Overview of HEP Wide Area Networking: Producer Perspective

F. Flückiger

CERN LIBRARIES, GENEVA

CM-P00059920

Presented at the "Computing in High Energy Physics 1989" Conference
Oxford - April 1989

OVERVIEW OF HEP WIDE AREA NETWORKING: PRODUCER PERSPECTIVE

Francois FLUCKIGER

European Laboratory for Particle Physics
CERN
CH – 1211 Geneva 23, Switzerland

ABSTRACT

The prime role of HEP network producers is to understand user requirements and to translate them into policies and solutions; the next stage is to manage in a collaborative way the resulting services. Close coordination is essential, and concrete steps have been taken by HEP in Europe and the USA to set up the appropriate management structures. External constraints also exist (PTTs, policies on standards, ...) and the HEP network provider has to accommodate all these components in the planning of future services. This paper mainly discusses what has been achieved worldwide by HEP in this context – a set of coordinated conventional services using multivendor and proprietary protocols and mainly based on leased lines – and what can be expected in the coming years: advanced services consistent with the Supercomputer – Workstation era, based on high (megabit) to very high (hundred megabit) links. This is required to actually achieve collaborative and distributed processing of HEP data..

INTRODUCTION

A producer of services may see wide area networking from a number of complementary angles. What sequence to adopt to describe them? Why not alphabetical, starting with A: what has been Achieved.

A: ACHIEVEMENTS

Over the last five years, a set of coordinated undertakings from the HEP community has led to an impressive list of achievements. The most notable are:

- an infrastructure of international HEP leased lines;
- an international private X.25 network with a common addressing scheme;
- a worldwide DECnet (10 000 nodes);
- international coloured book services;
- an emerging SNA/RSCS network;
- an emerging TCP/IP network;
- a set of converters and gateways with unique functionalities.

This effort, although still insufficient, has provided HEP with a unique tool for international collaboration, as compared to many other research disciplines. The following concentrates on the international aspects of HEP networking.

1. HEP Leased Line Infrastructure

Today, a total of 20 international leased lines partially or totally dedicated to HEP are in operation over 3 continents (11 lines at 64 Kbps; 9 in the range 9.6/19.2 Kbps). The following countries have one or several connecting points to the HEP leased lines infrastructure: France, Germany, Italy, Netherlands, Spain, Sweden (giving also access to Denmark, Finland, Iceland, and Norway), Switzerland and the United Kingdom; the USA and Canada; Japan.

In France, Italy, Spain, USA and Japan, the international links connect to a national infrastructure of leased lines dedicated to HEP. In the UK and Scandinavia, they connect to general purpose leased line networks (JANET and NORDUNET respectively).

The set of international HEP leased line forms one of the biggest subject – oriented intercontinental infrastructure. It is complemented in most countries by access to the PTT public X.25 networks, and by the use of general purpose research networks such as BITNET/EARN and USEnet/EUnet.

Plans are well advanced for additional European and trans – continental links, and for the upgrade of several of them to the range 1.5/2 Mbps as described in the last chapter.

2. HEP X.25 Network

The private HEP X.25 network runs on top of the leased line infrastructure. It covers France, Italy, CERN/Switzerland and the USA, and has nodes in Germany, Netherlands and Spain. It is connected to the JANET and NORDUNET general purpose X.25 services.

It uses a common convention called the HEP X.25 addressing scheme which is based on the CCITT X.121 standard. Where the scheme is fully implemented, full connectivity exists between all the connected hosts (DTEs), and any DTE can be called using the same address from any point on the network.

3. HEP DECnet

This is currently the biggest HEP network service: more than 10,000 nodes spread over Austria, Denmark, Finland, France, Germany, Italy, Norway, Portugal, Spain, Sweden and Switzerland in Europe, and also USA, Canada and Japan.

Except for Austria and Portugal which are linked via the public X.25 networks, the HEP DECnet runs over HEP leased lines, mostly on top of the HEP X.25 service. The HEP DECnet is coordinated with the Space Research Analysis Network (SPAN) run by NASA in the USA and ESA in Europe.

Additional HEP connections are planned with Belgium and the Netherlands.

4. HEP SNA/RSCS Network

This is a facility emerging in Europe. International SNA services are currently available between CEA – Saclay (F), IN2P3 – Lyons (F), ETH – Zurich (CH), Uni – Geneva (CH) and CERN. In addition RSCS/BSC services are available between RAL (UK), DESY (D) and CERN. However, the bulk of the RSCS services between HEP sites is currently provided by the EARN/BITNET general purpose network.

The HEP SNA/RSCS services run currently directly on HEP leased lines (or sub – channels via the use of band – splitters), and not (yet) on top of lower layer facilities such as the HEP X.25 network. Additional SNA connections are being considered between CERN and INFN – Bologna (I), RAL, CIEMAT – Madrid (E), and DESY.

5. HEP TCP/IP Network

TCP/IP services have been in use for several years by HEP on a local or regional basis in almost all the countries. On the international front, Japan (KEK) and the USA (LBL) exploit an IP connection. In Europe, a first international TCP/IP facility has been opened between

the Netherlands (NIKHEF) and the Nordic countries (especially the Niels Bohr Institute – Denmark).

Other international TCP/IP services are planned at short notice in Europe including with France, Germany, Italy, Spain and Switzerland. Transatlantic HEP services are also being considered.

6. HEP Gateways and Converters

To improve connectivity between its various network services, HEP has developed and installed a number of converter and gateway facilities: the GIFT system for File Transfer, jointly developed by several organizations including INFN, and in operation at CERN; for E-mail, a number a gateways including INFN – Bologna, CIEMAT – Madrid, Bohr – Copenhagen and the MINT system at CERN. In several cases, the functionality of these HEP converters (e.g. the GIFT on – the – fly multiprotocol system) has no equivalent outside of HEP.

b, C: COORDINATION

To operate the wide range of HEP networking services, collaborative management and planning is necessary. Coordinating structures have been set up in Europe and the USA to jointly operate and manage these facilities.

The conjunction of the international networking facilities and their coordinating and management structures is collectively called **HEPnet**.

In Europe, a group of national HEPnet managers (called HTC: HEPnet Technical Committee) has been set up by the HEP Coordinating Committee for Computing (HEP – CCC). User requirements are expressed by a group (called HRC: HEPnet Requirement Committee) set up by ECFA.

d, e, F: FAILURES?

Twenty international leased lines ...! largest DECnet in the world ...! intercontinental HEP X.25 ...! GIFT ...! Straight access from Rome to Tokyo and Madrid to Berkeley ...! Is everything OK? Are users fully happy? No, and for two main reasons:

- higher bandwidth allowing advanced applications are urgently required; actions have been launched in this direction and are described in the last chapter;
- serious problems remain with the conventional services described above.

The most notable points of user dissatisfaction on international HEPnet conventional services are as follows:

1. user interfaces: multiple and non – friendly;
2. international full screen terminal access services: intensive use practically impossible (hampered by round trip delay).
3. bad response time over DECnet and X.25 (long routes, slow routers);
4. mail services: unreliable, slow;
5. mail gateways: not always transparent, too few, behaviour unpredictable;
6. file transfer services: poor between certain pairs of systems (e.g. VM – UNIX);

7. almost no directory facilities (how to find the E-mail address of Mr X, the DTE address of Host Y?).

Major improvements are therefore necessary to reach a higher level of satisfaction, even on conventional services. They may result from the work of the coordinating structures (e.g. optimized topologies to reduce long routes, more mail gateways, ...), the coordinated use of new technology (faster routers – X.25, DECnet, IP, IBM controllers –), dialog with and input to suppliers (user interfaces), or even from specific developments (such as specific tools for directory services).

Another area of concern is the need to rapidly reduce the number of countries where physicists are still somewhat disfavoured in terms of HEPnet services (such as Belgium, Greece, Portugal), and to also improve services with other regions (such as China, India, Africa). Positive steps have been taken in this direction over the last year. The ultimate goal would be that wherever he works, a physicist may benefit from the same level of service, HEPnet being viewed as a basic and mandatory tool for physics collaborative work, as is postal mail or telephone.

g, H: HOW MUCH?

“How much does it cost to run all these services?” “Why all these leased lines, and not more public X.25?” “Should not networking be done by dedicated organizations and professional staff?”. These questions have been heard here and there, often from outside the community.

HEPnet serves an amorphous and complex community with demanding and diverse needs. The range of required services is therefore wide, and the techniques (protocols) to provide them are numerous; this is also necessary to exploit fully the advances of technology. HEPnet has therefore no alternative than to accept for the time being a reasonable diversity of techniques. It is however necessary to master the introduction of additional protocols, in order to avoid redundancies (techniques providing similar services between the same types of systems).

In an ideal world, a single set of vendor – independant protocols would be used (OSI, Coloured Books, TCP/IP suite). In practice, only progressive reduction of the diversity of protocols will be possible, and the most advanced services at a given time will never be available immediately in a standardized form.

The leased line approach is currently the most cost – effective. In Europe, the exclusive use of the public X.25 networks – which is the only current alternative – would multiply the costs by a factor of 5 to 10. When other PTT/PTO (Post and Telephone Operators) services become available (ISDN, MDNS, ...) and when their costs are better known, a reassessment of the situation will take place. From a service point of view, leased lines have the advantage to be protocol independant, so that all the necessary flexibility is guaranteed for the combination or rearrangement of the services.

Computing and networking are two strategic components of experimental particle physics. For this reason, the community has to keep a reasonable control of these tools so that they can satisfy its advanced and evolving requirements. In some cases, the basic operation may be delegated, when this results in net benefits and if the quality and flexibility of service is maintained. In other cases, HEP may also benefit from joining its forces with those of other disciplines.

i, j, k, l, m, n, O: OSI

OSI refers globally in the following to the conjunction of the Open Systems Reference Model from ISO and the set of protocols developed by ISO and CCITT. What do we think about it?

OSI is probably a unique effort of standardization in the history of computing: it has already lasted 12 years (a quarter of the whole computing history), and not all the standardizations undertaken so far will be completed before the middle of the next decade.

Three comments will be made on OSI, which are relevant to HEPnet:

- OSI is later than many of the HEP producers thought 5 years ago.
- Building **large scale** OSI networks such as HEPnet seems unlikely before some time: the practicalities for routing and look-up in directories appear to have been overlooked.
- At a given time, the most advanced applications, such as those required in HEP, can not be standardized immediately, by their very nature.

OSI is one of the activities which, if successful, may help to reduce the diversity of services to be supported. It therefore deserves to be encouraged by the HEP community. However, it is a fact of life that not all standards in general can be successful (so far, the most successful OSI standards have been X.25, X.400, X.500: they have a common property, the "X.": they come from CCITT; Ethernet, HDLC from ISO are also successful, and they come in fact from industry). Several OSI standards will fail (too broad, too complicated, too late, self-redundant, such as the many OSI protocols to transfer a file). Several others will succeed (the "X." series, TP, FTAM, ODA/ODIF, ...). The mission-oriented networks such as HEPnet will continue to monitor this evolution and launch OSI initiatives or services as appropriate, open networking remaining its strategic direction.

P: POLITICS

Politics is an inevitable component of the life of network service producers. Why? The first obvious reason is the central role played by the communication standards. Standards in general have always been and will remain a key weapon in industrial and commercial strategies, at the level of firms, nations and continents (protection and attack of markets). In the field of telecommunications, this is aggravated by the explosion of the markets, the deregulation process which triggers new industrial interests, the 1993 open market in Europe especially for Value Added services, and finally the strategic role that computer communications standards plays directly on the computer sales.

These considerations seem far from HEPnet! In practice, external financial resources are sometimes conditional on the use of certain techniques. Certain forms of help and sponsoring appear to be mutually exclusive. This must simply be remembered by the users who have also to contribute to the formation of the appropriate positions to be taken in such cases.

The most detrimental consequence for the HEP community would be a forced and artificial fragmentation of this worldwide community, under diverging outside pressures, such as religious or industrial war on certain flavours of OSI itself (e.g. the USA/Europe debate on connection-less versus connection-oriented network service). Particle physicists form a transnational community and HEPnet services have abolished the frontiers and oceans. It would be sad that artificial borders are re-established and unnecessary gateways and translators be made mandatory.

q, r, s, T: TOMORROW

Modern Physics experiments will produce from 2,000 to 10,000 tapes per year of raw data. Most of them will have to be transferred to and/or accessed from dozens to hundreds of sites in the world, as well as calibration data. External processing centres will be needed. Hundreds of megabits will be needed between processing centres and the accelerator centres. Services will include bulk data transfer, distributed computing using workstations accessing supercomputers (including remote windowing, remote file access, remote procedure calls, remote graphics and imaging, ...).

First steps have been taken in Europe and the USA in this direction. Leased lines in the range of 2 Mbps have been or are being ordered between CERN and INFN – Bologna, ETH – Zurich, IN2P3 – Lyons and CEA – Saclay, despite the exagerrated high cost of these links.

These links will use a combination of protocols; in the most complicated cases this will comprise: X.25, DECnet, SNA and TCP/IP. The technique currently favoured is the use of high speed intelligent Time Division Multiplexers, where the services are run separately on different channels. This technology is boring, but flexible, well – proved and off – the – shelf (used by the PTTs). It also permits the introduction, if desired, of other integrated services (video – conferencing, voice, ...).

In the USA, plans also exist for the rapid upgrade at T1 (1.5 Mbps) speed of the Energy Science network (ESnet) set up by the DoE and used by physicists. Discussions are underway for the upgrade of the transatlantic HEP links. In Germany, particle physicists are playing a key role in the launching of an ambitious 140 Mbps project. All this indicates that although having to consolidate its conventional services, HEPnet remains an initiative turned to the future.

CONCLUSION

The conclusion will take the form of 12 short messages:

1. HEP has the richest and biggest subject – oriented network but major improvements are needed.
2. A wide range of conventional services is offered but redundancies should be avoided in the future.
3. TCP/IP services will be in use everywhere within 18 months.
4. OSI is late; it will work for several services. It deserves to remain a strategic direction.
5. Official and de – facto standards may not be immediately adequate for huge networks (millions of objects).
6. Protocol flavour disputes (e.g. ISO CONS versus ISO CNLS) are non – sense.
7. Artificial frontiers, due to protocol schismes, between countries or continents should not be re – created.
8. Politics exist.
9. HEP needs to keep control of its computing and networking.
10. HEP 2 Mbps links will come this year.
11. Time Division Multiplexing is boring but will be used for megabit links.
12. In a world where the technology advances fast, the user needs explode, the PTO environment changes everyday, and supplier strategies are often unpredictable, then the network service producer should not feel guilty to adapt or change its policy every 3 years.