SMDS: Background and Status

Duncan Smith
Networks and Communications Laboratory
HP Laboratories Bristol
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SMDS

The imminent introduction of SMDS service by the Regional Bell Operating Companies in the U.S. is their response to the burgeoning need for public data communications. This paper briefly describe SMDS and the technologies involved. It also examines the prospects for SMDS and its competitors as the data communications world awaits the advent of B-ISDN services over the next ten years. This includes recent work in this area by Hewlett-Packard Laboratories.

1 Introduction

The High-Speed Networks Department of the Networks and Communications Lab, Hewlett-Packard Laboratories, Bristol, has for the last year or more been working on Bellcore's SMDS (Switched Multi-megabit Data Service). SMDS is a connectionless packet-switched data service that will run initially at 1.5Mbps and will be offered commercially next year by the seven US Regional Bell Operating Companies or RBOCs, the large telephone companies formed from the anti trust-mandated break-up of 'Ma Bell' (AT&T) in the early eighties.

In the last few years the RBOCs have responded to the emergence of privately run data networks which have been taking advantage of the growing demand for metropolitan and wide area connectivity in the US. SMDS represents the RBOCs' attempt to increase their market share and establish themselves as key players in a business area that will rapidly come to rival old-fashioned voice-only telephone lines in importance as an area of future growth for them.

The technology of SMDS — based on the IEEE 802.6 standard — should give the RBOCs an edge in this struggle, providing as it does a migration path towards the much-discussed broadband ISDN (B-ISDN). This will become increasingly apparent as customers begin to demand more bandwidth than current systems can support. It will also become apparent in terms of the need to switch data to avoid the rapid proliferation of fixed links as individual MAN needs grow.

SMDS is targeted at such uses as medical imaging and health care, CAD and multimedia applications where geographical distribution leads to a requirement for high bandwidth LAN-like performance over metropolitan and wide-area distances. A typical user might be a small- to medium-sized company with several widely separated sites each with its own LAN.

Many companies in the telecommunications field have already expressed support for SMDS by announcing their intention to develop SMDS chipsets and other hardware such as switches. These include AT&T, Fujitsu, Alcatel, Siemens and QPSX amongst others.

2 IEEE 802.6

SMDS grew out of an emerging IEEE network access standard, 802.6 [1], a MAN technology based on the distributed queue, dual bus model. As 802.6 has been modified so SMDS has changed to reflect it. SMDS is actually a defined part of 802.6 and in turn the Bellcore technical advisory documents that define SMDS [2,3] refer to 802.6 frequently. It was the final approval of 802.6 as an IEEE standard that paved the way for the RBOCs to support SMDS with confidence.

The idea of DQDB is that data flow is bi-directional; there are two buses connecting each point in a DQDB network:

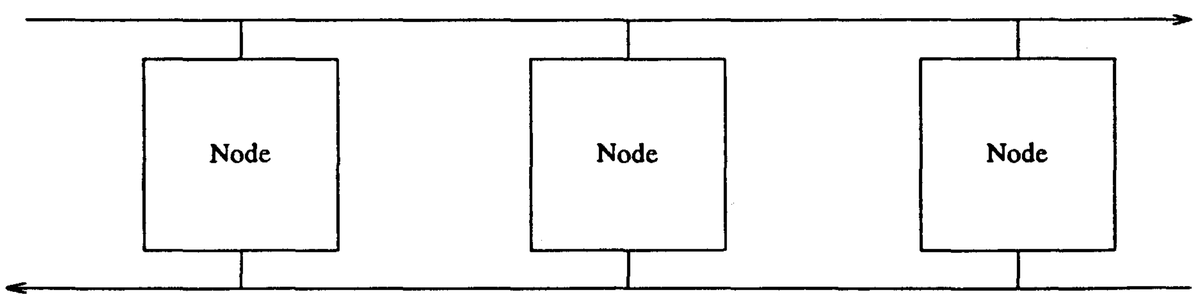

Fig. 1: Distributed queue dual bus network

Data passes in both directions simultaneously through each node which must queue its own data for access according to a distributed queueing algorithm. The data stream is divided into slots of fixed size so the access requests of downstream nodes (received via slots coming upstream) are satisfied by allowing enough empty slots to pass by before data can be inserted. To avoid access latency caused by a node's position along the network, all nodes are required to allow to pass by one slot in every eight that they would otherwise be allowed to use.

3 SMDS

Initially, Bellcore only defined what is now known as the DS3 data rate operating over T3 digital data lines running at 45Mbps. Since then another, DS1, has been added for T1 line rates of 1.5Mbps.

An SMDS node or customer premises equipment (CPE) could in principle operate as part of a full DQDB access network but at DS1 rates will be implemented as a single attachment CPE connecting with the MAN switching system (MSS) in the form of a SMDS switch. The single CPE node has two links with the MSS, one for receive and one for transmit. The connection between the single CPE and the MSS is a point-to-point link and so the DQDB protocol outlined above is simplified; slots are filled as required by the CPE:

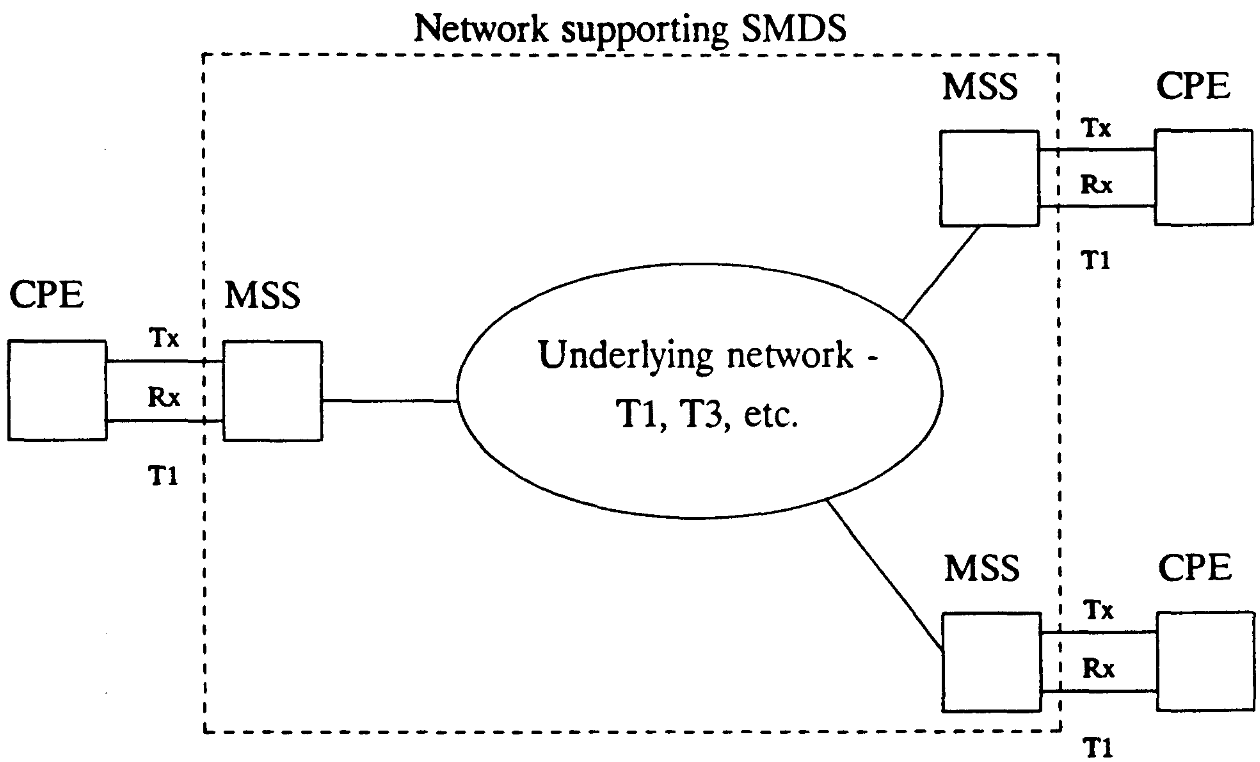

Fig. 2: MSS as SMDS interface for CPE

Note that the MSS is simply the interface to SMDS as seen by the CPE. The network supporting SMDS could be built over any sort of network technology that can carry SMDS.

At DS3 rates, which unlike DS1 allow for access classes at less than the full line rate, full DQDB or multi-attachment CPE will probably be developed.

3.1 SMDS Interface Protocol

An SMDS node operates a three-layer protocol, the SMDS Interface Protocol or SIP which functions as the MAC layer in the protocol stack allowing full interworking between systems using DARPA and OSI protocols.

The topmost layer, layer 3, involves the encapsulation of the packetised data in blocks 9188 bytes in size and the addition of the appropriate headers and trailers giving the amount of data included and the source and destination addresses. A large file would therefore be spread over more than one packet. The layer 3 protocol data units (PDUs) are passed to layer 2 which segments them into units which contain 44 bytes of the layer 3 PDU and adds headers and trailers including a CRC:

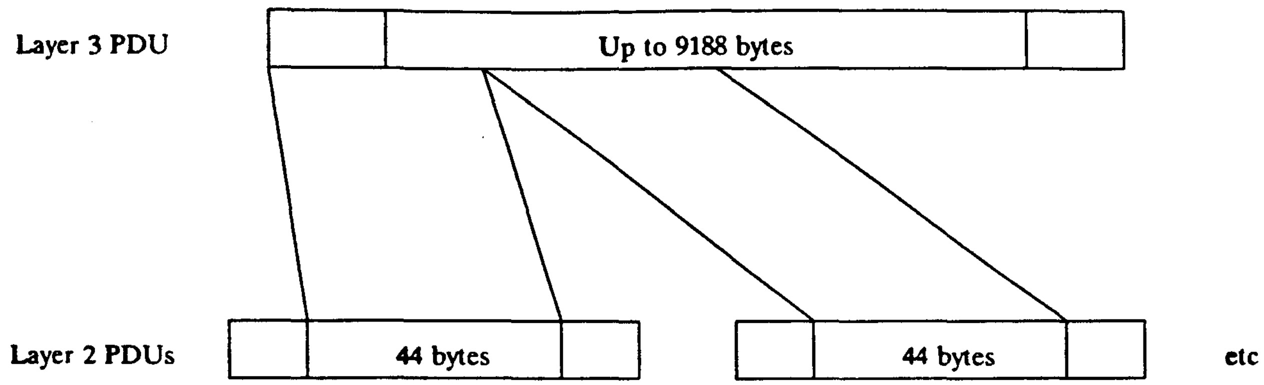

Fig. 3: SMDS Interface Protocol (SIP)

Addition of an access control field completes the 53-byte slots which are passed to layer 1. In layer 1 the physical layer convergence protocol or PLCP handles the combination of the data with the user path channel which allows performance monitoring and provides a generic physical layer interface. The PLCP is different for different line rates and sits directly above the framing and line interface hardware. Integrated circuits are already available to perform these last two functions.

The fields of the headers and trailers added in the topmost layers are compatible with those described in 802.6 and so include the latter's provision for extensions to the protocol.

3.2 SMDS in Europe

Europe has a different connectionless MAN standard based on 802.6, the CEPT G.703 standard which supports different data rates to SMDS (E1 and E3, 2Mbps and 34 Mbps respectively) and so would require different physical and PLCP layers for SMDS to be able to run over it. European 802.6 trials are imminent in countries as diverse as Finland, Austria, France and Hungary.

3.3 Future Developments

The RBOCs plan to offer SMDS on a commercial basis from the third quarter of 1992 and trials are currently underway within most RBOCs. SMDS is to be offered to customers at the lowest, DS1 data rate of 1.5Mbps. At this data rate, some workstation applications might use an entire T1 line and direct connection is an option, rather than via a bridge or router. The next higher data rate, DS3 (45Mbps), is already becoming widely used in the form of T3 trunk lines supporting SMDS and might be utilised by for example a supercomputer as a single connection, otherwise fractional T3 lines might be leased for bridging and routing between backbone LANs and FDDI networks.

SONET rates (155Mbps) are already being discussed and trunk lines with these rates will probably be seen well before the end of the decade.

4 Competing Technologies

4.1 Frame Relay

Frame Relay is, unlike SMDS, connection-oriented (point-to-point). It has gained market share recently by offering an immediate solution to demands for MAN connectivity in the US and works over leased T1 lines which are divided into 64kbps (basic rate) channels which can be combined up to the 1.5Mbps primary rate of the whole T1 line. However, Frame Relay is only currently defined up to 1.5Mbps and there is no obvious migration path to the addressing scheme for B-ISDN, E.164.

4.2 FDDI

FDDI is becoming well established in the backbone LAN and high performance workstation interconnect markets but is more a complement to SMDS than a competitor because of the 100km limit on network size and the lack of any expansion path beyond 100Mbps at present. Whereas FDDI will begin to supplement LAN technologies such as Ethernet on campus scales, SMDS will probably emerge as distances increase to take in LANs/MANs in different cities.

5 Hewlett-Packard Laboratories and Interop '90

At the Interop '90 trade show on computer networking and interoperability in San Jose, California, in October 1990 four of the RBOCs provided a large demonstration booth show-casing SMDS publicly for the first time. Hewlett-Packard Laboratories participated in this by providing a workstation DS1 interface to SMDS — a single CPE — allowing a Hewlett-Packard workstation to act as a router and server for an HP AIMS (Advanced Image Management System) client talking via SMDS to another similarly equipped workstation in Atlanta, Georgia. Colour images were retrieved from the server in Atlanta in real-time with no discernible increase in the delay that would have been apparent had the server been sited at the booth:

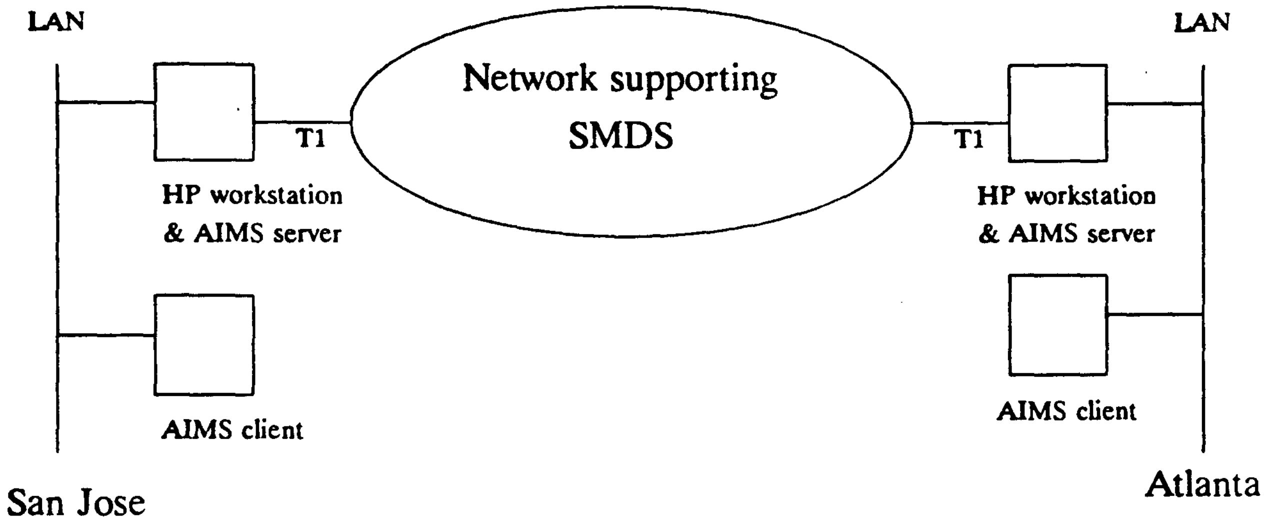

Fig. 4: SMDS at Interop '90

The workstation interface performs the functions of layers 1 and 2 in hardware, with the segmentation and reassembly of data, layer 3 and all management functions performed in software. The routing is a 'free' by-product of using a workstation as the platform. A workstation DS3 interface to SMDS would almost certainly require that segmentation and reassembly be done in hardware.

6 Conclusion

Although it is an unfamiliar acronym now, by the mid-nineties SMDS will have changed the face of public data networking in both the US and Europe. The RBOCs estimate that by the year 2000 the market for SMDS will be worth close to one billion dollars annually. The question will be not 'Will SMDS establish itself?' but 'How will SMDS migrate towards B-ISDN?'

7 References

1. IEEE 802.6 Standard, "Distributed Queue Dual Bus Subnetwork of a Metropolitan Area Network", January 1991
2. Bellcore Technical Advisory, "Generic System Requirements in support of Switched Multi-megabit Data Service", TA-TSY-000772, Issue 3, October 1989
3. Bellcore Technical Advisory, "Local Access System Generic Requirements, Objectives and Interfaces in support of Switched Multi-megabit Data Service", TA-TSY-000773, Issue 2, March 1990