical link, as shown in figure 3, is made of a dual FDDI ring which is in fact a collapsed backbone (and the OSPF logical backbone), onto

**Table 1**

<table>
<thead>
<tr>
<th>Router</th>
<th>Protocols</th>
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</thead>
<tbody>
<tr>
<td>HQ</td>
<td>IP, IPX</td>
</tr>
<tr>
<td>HQ1</td>
<td>IP, IPX, SNA/SPT, ISDN (back-up link)</td>
</tr>
<tr>
<td>HQ2</td>
<td>IP, IPX</td>
</tr>
<tr>
<td>HQ3</td>
<td>IP, ISDN (alternate back-up route)</td>
</tr>
</tbody>
</table>

**Protocol Traffic on HQ Routers**

HQ Network Design

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which the Wellfleet Communications Inc. Backbone Concentrator Node (OS version 7.71), major NetWare servers, IBM host, and other networking equipment are connected. Again, the design rationale here was security and redundancy. The FDDI backbone also establishes the administration boundary in terms of network operation and responsibilities.

Again, in this case this router configuration responds to the same design criteria and rationale discussed earlier. Protocol traffic is shown by router in Table 1.

**OSPF Areas**

We finish this paper with a discussion of routing protocols. Some "facts of life" led us to choose OSPF. Those criteria are reflected below:

The network is a true heterogeneous multi-vendor transport network, and thus requires a standard routing protocol.

Even though the network is a single autonomous system using a type B network address, for organizational reasons mentioned earlier, the network is logically divided in two independently manageable areas, for which the boundary is the FDDI ring in HQ (see figure 3).

Due to different LAN topology and history, the type B address has been subdivided to accommodate different subnet sizes and thus must support a variable subnet mask (the design of the extended LAN network further complicates the situation by introducing a third small point-to-point subnet mask for IP address saving).

Figure 4 shows the autonomous system with the two distinct management areas and the OSPF backbone. Any network growth or change in any administered areas can be done independently of each other, assuming that a few basic rules, such as naming and addressing, and OSPF conventions are observed.

Thus, the introduction of OSPF helped us to solve the above issues, and brought us several nice goodies, some of them being fast network reconfiguration and better control of the meshed implementation with alternate redundant links.

**Conclusion**

MULTI-VENDOR wide area transport networks are a reality today.

Any conscientious network manager would avoid, for good and pertinent reasons, mixing and matching vendors and technologies when building a brand-new network. However, other factors may force a manager to use different box manufacturers, and allow them to interoperate. Among those factors, buzz words such as "consolidation", "acquisition", or simply "functionality" or "economy", might be good catalysts for this process.