Satellite-based Networking for the Enterprise

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Abstract: This paper describes a satellite-based solution which employs the SCPC/DAMA VSAT based networking system capable of providing a wide variety of communication services for extended corporate network. With an IP multicast-enabled satellite overlay, an ISP could roll-out advanced services, improve network response time, provide customized service offerings and increase revenue.

Key-words: SCPC/DAMA VSAT, Satellite-based network, Internet Service Provider (ISP), Quality of Service (QoS)

1 Introduction

There are major challenges to providing reliable, cost effective and efficient data communication for businesses [1-17]. With the paradigm shift over the past ten years from centralized host computers to a network of distributed servers and their clients, effective data networking has taken on whole new degrees of importance and meaning. In many instances these new requirements can't be met with terrestrial communications. Sometimes there is no terrestrial network connecting the required locations. In other instances expensive, budget-challenging, dedicated lines are the only alternative. In still other instances there is a lack of bandwidth or the necessary interconnecting topologies are not available. Furthermore, big data volumes are in — and will continue to grow.

Most of the traffic (approx. 80%) is pulled from a relatively small number of server sites (20%), and the typical ratio of data leaving a server versus data entering a server is 10:1. Traditional terrestrial connections do not support this asymmetric traffic loading, but satellite does [18]. Outbound 2Mb/s carriers can be coupled with low speed (4.8 - 64 Kb/s) inbound connections. (The inbound circuits are used for query data, interactive sessions or protocol support — implemented as simplex circuits to save satellite bandwidth and power.)

A satellite-based solution can bypass terrestrial infrastructure and make direct connections between users and the host server. Satellite is also the answer for the increase in voice and video applications over IP. As users try to use the Internet for these services, they quickly find inadequate bandwidth, resulting in low service quality. By setting up private intranets using satellite, these applications can be implemented quickly and over very large geographic areas, with very high quality of service (QoS).

2 Internet and Multimedia by Satellite

Satellites are ideally suited for interconnecting widely dispersed servers and for providing local access points to the high-speed Internet infrastructure located thousands of miles away [19].

In SCPC/DAMA VSAT System (Single Channel per Carrier/Demand-Assigned Multiple Access), connections are made on a point-by-point basis between any two nodes in the network using SCPC carriers. These connections are made basing on user demand with key attributes like service type and transmission rate pre-defined [20]. The overall control structure is similar to the VSAT (Very Small Aperture Terminal) system in that the allocation of the resources, service attributes, and the administration of the system are provided by a central controller. Communication between the remote terminals and the control site use the same TDM/TDMA (time division multiplexing/time division multiple access) VSAT type channels but at low data rates (like 19.2 Kb/s) since only control traffic is carried.

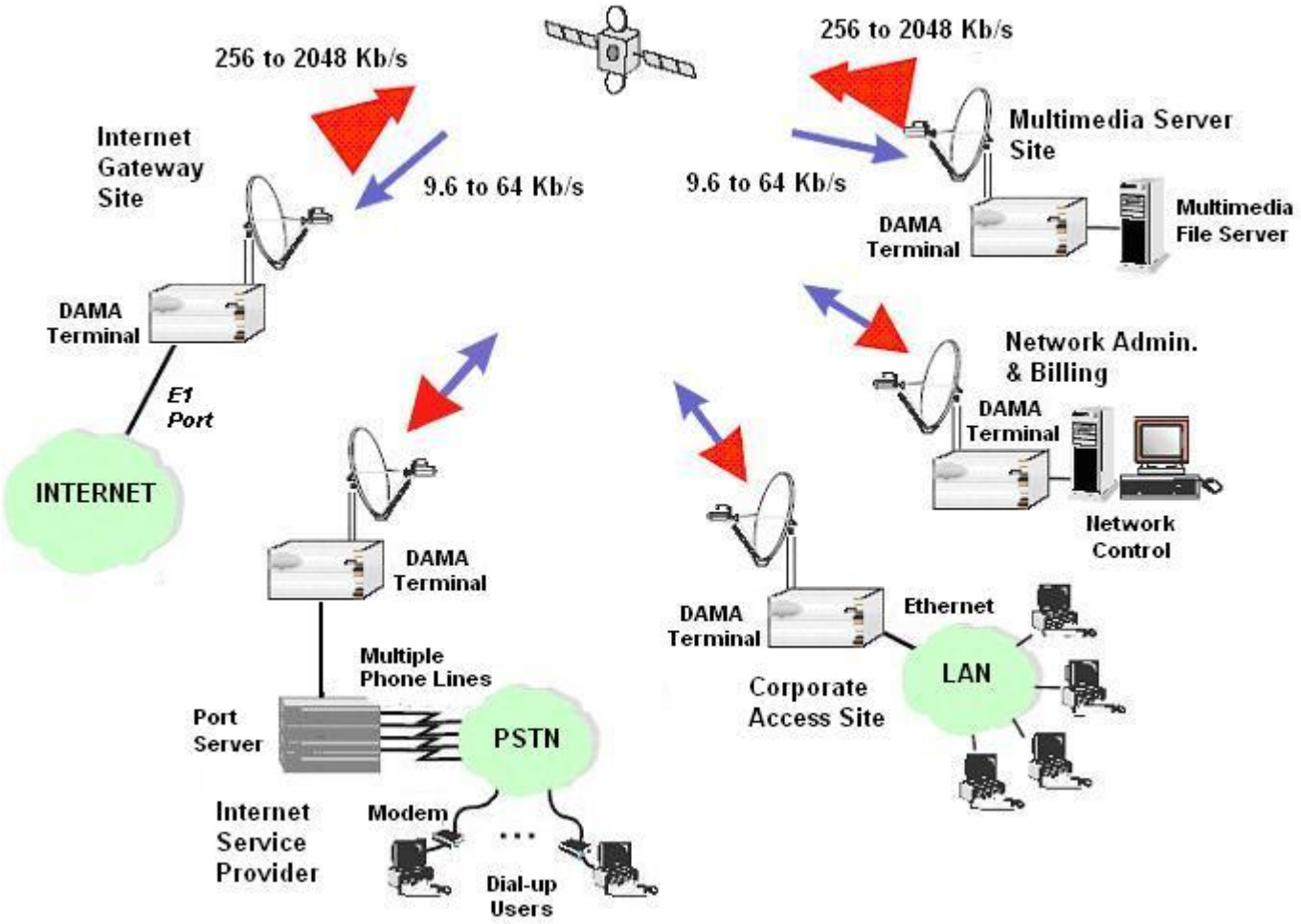

Figure 1. SCPC/DAMA Based Multimedia Network

The key distinguishing feature of SCPC/DAMA is that the service connections are made directly between any site in the network. These connections can also be full-duplex equal rate, unbalanced rate or even one-way broadcast or multicast if desired. Figure 1 presents a multigateway and multiserver network for Internet and multimedia clients located at various types of sites. The Internet outbound channel now operates at rates of 256 to 2,048 Kb/s, so throughput can be up to eight times faster than the VSAT approach. This wide-band one-way channel is shared among all Internet user sites. If even greater capacity is desired, then multiple 2Mb/s carriers can originate from the Internet gateway, with traffic load balancing among the carriers. Higher speed means faster response times for the end-user. Furthermore, these large capacity channels are time shared among all users in the network, so users are charged only for the portion they use.

To complete the service connection, a return link is established from each remote site. Since this channel services only one site, the data rates can be much lower. Depending on the traffic loading at the user site, data rates can vary from 9.6 to 64 Kb/s. With low speed return channels, very low power (1/4 and ½ watt) RF equipment can be used thereby decreasing the cost of the DAMA terminal significantly.

The transport channels are just a portion of the solution however. At each user site, the data needs to be routed and interfaced to the end-user LAN, POP port server or individual work station. By integrating the remote router function into the terminal a number of benefits are derived. Equipment costs are lowered, end-user equipment is directly connected to the DAMA terminal, and installation and maintenance costs are reduced.

Special processing can be implemented in the integrated router function such that TCP/IP operates more efficiently. When transporting TCP/IP over satellite channels the throughput capacity is limited due to the increased transmission delays. Using special processing techniques, this limitation can be mitigated permitting throughput above the approximate 400Kb/s capacity ceiling. With special attention to design, this compensation can be implemented transparently with no impact on user applications.

Using special compression techniques the return channels can be implemented with lower bandwidth than typically needed while supporting the higher outbound capacity. Further performance gains can be achieved by tightly coupling the IP routing function with DAMA. Return channel capacity can grow as necessary to very closely match the demand at any one site.

With DAMA, the return channel can be implemented at a nominal rate of 19.2 Kb/s for example, and when loading increases, a second higher speed channel, say 64 Kb/s can be established without user or operator intervention. If demand increases yet further, then the first channel can be re-established at a higher rate. This bandwidth growing technique exists in some flavors of remote access routers used for terrestrial dial-up networking. Coupling this feature with DAMA satellite channels makes for a very powerful, yet cost effective networking solution that goes far beyond existing satellite-based networking solutions.

With the flexibility of the DAMA system architecture, a single network can be put together that can provide both public access (e.g., Internet connections) as well as private enterprise-wide intranet (e.g., file servers, multimedia servers, etc.). Users sitting at terminals connected to the LAN at the corporate access site can launch a Netscape browser to surf cyberspace or run FTP (file transfer protocol) to download an assortment of files off the distant multimedia server. Furthermore, other types of services can be added to the DAMA terminals to provide telephone, fax, and video conferencing connections. When needed, the infrastructure can grow far beyond the initial networking application to meet a host of other communication needs.

In DAMA system, the network billing and system administration functions can be located at any site in the system, unlike the VSAT system where it must be located at the hub. This is significant if the network is being operated by a provider who has all gateway nodes located on customer premises.

3 Objective

The main objective was to set up a flexible, open and cost-effective SCPC/DAMA VSAT networking platform oriented to videoconferencing via satellite, business video, intranet and internet data services. The solution should provide centralized network monitoring & control as well as centralized session accounting system.

4 Requirements

A broadband satellite communication network should provide a flexible and cost-effective solution for the IP data, video and telephony connectivity requirements. The enterprise's needs includeed LAN connectivity (IP data), Internet access, file transfers, telephony and video conferencing.

5 Satellite-based Network Solution

The network architecture comprises the following components:

- PolarSat's FlexiDAMA using SCPC/DAMA satellite access technology to provide full mesh circuit and packet switched connectivity with dynamic in-circuit bandwidth-on-demand to provide maximum flexibility and bandwidth efficiency [21]. The FlexiDAMA unit (FDU) contains a DAMA Controller Card (DCC) along

with one to six Voice Channel Units (VCU) or Data Channel Units (DCU). The FDU interfaces, on the satellite transmission side, at 70 MHz or optionally at L band. The DCU card handles synchronous data from 9.6 to 2048 Kb/s, low speed asynchronous data (1.2 to 28.8 Kb/s), or direct 10BaseT Ethernet data on a single card using common hardware. The VCU handles 9.6/16/32 Kb/s for voice and inband fax/data. User applications serviced by FlexiDAMA systems ranges from simple telephone connectivity to complex intelligent data services such as LAN/WAN and Internet access and broadcast applications like video-conferencing and distance learning. FlexiDAMA supports voice connectivity using VoIP or analog circuit-switched connections.

- PolarSat's SkyIP is a low cost terminal option for remote sites when a single IP or serial data connection is required [22]. It integrates the satellite modem and router/bridge function to provide a very low cost unit. SkyIP units provide both SCPC/DAMA and BoD (Bandwidth on Demand) to efficiently use satellite bandwidth and reduce operating costs.

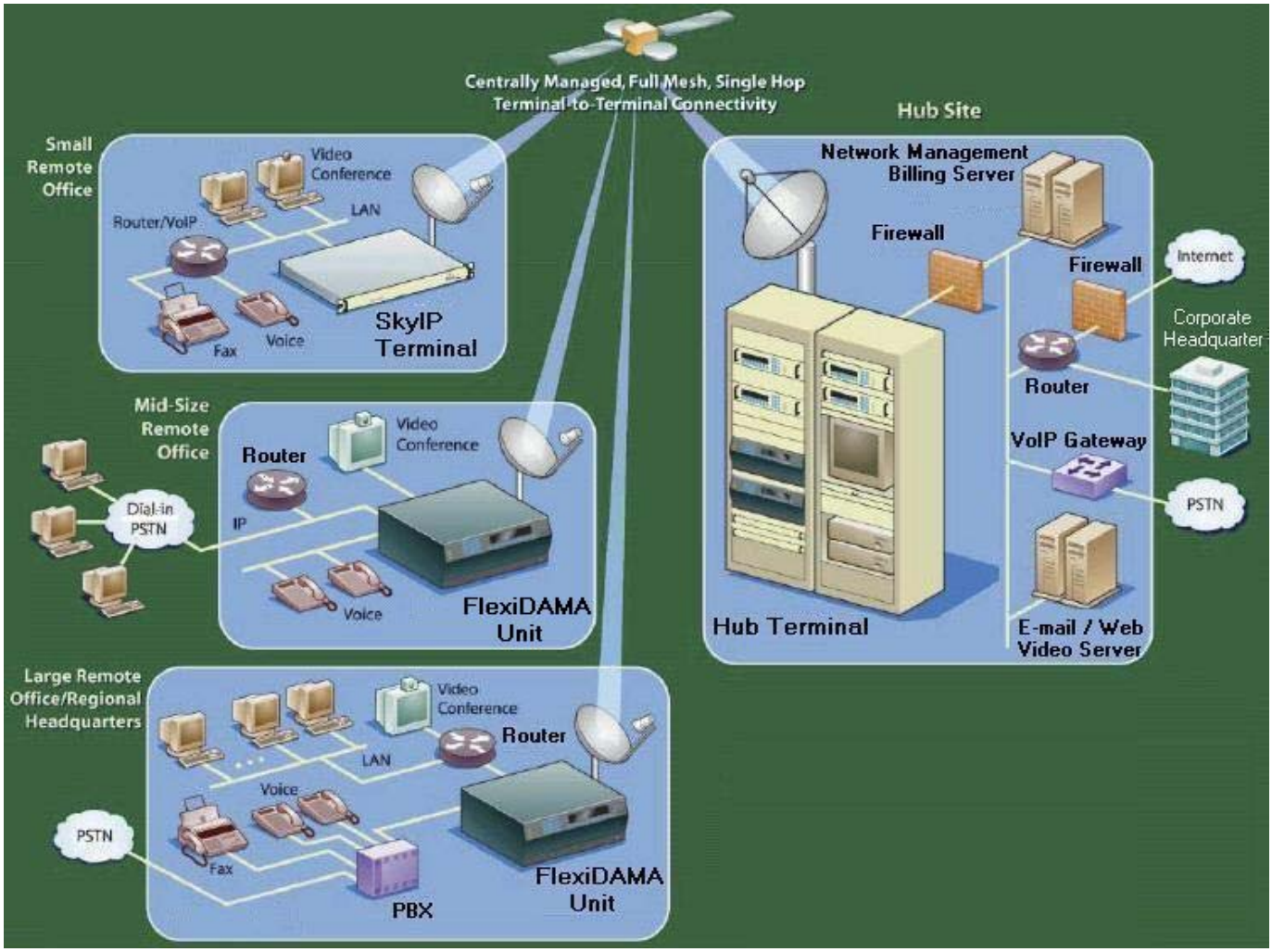

Figure 2. Deployed satellite-based communications network

Remote sites contain FlexiDAMA or SkyIP terminals, as shown in Figure 2. SkyIP terminals provide a low-cost solution for single IP connection to a remote site, while FlexiDAMA Terminals allow more flexibility in making connections anywhere in the network. FlexiDAMA Terminals are required when more connections to other sites, more data types or analog voice circuits are needed.

The modular FlexiDAMA architecture not only supported easy network expansion but also offered an integrated network of physically independent sub-networks with a shared hub. Each sub-network could be assigned a separate computer to support the DAMA call processing functions of that particular sub-network. Intra sub-network communication could be authorized or prohibited by the network manager at the Network Control Center. This resulted in a cost effective initial capital investment.

6 Conclusion

Deployed SCPC/DAMA solution brought a new dimension to client-server networking. It's fast access and high transmission rate capability provided performance to users that could surpass the "plugged-in" world of terrestrial networking. Advanced capacity management provided a higher level of service reflected by quick responsiveness even during peak usage times, an attribute that is difficult to achieve in the traditional wired connections. The high degree of flexibility in making connections anywhere in the network gave users essentially transparent high-speed access to multi-site servers. Service provider could offer higher service quality levels to clientele, yet did so at reduced operating costs thanks to intelligent DAMA networking.

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