Adirondack Area Network

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AANet

A Brief Overview

The Adirondack Area Network (AANet) originated as a community network initially funded through the 1995 New York State Advanced Telecommunications Project (NYSATP). AANet is a rural community network utilized by various types of institutions.

The outcomes are extremely diverse in the AANet partnership. Some specific examples of programming over AANet are:

• The Adirondack Economic Development Corporation plans to deliver live interactive entrepreneurial training over line. This 60 hour seminar on entrepreneurial training can be attended in a multi-point interactive video conference available throughout the Adirondacks. It is designed primarily for persons who wish to start a small business.

The AEDC currently serves as an Entrepreneurial Assistance Center for the Empire State Development (ESD) and offers assistance in

Business Start-up Procedures
Business Plan Development
Accounting and Record Keeping
Government Assistance Programs
Basic Management Techniques
Sales and Marketing
Financial Management and Controls
Accessing Financial Assistance

The goal is to deliver all of these programs via AANet saving time and money.

• Shared services for small businesses give rural businesses access to markets they could not reach otherwise. For example, it is not cost effective for every small business in the Adirondacks to have their own web server. Through AANet, small businesses share a single server and if needed may migrate to their own servers.

• Certification in specialties such as physical therapy, special education, or occupational therapy is available on line. These programs allow specialists to renew certification, obtain certification or to upgrade skills. In some cases, state wavers to allow uncertified professionals have been granted because there are not certified professionals in the region. By offering certification over line, the Adirondacks benefit by enhancing available professionals in the region and attracting new professionals who would otherwise not locate in this remote region due to the lack of programs available for continuing professional development.

• In 1997, the Adirondacks suffered a devastating ice storm. It became clear that an integrated network like AANet is an important tool that can speed disaster recovery. The video sites are used to coordinate recovery teams, offer on-line interactive question and answer periods, provide on-line form preparation and a host of other activities. Since most of the infrastructure supporting AANet is buried, only one video site lost its AANet

connection during the ice storm even though telephone communication was severely crippled.

• The medical centers have embraced AANet and have held many on-line events including (but not limited to): ethics committee meetings, telemedicine, teleconsulting, teleradiology, telemedicine committee meetings, on-line minimally invasive surgery, grand rounds, mini-meds and National Board of Medical Examiners meetings. Dr. Timothy Johnson, generally known for his medical commentary for ABC news, mediated a 3 day conference over line in the fall of 1997.

• The K-12, BOCES institutions and The ARK are offering educational programming including (but not limited to): School to Work Program (see the URL http://neric.org/fehb/aanpict.htm), distance learning, teacher training, on-line administrative meetings, and superintendent's bi-weekly meetings. Loretta Long, Susan from Sesame Street, offered interactive courses for educators utilizing AANet.

• Higher education institutions deliver on-line interactive distance learning credit and non-credit bearing courses. Recertification and continuing education for pharmacists, nurses, occupational therapists, physical therapists and athletic trainers are or offered on-line through AANet.

• Cultural events are broadcasted live. The Little Theater at The Sage Colleges hosts the New York State Theatrical Institute's performances in Troy, NY, and hopes to broadcast some of these performances.

• In August of 1999, The St. Regis Mohawk Tribe was connected to the AANet. They plan to offer educational programs related to Mohawk culture and history. In addition, they plan to utilize their video conferencing equipment for telemedicine.

• The North Country Legal Services, the Rural Law Center and the Albany Law Science and Technology Center utilize AANet to explore legal issues and offer legal services to their constituencies.

The sampling above epitomizes the applications that are either established or in progress. While this network has only been in full production since September 1997, the programs are already extensive. The creativity of a diverse set of institutions bestowed with a new and exciting tool at affordable rates has been phenomenal. With the addition of new members and further diversification, we expect continued innovation and collaboration. As AANet continues to expand, the cultural, educational and economic enrichment of the region escalates.

The applications in a successful rural network must all run over one wide area network (WAN) with inexpensive lines. It is not cost effective to install parallel networks. Entrepreneurial training, business communications, telemedicine, distance learning, links to libraries, LAN/WAN connectivity, PBX cascading, internet connectivity, web services and a host of other features are all obtainable through AANet. Another advantage of an integrated community network like AANet is that new relationships develop between institutions that would not normally occur. For example, clergy in the Adirondacks conversed with Dr. Timothy Johnson and other medical professionals during an on-line conference sponsored by Albany Medical Center concerning medical ethics and the right to die.

The physical network provides connectivity for a wide range of institutions primarily via frame relay technology with bandwidths from 56 kbps to 1.5 mbps. Two 45 mbps connections are used at the hub of the AANet. The full structure is a ``hybrid cloud'' including ATM, point-to-point lines, POTs and satellite downlinks. Members may utilize any internal network they like, the only requirement is TCP/IP for video (H.323). ISDN is provided as a service to members through video gateways to ISDN providers. H.323e and H.320 are supported at the gateways for backward compatibility.

In a typical T1 line to an institution the services are integrated. That is, through one physical connection an institution may obtain several permanent virtual circuits (PVCs) each dedicated to a particular service. For example, Internet connectivity, Distance Learning, institution-to-institution LAN connectivity and administrative are obtained through different PVCs on the same physical frame relay line. Large urban institutions may elect to obtain high bandwidth lines while small rural institutions may elect to obtain lower bandwidth lines. In addition, any member of the AANet may choose their level of public exposure and security by directing PVCs to meet their particular needs. The frame relay cloud is completely routed so partners utilize AANet services seamlessly. This Internet II model accomodates, both the large bandwidth instistutions and smaller institutions desiring similar outcomes on a smaller scale.

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A Historical Summary

In 1994 the concept of a community network throughout the Adirondack region was evolving. Many independent groups were arriving at the same conclusions: even though the enduser outcomes varied, lack of infrastructure and customer premise equipment prevented development of any programs. The announcement of New York State Advanced Telecommunications Project's (NYSATP) Request for Proposals appeared in the same time period. The Adirondack Area Network (AANet) was funded in 1995. Through this initial effort 45 institutions, primarily from remote areas within the Adirondacks, obtained new telecommunications capabilities providing Internet connectivity, distance learning, telemedicine, and other network services. Prior to this effort, network services were almost nonexistent in this region. Due to the lack of network infrastructure, little customer premise equipment existed in the region with almost no technical support. Thus the rapid implementation of the AANet is unprecedented in New York State.

In order to prove the viability of frame relay as an integrated network solution capable of supporting voice, video and data, 5 of the 45 initial sites were chosen as beta video sites. Due to the success of this initial effort, 20 additional video units were connected to AANet in the first year alone. AANet is the first successful implementation of an integrated network supporting data and interactive video simultaneously on a public Frame Relay/ATM cloud. Institutions in AANet receive both video and data (such as Internet connectivity) over a single network connection. Many also have voice over IP and Frame Relay as well. Moreover,the traditional expensive Internet II large bandwidth fiber connections to the institutions an expensive fiber connection to the institution are not required. AANet provides an extremely economical solution in a region accustomed to prohibitively expensive telecommunications costs. This Internet II model design was to accomodate the full spectrum of bandwidth users.

Once the technology was proven, ISDN capabilities were added for backward compatibility and to enable interactive video connections outside the region. Again, due to the innovative network design, ISDN was added as a shared resource reducing the cost to individual institutions. Moreover, for some institutions ISDN is not available at their location. These institutions take advantage of ISDN utilizing ISDN at other institutions via the frame relay cloud.

Numerous grants have been written, many of which have been funded, based on the success of AANet. In addition, funds from private institutions have been infused into AANet. The startup funding initially provided through the NYSATP was more than tripled by 1997. According to industry insiders, AANet is the fastest growing IP network encompassing interactive video in the United States. As a direct result of the NYSATP award to AANet, the region enjoys an economical cutting edge community network.

From its inception, AANet has sought to form a diverse partnership of community institutions. It is our belief that diversity breeds stability in a regional network and we attribute much of the success of AANet to this diversity. The charter members included 2 Boards of Cooperative Educational Services(BOCES), 27 school districts, 6 medical facilities, higher education facilities, 2 free legal aid organizations, The St. Regis Mohawk Tribe, and The Ark (an after- school school in a housing project). In addition to adding more institutions like the charter members, AANet has further diversified its membership, to include government agencies, Planned

Parenthood, small businesses, HIV Clinics, and a host of other institutions.

Because AANet is a routed network, every member can communicate with every other member through the network. This has opened unexpected communications throughout the region. Clergy, the Adirondack Economic Development Corporation, The Department of State, and The Department of Education have conferenced to or from Adirondack Medical Center for example. Adirondack Medical Center is also planning virtual field trips for children attending Lake Placid Elementary School to the Indianapolis Zoo and The Henry Ford Museum. Dmitry Feld of the United States Luge Association is scheduled to speak to children and adults over the AANet about the winter olympics and the luge.

Since AANet enjoys such diverse membership, aside from the cross-discipline program sharing, the technology itself is balanced more efficiently. For example, when many different types of institutions obtain Internet connectivity from a ``reservoir Internet gateway'' through infrastructure that is designed to ``load level'', the Internet bit stream is used much more efficiently. This lowers the cost and increases the level of connectivity to all end-users. Voice over Internet Protocal(VoIP) and Voice over Frame Relay(VoFR) are now implemented over AANet for many of the members, adding to their disaster recovery plans and saving line usage on their standard Public Telephone Company lines. Over-line security cameras have also become necessary with the recent events in the news. In general the resource sharing between the member institutions has decreased costs and increased services for all.

The first network of its kind, AANet has been spotlighted in numerous conferences and publications in the United States and abroad. Due to this notoriety, AAnet has been sought after to work with video conferencing users, video conferencing corporations, network providers and carriers to implement similar integrated networks. The AANet model, technologically, monetarily, and programically has been such a success that in February of 1998 AANet was chosen as one of America's ten best solutions as a rural community network. AANet presented a live demonstration at the ``Connecting All Americans for the 21st Century Telecommunications Links in Low Income and Rural Communities'' conference, where Vice President Al Gore, Assistant Secretary of Communications and Information Larry Irving, Chairman of the Federal Communications Commission William Kennard and Executive Director of the Public Utility Law Project Robert Piller recognized the achievements of AANet and its members. In May of 1998 again AANet and the member institutions were honored in a ceremony in which Senator Majority Leader Joseph Bruno proclaimed: ``*When teleconferencing came into vogue a decade or so ago, it was both expensive and of poor quality, two hurdles the Adirondack Area Network has solved. What's exciting is that what's happening here in the Adirondack Area can happen throughout the country and, in fact, the World. What's happening here this morning is revolutionary.'' Senator Ronald Stafford announced ``The advanced high speed technology will improve our rural areas, business climate, enhance health care services and enrich educational opportunities by linking the North Country and New York Capital District through an interactive community network.''*

AANet now offers network integration services and hardware in cooperation with industry partners to facilitate multifunctional networks customized to a customer's particular needs. (See the diagram that follows.) The Adirondack Area Network's corporate affiliates include RADVision, Bell Atlantic, ICI, CISCO, REALTECH, Adirondack Cabling Inc., Tandberg, NEC, Vtel, Intel, Zydacron, Vcon, Applied Theory, NYSERnet.

Over the next year the AANet intends to expand within its existing area (a land area twice

the size of the State of Vermont), further diversifying its membership. Extending AANet services to small businesses, government agencies, churches, and community centers is imperative to enhance the network and stimulate the economy of economically disadvantaged regions. In addition, expansion to new areas is a high priority. Our immediate objective is construction of statewide integrated community network that expands into neighboring states. For more information about AANet see our world wide web site at ``www.aanet.org''.

AANet is a 501©3 nonprofit corporation chartered to manage this integrated community network and to offer integration services (including Internet connectivity, interactive video conferencing and voice) and hardware to other nonprofit and for profit institutions.

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A Technical Summary

Groups throughout Upstate New York independently studied telecommunications to ascertain the needs of the region. In 1995 these reports merged to form a comprehensive needs assessment. Internet access, connectivity between institutions, distance learning, teleconferencing and telemedicine were all identified as high priority. Due to the economically disadvantaged nature of the region and the vast distances involved, a high bandwidth network dedicated to high quality video was immediately dismissed as too narrowly focused and too expensive. Even parallel network models such as ISDN for video and point-to-point connections for IP traffic was cost prohibitive and lacked the flexibility that a community network requires. Satellite up and down links presented many problems in addition to the obvious high costs involved. Multichannel video systems require point-to-point T3 lines or SONET technologies and as a homogeneous model certainly would not be affordable in this region. Frame relay is economical and can guarantee the bandwidths necessary for high quality video using Permanent Virtual Circuits (PVCs). Moreover, since frame relay connections with bandwidths as low as 56 kbps are available, institutions who can only afford low bandwidth connections can be served. Since frame relay was the only available technology capable of supporting an integrated rural community network at affordable prices, AANet adopted frame relay for its WAN yielding an Internet II model for all types of endusers.

Several Virtual Private Networks (VPN) exist in AANet frame relay cloud for general use by the community. For example, Voice over IP, video conferencing and Internet connectivity all are separate VPNs. The video network is a binary star topology with two 45m/s frame relay lines acting as hubs at The Sage Colleges and Albany Medical Center, respectively. These hubs are being connected privately via ATM. Access to the Internet is also accomplished via a binary star topology utilizing gateways to our Internet providers, NYSERNet and CMA. Video is carefully isolated from all other VPNs; that is, video PVCs are disjoint from data PVCs. Actually, since video is encapsulated in TCP/IP or H.323, video traffic is also TCP/IP data in our network so it is a misnomer to refer to a video network in the AANet. It is, however, convenient.

Each site is connected to the AANet frame relay cloud via a router. The serial (or, in the case of T3 connections, HSSI) interface is subdivided into subinterfaces, one for each data-link identifier (DLCI). DLCIs supporting video are assigned a committed information rate (CIR) of 512 kbps and DLCIs supporting data (eg. Internet traffic) are assigned appropriate CIRs. It is not necessary to set the CIR for a video DLCI at 512 kbps since a video call at 384 kbps utilizes about 460 kbps in the WAN, but this is the nearest CIR offered above 460kbps. The sum of the CIRs for data DLCIs on a circuit should not exceed the difference in the port speed of the circuit and the bandwidth required for video. As a matter of policy, the excess burst rate B_e for a DLCI is set to the same value as the CIR for that DLCI.

Legacy video room systems are connected directly to a Video Interface Unit (VIU) manufactured by RADVision. There are two types of VIUs. One is ``pure'' H.323. The other type of VIU (using H.323e) encapsulates the H.320 video stream in TCP/IP. In conjunction with Video Gateway, also manufactured by RADVision, these VIUs establish the connection over the TCP/IP network. The VIU also buffers the video data to compensate for latency on the network and provides the clock to the Codec. Desktop units employ either a software only solution or require a Video Interface Card (VIC) depending on the type of Codec used. Many codecs now supply a pure H.323 signal, eliminating the need for a VIU with these systems.

The Video Gateway performs PBX type functions for the video network. Each VIU is assigned a four digit extension (analogous to a four digit extension assigned in a PBX) and an IP address. They are ``registered'' with the Video Gateways. The Video Gateway resolves these extensions into IP addresses and enables the network connection between VIUs. Each Video Gateway on the network is also assigned a three digit ``exchange'' and an IP address. These gateway ``exchanges'' are also resolved into IP addresses by the Video Gateway. As a result of these mechanisms, a user ``dials'' what appears to them to be a telephone number in order to establish a connection to another video unit. To connect to a unit associated with the same Video Gateway as the originator of the call, the four digit extension is ``dialed''. To place a call to a unit associated with a different Video Gateway, a seven digit number is ``dialed''.

Utilizing a WAN module in a Video Gateway, ISDN calls can be placed from any video unit in the AANet frame relay cloud even if ISDN is not available at that location. For example, a user at Adirondack Medical Center can seamlessly place an ISDN call through ISDN lines attached to a Video Gateway at AANet's Network Operation Center, even though the two institutions are 150 miles apart. A connection is established between the VIU attached to Adirondack Medical Center's Codec and AANet video gateway over the AANet's frame relay cloud. The ISDN call is routed through this connection. The user at Adirondack Medical Center``dials'' the service on AANet's Video Gateway. For example, for them to obtain an ``outside line'' at a line rate of 384 Kps, they simply dial 9-1-area code-phone number. It is just like their usual phone calls. Technologically the 9 tells the RADVision Gateway ``do a line hunt for six 64Kps channels on the PRI lines, bond the channels, and complete the video call to the given ISDN phone number''. Therefore AANet members have connectivity to non-AANet members through ISDN lines. Moreover most AANet memebers do not have ISDN locally, yet obtained this functionality seamlessly via their Frame Relay/ATM connections. They need not worry about IMUXs, SPIDs, changing physical lines, etc. The process is completely automated.

In the previous example the ``9'' is a service that is defined on gateways. Other services are defined as well. A phone number that is preceed by 8, request the a four channel bonded call to the given ISDN number, a 256Kps call.

Some AANet members desire their own services defined on the gateways and gatekeepers. These institutions have reserved ISDN lines and aservice defined for them. This is accomplished in several ways. The above mechanisim can be used or for maximum flexibility the Radvision gateways also are available with V.35 interfaces. Devices such as IMUXs can easily be attached via these interfaces and new services are defined. In this senerio the reserved service is given only to the institution. A typical dial pattern in this example would be 90 #01115184316530. Here a WAN port on the given AANet gateway whose two digit number is 90 is being requested by the end user. The numbers following the pound sign are passed through the Video Gateway's WAN port to the IMUX. The first three numbers after the pound sign (011 in this example) determine the type of ISDN call being placed (a MUXed call at 384Kps in this case) and the remaining digits are the telephone number of the remote ISDN site.

AANet also utilizes Video Gateways to connect legacy Multipoint Conferencing Units (MCU) to the network. Each port on the legacy MCU is connected to a WAN port on a Video Gateway. In this case, the Video Gateway establishes connections between the MCU and VIUs attached to video units participating in the multipoint conference the H.323 and/or H323e conversions for this MCU.

Pure H.323 RADVision MCUs are also used in the AANet. In this case gateways do not ``front-end'' the MCU ports. These MCUs are IP devices. Notice with the servicing features H.323e, H.323, H.320 devices, and even satellite signals, can seamlessly communicate without the enduser even realizing what type of terminal point they are.

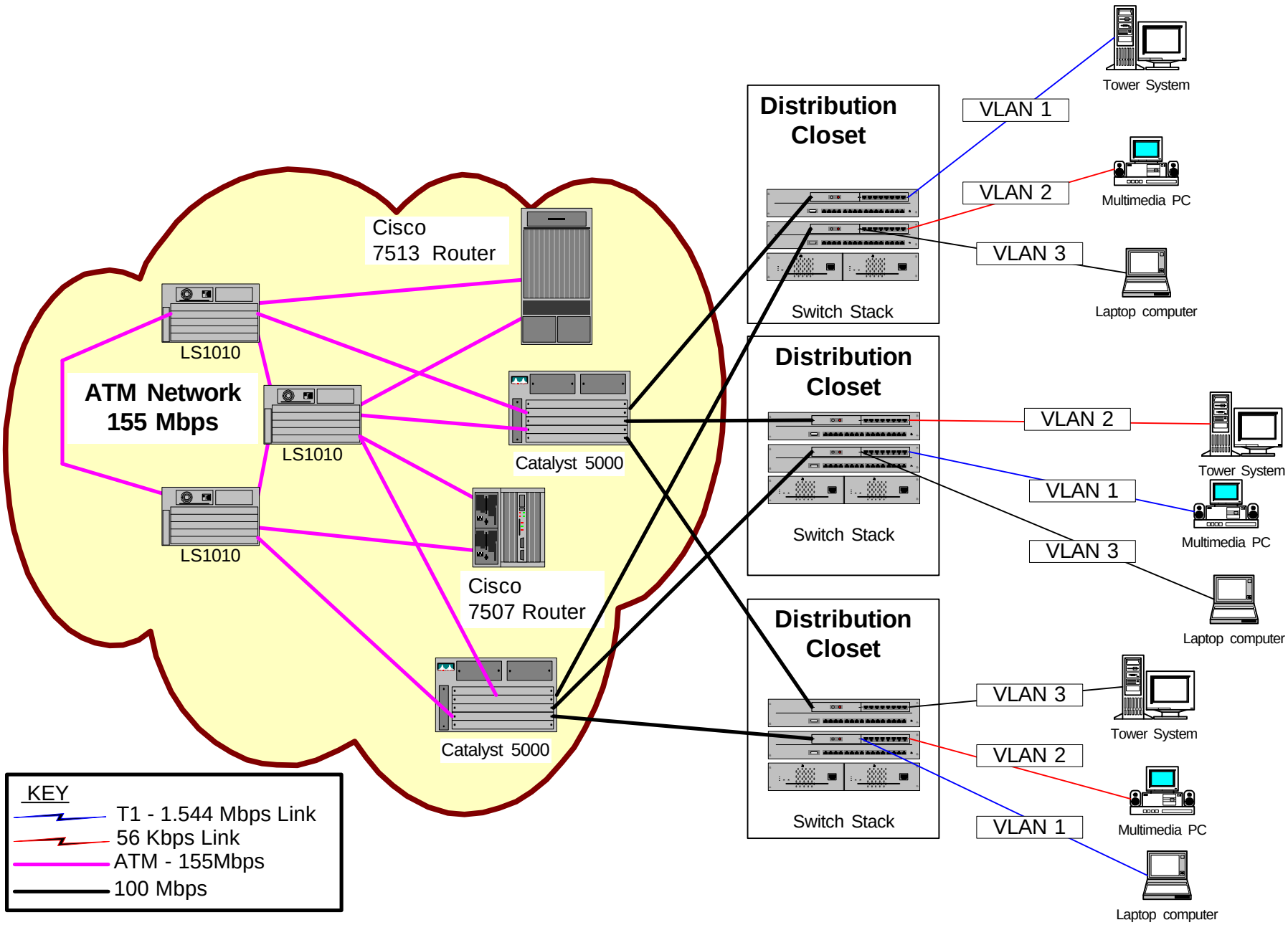
By utilizing a routed protocol for video, users can easily establish connections whenever they choose with any other site. Because frame relay is billed at a flat rate, users can use their video units as much as they like without incurring additional charges as opposed to the typical ``by the minute charges with pure ISDN calls''. This makes it very easy to incorporate network costs for video conferencing into institutional budgets. Since ISDN is incorporated into the network design, connections can be established with sites outside AANet easily and ISDN lines can be shared throughout the WAN. AANet members even use this mechanism to communicate with satelite based networks having these capabilities. A striking example of a mix of H.320, H.323 and Satellite based technologies co-existing in a seamless fashion is the State of Orgeon's On-line video and data services group. Finally, the integration of video, voice and data on a single network alleviates the need for parallel networks reducing costs dramatically.

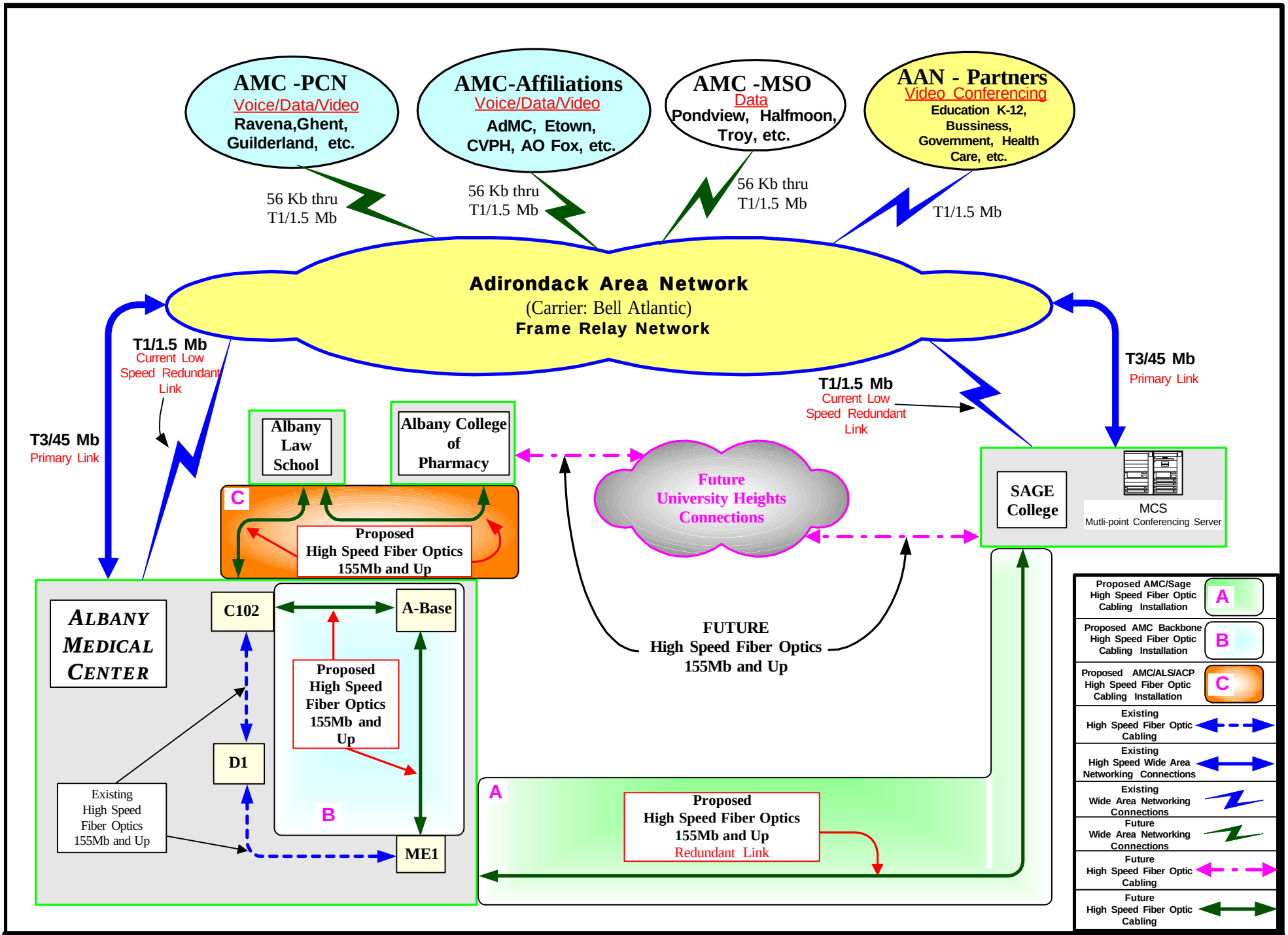
The Radvision Gateways, Gatekeepers, and MCUs provide a host of services to acheive the outcomes of endusers that include (but is not limited to):

- IP to video number translations (both dynamic and static)
- IVR - Interactive Voice Response
- Video Unit Registration
- Centralizing of ISDN (BRI and PRI)
- Line hunt features on the ISDN
- Direct Connect Reserve Services
- No mechanical switching of line media
- DID - Direct Inward Dialing
- Analog phone dial-in to video conferencing units
- multipoint bridging for video and/or phone
- V.35 connections tied to service ports
- Atomatic protocol conversion, including H.320, H.323e and H.320 and analog voice
- all the terminal points in the LAN and WAN see each other with out ISDN, yet have full ISDN capabilities
- Legacy MCUs, Codecs and sattlite signals are intergated into the system
- ``on the fly web'' MCU GUI
- MCU port multipication

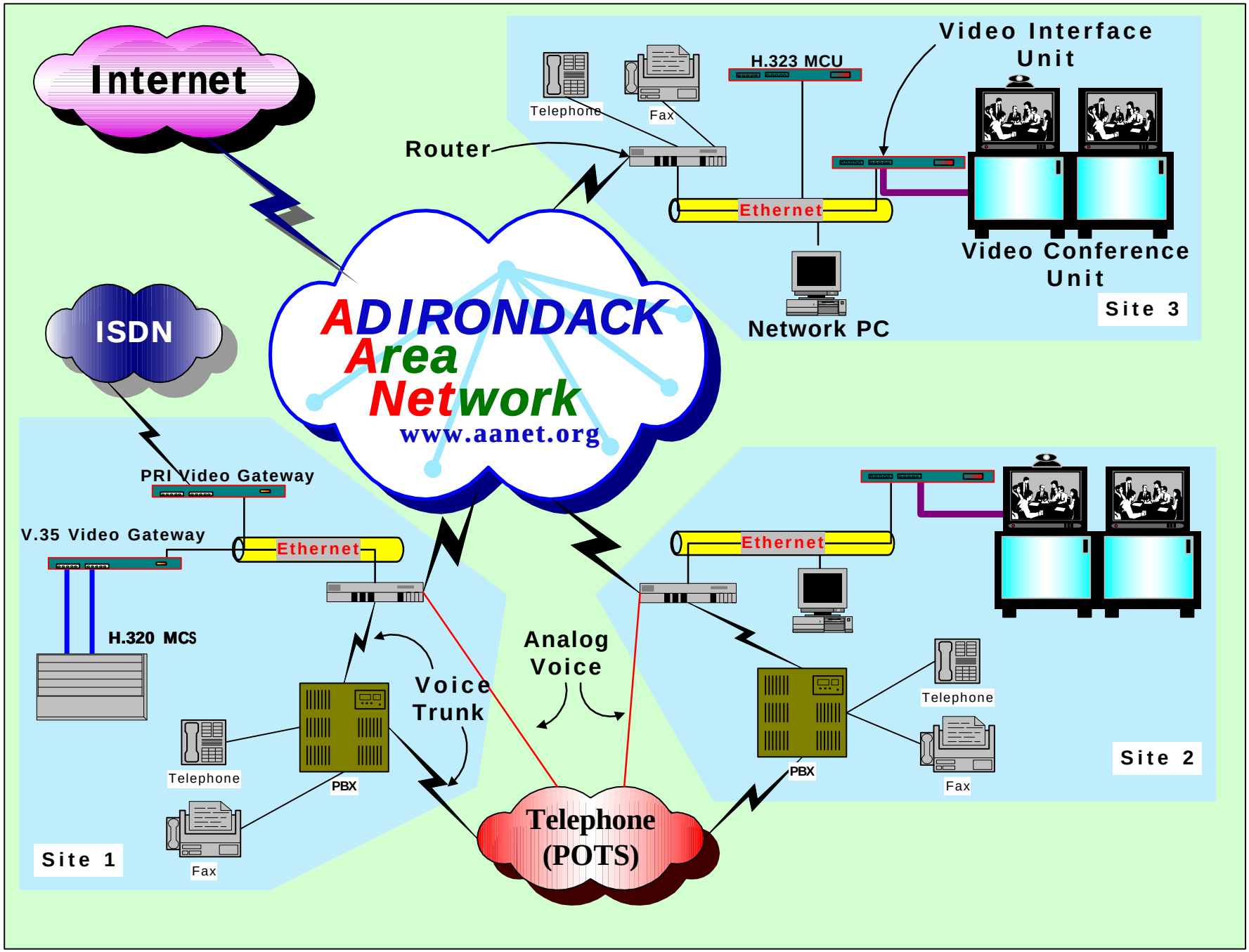
The AANet Network Operation Center has an ATM core. The network diagrams that follow are Albany Medical Centers internal network, the University Heights Association Network (in progress)and a conceptual diagram of AANet Wide Area Network. AAnet's NOC is located at the Sage Colleges and is an integral part of the University Heights Asociation. See our home page at www.aanet.org

Albany Medical Center Local Area Network Links





Albany Medical Center/Sage College/ University Heights Network Connectivity


Internet
ISDN
ADIRONDACK
Area
Network
www.aanet.org
Router
Telephone
Fax
H.323 MCU
Video Interface
Unit
Ethernet
Video Conference
Unit
Network PC
Site 3
PRI Video Gateway
V.35 Video Gateway
Ethernet
H.320 MCS
Voice
Trunk
Analog
Voice
Telephone
PBX
Fax
Site 1
Ethernet
Telephone
PBX
Fax
Site 2
Telephone
(POTS)

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Biography of David C. Bonner

Dr. David C. Bonner has a broad background in science and technology. He holds 3 degrees in mathematics (BS, MA, PhD) and two in physics (BA and MS). He has research projects, or has been a part of research teams, in mathematics, technology, geology and environmental engineering. After he obtained his PhD in mathematics from State University New York at Albany he went to the Australian Nation University Institute for Advanced Studies where he again became interested in new technologies and networks.

In 1992 he returned to the US as a professor at The Sage Colleges. Here he became Chair of The Sage Colleges Mathematics and Computer Science Division. As chair of this division, he and his colleagues developed a network connecting the four Colleges that comprise The Sage Colleges which is now known as SageNet. Under his direction he and the Division began to study various methods of transport and protocols for voice and video along side of data streams.

With high success eminent in this research and development effort, Dr. Bonner decided to develop a ``Human Network'', putting these technological network designs to test. Initially funding from the New York State Advanced Telecommunication Project (NYSATP) was obtained to connect the first 45 institutions and is now what is known as AANet,a not-for-profit organization. AANet is the first Community network of its nature, technologically and program wise. AANet has been recognized as a revolutionary community network by many organizations and persons, including: the US Department of Commerce, the National Telecommunications and Information Administration, The USDA, The Public Utility Law Project, Vice President Al Gore, Chair of FCC William Kennard, New York State Governor George Pataki, New York State Senators, Joseph Bruno and Ronald Stafford, and many CEOs of Technology Corporations.

Dr. Bonner presently serves as President and CEO of AANet and Director of Sage Technology Initiatives. He also serves on NYS Governor George Pataki's technology task force, The Albany Medical Center Telemedicine Committee and The Albany County Fiber Project task force. AANet serve as consultants to many other network groups, including Telgua (the telecommunications and voice network for Guatemala), Oregon EDNet, Questar III, Applied Theory, NYSERnet, Illinois' educational Network, Bell Atlantic Inc. and many hospitals and school districts.