Voice Over IP as a Model for Multi-Services Networking

Outcomes of a VoIP Workshop
Snowmass Village, Colorado
August 4 - 5, 2000

Recommendations to the Higher Education Community

By
E. Michael Staman
Peyton Anderson Chair, Information Technology
Macon State College

October 9, 2000

This project was partially funded by EDUCAUSE and the National Science Foundation, award # 0083358

Prologue

The Internet is proving to be instrument of astonishing adaptability. It continues to create new opportunities, with the ability to support telephone conversations using the Internet protocol as perhaps the most prominent current example. In many companies and on most college campuses making heavy use of the Internet, the same people responsible for the phone system frequently manage data communications. Cost analyses inevitably lead to the idea of using the Internet to supplement or supplant the switched telephone system. .

So why not switch? The impact of the Internet at this point, and the changes that will evolve from the deployment of the next generation Internet, intentional and otherwise, may well be dwarfed by coming evolutions. Rapid technological development and intense competition by telephone carriers will soon make raw bandwidth – the capacity for transporting data – very inexpensive. That in turn will change how we imagine using the network. With the cost of bandwidth no longer an obstacle, larger scale, much more intensive applications will emerge. As the most obvious example, consider the impact in the commodity network when the World Wide Web rapidly accelerated network awareness and network use.

These developments suggest that future campus-networking issues may well quickly surpass those that evolved when VoIP was first contemplated. As an example: the cell phone, personal digital assistants like Palm Pilots, the hand held computer, and very high quality screens are merging into powerful handheld devices combining the functionalities of their disparate predecessors. Concurrently, wireless networks are becoming extensions of the ground-based Internet. The network is evolving into a pervasive resource, and its appliances continue to be generated at a rate inhibited only by whatever limitations exist within the genius of the entrepreneurial spirit. .

And so the participants at a summer workshop on VoIP immediately moved initial discussions about voice to the larger question of multi-services networked environments, and how to plan, deploy, and manage them. The term adopted for this environment is “Integrated Communications Services.” They concluded that there is no doubt that we will be adopting integrated communications services. Users will demand them and vendors will offer them. As with past technological evolutions, the research and education community is likely to shape the evolution of integrated communications services through research, early adoption, and ultimately widespread implementation. .

Implementing ICS on a broad scale is beset with policy, planning, and technical challenges. Many VoIP challenges are the same ones that must be solved for integrated Communications services, so VoIP makes a superb proxy for helping us understand these issues, and that is the motivation for this report.

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Voice over IP as a model for multi-services networking

Introduction

Background

This report has its genesis in a Voice over IP meeting held by Net@EDU in Tempe on February, 1999. Several follow-up events evolved pursuant to that meeting: the creation of the Net@EDU VoIP working group, working group meetings at EDUCAUSE, Long Beach in October, 1999 and at the Net@EDU annual meeting in February, 2000. Funding was then received from the National Science Foundation for a meeting to attempt to codify the status of VoIP and prepare a series of recommendations on the topic to the higher education community. An invitation-only workshop, a "VoIP Summit," was held in Snowmass Village on August, 2000. The list of participants, and co-authors of this report, is presented in Appendix x.

VoIP's evolution to Integrated Communications Services

That the questions to be addressed were superordinate to VoIP became apparent during the early discussions of the Summit. Many (most) topics seemed to transcend VoIP to encompass campus networking as it evolves from today's legacy data networks to an environment that became known as "Integrated Communications Services (ICS)." VoIP, initially thought of as merely running telephones over an IP network, is no longer a technology problem (if it ever was). Rather, it represents a class of business and policy problems that surface as one contemplates an integrated, multi-services networking strategy, and hence the decision to change the name of the project. Early adopters are moving to multi-services environments that encompass voice, data, and video today and that contemplate a rich variety of network-connected devices tomorrow: security devices, environmental monitoring, health care, and the like.

The issue is ICS, and VoIP represents both a proxy for ICS and an early example of issues that will evolve as institutions migrate to a networked, multi-services environment. This document attempts to move the discussion to ICS. VoIP is referenced either as a specific example or, where necessary, as specific content unique to voice technologies.

Purpose of this document and definition of intended audience

Participants at the Summit can be accurately described as early adopters. Most have specific experience in deploying VoIP; all are in the early stages of moving their institutions to multi-services environments of one sort or another.

The intent of the Summit was to create a compendium of experiences, known deployment issues, and recommendations to the higher education community

regarding them. The document is NOT INTENDED to be a technical treatise. To the extent possible this document has been created in a framework focused on the needs of senior management within the higher education community, CIOs contemplating multi-services for their institutions, and the community at large interested in VoIP and Integrated Communications Services.

Although this work began with a focus on Voice over IP (VoIP), it became clear early on that the issues under discussion were broader than pure Voice over IP. A great many of these issues focus on strategies, policy questions, management, technical and operational issues related more generally to the impact of converging communications services. As a result, the focus of this work has evolved to that of Integrated Communications Services (ICS). Voice over IP (VoIP) is but one incarnation of ICS. This paper discusses ICS, generally, with VoIP as a current, specific example of the issues at hand. Elements specific to VoIP are noted in the text.

Positioning multi-services networking

Multi-services will continue to evolve, and campus networks will need to be able to respond. Best effort will no longer sufficient. Architecture will need to incorporate QoS, security, scalability and appropriate network management tools. Campus technology executives will need to understand that levels of expectations for communications networks are increasing significantly, with VoIP as but an early example of the range of services and network devices now evolving.

An Integrated network moves us from silo communications services to presenting our research and education community with an entirely new environment to be exploited. Of no surprise, many policy questions surface quickly in an environment contemplating a multi-services networking strategy

Value proposition

To begin, there will be the fundamental questions central to all strategic decisions: How does the deployment of a multi-services network advance an institution's research and educational mission; how does integration of technology extend the ability to meet other goals; how can ICS be leveraged to best advantage?

Cost is an integral element in any value proposition. The questions will become whether an ICS strategy is less expensive, whether new costs are at the margin or represent new investment, and whether individual costs for one element or another (data costs, voice cost, video cost) is actually more expensive than before, in separate networks. A key responsibility for technology executives lies in the preparation of other campus executives so that they understand what

integrated networks provide. At issue will be the nature of new services to become available, how they differ from those of the past, and how an ICS approach provides universities with technical, operational, managerial, and strategic opportunities which are fundamentally different from those provided by the legacy networks deployed in most institutions today.

Value proposition recommendations:

1. Develop the concept of integrated communications services rather than VoIP. An ICS strategy impacts all university constituencies: university decision makers, faculty, students, boards, the public, executive and legislative branches of state governments.

2. Decide what services will be provided and establish levels for expectations. While seemingly an obvious statement, the key phrase in the preceding sentence is "establish levels for expectations." Then establish performance measures and baseline strategies as the foundations for future management activities, such as cost comparisons, historical analyses, and measuring progress, performance, and achievement of goals.

3. "Homework" on the above issues should include executive-level communications – plans to create such a network, costs, phases, why such services are important. Discussions in the literature regarding institutional competitiveness with impacts ranging from research faculty to student recruitment are on target, and observations that infrastructure is a mission-central resource can be substantiated.

4. Technical analyses should include insuring vendor choices that insure upgrade abilities – technological capabilities, services and standards will continue to evolve in the foreseeable future.

5. Financial analyses need to focus on operational and technical scalability. In the case of ICS, centralized services appear to have such characteristics. Centralization provides stronger foundations for insuring standards compliance, capitalization for future expansion, decreased cost-per-unit services, such as the network operations center and help-desk services, and the ability to achieve critical mass levels for financial and operational support of what is becoming a presumed mission critical resource.

Strategic issues

There are several tasks fundamental to implementing any strategy of significance, and Integrated Communications clearly falls into the "significant" category. Although they are often discussed in specific contexts in other places

in this document, they are identified here because of they are critical success factors. They go directly to the question of timing, strategy and communications -- when is the right time to begin migrating to a multi-services environment, how should the services be positioned, and who should be involved in the process?

Strategic issues recommendations:

6. Create strong consensus. Integrated Communications Services impact every institutional constituency.

7. Engage well-defined risk management and risk mitigation strategies early and often during the process of evolving into a multi-services environment.

8. Build robust, easy-to-understand models (many models) and roadmaps.

9. Insure that investment strategies have clear, well-understood options in the cases where there are multiple paths to a given goal.

10. Insure that strategies include processes for continual monitoring of the marketplace – technological evolution, vendor offering, and pricing options.

11. Develop strategies grounded in best practices obtained by researching successful efforts by peer institutions.

Operational and lay technical overview

First, from the perspective of voice communications, VoIP represents a new class of device on the network. VoIP increases the mission-critical nature of the data network. This increased level requires more robust technical support and maintenance coverage. Other, non-VoIP devices will follow.

These new devices require careful consideration of existing end-to-end management, interoperability, configuration management, and refinement of the add-move-change process. Issues include interoperability between internal and external campus networks, capital investment cycles of shorter duration than in the past, wireless, and standards (For VoIP, as example, consider researching the literature discussing H.323 Vs SIP).

Services and support

Planning requires an evaluation of the technical requirements of end-user needs and existing applications to ensure that network management tools monitor those functions (such as latency and quality of service). More extensive monitoring to the desktop devices than currently exists in legacy networks may be required.

Compatibility with past features and services is essential. New services and devices must support activities integral to business functions as well as those currently in place, and at the same time opportunities to enhance productivity is clearly at hand. Individual users will be interested in gaining services that enhance business functions as long as existing services are maintained (or acceptable options are presented.)

A mission-critical network requires very robust technical support and maintenance coverage. As the voice and data network converge, so must staffing for help-desk operations. Integrated processes and tools are needed to provide effective help-desk functions for ICS.

Services and support recommendations:

12. Communicate clearly the intent to continue to support existing central features.

13. A customer survey can prove to be a useful communications mechanism, not only to discover existing features, but to determine interest in features which will become possible by the deployment of a multi-services environment. At this point the question goes to fundamental change, and a view of the larger possibilities will become an important part of institutional discussion. The question of working at home, for example, will result in discussions ranging far beyond those required to physically provide and sustain supporting technical services.

14. Evaluate existing tools and processes and consider opportunities to integrate and consolidate to improve help-desk effectiveness.

15. Consideration should be given to overtime, on-call status, improved remote access capabilities. Identify inconsistencies in support levels among various services, and consider strategies for increasing coverage

Safety and security

The most visible topic in this category is Emergency-911 (E911) services. Here is an issue specific to voice services, and which is perhaps the one most commonly discussed (and easiest to understand) in the context of migrating away from legacy voice services. VoIP applications will require implementation of E911 database administration tools capable of accommodating dynamic locations. But mobility also causes a problem because the device number is tied to the unit and not the jack on the wall. Wireless VoIP phones add yet another challenge

Further, there is the question of how to deal with uninterrupted power requirements. Today most PBX systems have a series of wet cell batteries (like automotive batteries) that provide power to the switch. There is currently no standard means to power devices such as IP Telephones across a LAN, and there are significant questions about costs and increased complexities involved in modifying existing data networks. Appendix x contains a more detailed discussion of this question, and the issue is further discussed in the Colorado State study presented in Appendix x.

Safety and security recommendations:

16. Define vulnerability of new devices on the network. If you have not done so already, consider hardened security tools – firewalls, for example.

17. Identify feasible solutions to maximize the effectiveness of E911. Be certain that user expectations match technical abilities. Consider external backup, perhaps strategically placed legacy telephones.

18. Research federal and state requirements as part of the process of developing solutions to safety and security issues.

19. Monitor X11 developments – activities that parallel E911.

20. Develop planning and policy to deal with emergency set locations, and power requirements for telephones and at router, switches and hub sites.

21. Recognize that safety and security includes protecting against physical as well as electronic intrusion.

22. Develop policy to insure investigation of abuse, protection of privacy, integrity of the network and prevention of toll fraud. Denial of service takes on heightened interest in voice environments.

23. For institutions with hospitals, understand the implications of HIPPA – a federal Health Information Privacy Protection Act.

Wireless

Planning for integrated services will provide an opportunity for a comprehensive review of wireless strategies. Wireless is increasingly becoming a primary instrument, and encompasses devices well beyond the voice arena. Consider, as examples, evolutions in laptops, PDAs, and security devices. Here is an opportunity to re-capture the issue as part of a more comprehensive planning activity, and to proactively integrate wireless into multi-services environments.

Wireless recommendations:

24. Include wireless solutions into multi-services environments at the initial phases – places such as concept statements, policy development, and initial technical designs.

25. Then, integrate wireless as "just another element" in an ICS strategy. For example, policy will need to include wireless acceptable use statements, just as AUP statements will be needed elsewhere.

IPv6

Planning for IPv6 is important. Voice will not drive the evolution of IPv6, but other considerations will (Security considerations, Quality of Service, Mobile IP, addressing space). Any strategy that contemplates ICS will need to consider whether or when to deploy IPv6.

IPv6 recommendation:

28. Understand vendor directions, Internet and technical evolutions, where IPv6 Vs IPv4 stands today, and begin building an initial knowledge base about v6.

Gateway to PSTN/PBX

This item is unique to our VoIP example. Institutions will need to interconnect to the larger network, and the question is how. The PSTN, whether an RBOC or CLEC, does not go away because of an internal migration to VoIP. While there may be a choice of service providers, the gateway issue remains in any case. The type of gateway that is implemented depends on the type of interconnect required (VoIP vendor, PSTN and/or PBX).

Gateway recommendation:

26. Reassure the administration that transition strategies include full interconnection to the legacy global voice network.

Management and Policy

Understanding who does what on campus will become even more important than in the past. Internal organizational relations and the services that are provided via legacy voice, data and video infrastructures will be impacted as result of deploying a multi-services network. An effective administration model for integrated services is critically important; the transition plan must be seamless; disruption to existing services non-existent. It has to work, and it has to work right the first time. Tolerances for problems will be much less than tolerances for data network problems, where many users have come to at least marginally

accept expect brief failures from time to time as a necessary cost of having the service. .

The underlying architecture on a multi-services network will prove to be an interesting element of the transition and new operating environment. Given that ICS is based on Internet technology, and further given the questions raised in the paragraphs immediately above, how can a central services focus be maintained? Many of the operational and service elements seem to mandate this, yet the underlying concepts which drove the evolution of today's IP environment in the first place clearly argued for distributed solutions.

Network administration

Acceptable Use Policies (AUP) will extend beyond those formerly developed for data, and will almost surely need to be merged with other internal policies. Soon the issues will extend to include policies for portability and wireless devices. Federal regulations may impact a given campus. A question will be which federal regulations impact which elements of a campus multi-services environment?

Directory services tie into security strategies – how to approach centralized authentication and authorization. The services are integral to how managing access to certificates, setting up the process of "just finding a person," the middle ware that enables interactions within the campus and inter-campus integrated services, and collaboration between intra-campus and external research groups.

Network administration recommendations:

27. Understand the changes that will occur, how change must be managed and proactively get in front of the curve. Build a resource center of models, lists of contacts and develop high-level articles discussing where things are going. Find a way to communicate lists of issues that need attention by units not directly under the control of Information Technology. Develop policy and seek consensus on acceptable use.

28. Research existing models on integrating internal organizations, reporting line complications, staffing changes.

29. Develop an enterprise directory strategy and implement directory services. Carefully monitor the Internet2 project, and try to develop strategies so that they can accommodate Internet2 standards as they evolve. Directory services is one of the elements that must be handled by the central IT. Meet with advisory groups if policy dictates, but assume leadership in this area.

Costs and cost recovery

Multi-services networking applications will require new billing systems and methodologies.

The question of cost recovery relates more generally to the questions of tracking usage, collecting data for analysis and engineering, encouraging responsible use, and billing philosophies and models. Policy issues are well known, representative of cost recovery policy questions everywhere: who pays for what, which services to bill for, how to integrate billing for new services into existing billing schema.

The need to make a business case for multi-services mirrors past needs for campus investments into new technologies. In the case of ICS, there are new opportunities and parameters to consider – merged technologies, merged staffs, new (perhaps multiple) levels of expectations for reliability and service, a significantly changed customer base, merged new and old revenue streams. A key discussion will focus on how to reallocate existing revenue streams (voice revenue, for example). Reallocation to other needs within the university without first understanding the totality of the cost and revenue structure resulting from a multi-services strategy will prove to be a disaster

Examples of cost recovery approaches include the Plant Maintenance and Operations model commonly in use today, whether Integrated Communications Services can be seen as a campus utility model, and the Cable TV cost model – basic service + some tiers + premium services. A common model appears to be migration to a single communications fee sufficient to cover both operations and capital replacement. Whatever cost recovery model is selected, recognize that its underlying assumptions must accurately reflect technical and operations support

Cost recovery recommendations:

30. Be careful not to justify your next-generation infrastructure on cost alone. Consider finding a new way of looking at cost and billing models. In the case of VoIP, for example, the issue is no longer just telephones, but rather an evolving set of new, integrated applications. Generate discussion on both the diverse uses to which the network will be put and the technical and political issues inherent in measuring them (are video bits somehow of different value than e-mail bits?).

31. Monitor new user-selected feature capabilities not previously available.

32. Identify usage metrics for the converged system (bandwidth, connect time, usage of specialized features, etc.). Consider flat-rate billing instead of attempting to bill for various services.

33. Engage campus policy makers in discussions about long-term financial sustainability of various models.

34. Consider positioning multi-services as a university mission service rather than revenue redirection, and develop discussion models containing alternative approaches to revenue streams and resulting support models.

Transition planning

Migration to a multi-services environment should be thought of as deploying a highly visible suite of new services rather than a "behind-the-walls" network upgrade, and institutions should deal with planning from that perspective. Discussions with constituencies will relate to managing costs, risks and expectations, explaining how the transition is consistent with institutional and technology services missions/goals, and discussions about the best approaches – phased Vs a flash transition, for example. The impact on customers will be highly visible. In the case of our VoIP example, issues of coexistence with an existing PBX, how much of the PSTN to replace, and whether to incorporate wireless into the mix will evolve.

Transition planning recommendations:

35. Continue, for however long it takes, the education process that is focused on why this transition is happening.

36. Understand customer and customer needs, well – very well.

37. Develop a migration plan considering end-user expectations for reliability and service, equipment cost justifications, integrated management systems, rate of migration, and the need for parallel operations

38. Compare vendor strategies.

39. Do not promise financial savings -- stress cost avoidance. Develop cost models for each approach under contemplation.

40. Read about and consider implementing change management policies and practices.

Training

Training, specifically cross training, is one of the key opportunities inherent in the evolution to integrated communication services. Rationales for cross training are manifest: costs can decline by having both help-desk and technical personnel crossed trained; response times should improve. Of key importance, as the first

point of contact with much of the user community, multi-faceted, trained individuals should be able to improve customer services levels in the field, in real time, and enhance customer satisfaction in the process.

VoIP is an excellent example for this topic. It will be necessary to define required skill sets needed to operate VoIP applications without regard to existing skills and classifications. Staff with backgrounds in voice communications have skill sets significantly different from those with data networking backgrounds. VoIP will require staff compensation, training, and professional development in new support positions capable of working with converged networks

Training recommendations:

41. Cross training is an important strategy. A policy direction involving multi-services networking requires integration of personnel, not only because of the issues above, but also to demonstrate an operational and services philosophy truly reflective of the implications of a multi-services environment. This area needs to become of the highest priority in order to support convergence.

42. Remember that training options range from internally provided, to vendor supported, to outsourced or purchased materials.

43. Evaluate enterprise circumstances and develop a migration plan to evolve existing staff. In doing so, attention should be given to wage inequities between voice and data staff.

Reliability and availability

This is the “5 9’s” discussion. Availability of services 99.999%of the time. This element of the discussion achieved initial understanding as universities began contemplating VoIP deployments. The principles, however, apply as other elements in a multi-services environment become available – security cameras depending on the network, health care monitoring services, and real-time support for environmentally sensitive research are several examples.

Reliability and availability issues take on heightened importance because multi-services networks impact significantly greater portions of the university community than legacy data networks. Therefore, expectations of service levels will equal or exceed those of current voice systems, especially as networks expand to encompass life- and safety-support services.

Reliability and availability recommendations:

44. Engage the campus community in discussions about the issues: life safety issues, legal issues, environmental protection. Insure that people

are engaged who understand and can discuss questions ranging from requests for wiretaps to responding to lawsuits.

45. Use these discussions as a foundation for a business case to ensure reliability. Investigate power. Look for single points of failure. Investigate reliability features from equipment vendors (redundancy). Design methods to insure full, 24x7 network monitoring … and operations.

Organizational structure

Many enterprises have already consolidated telecommunications and networking functions into the same organization providing common leadership and vision. It is important for "voice" and "data" staff to work collaboratively when designing, implementing, and operating converged networks. The unique value of expertise from multiple backgrounds should not be underestimated when considering organizational change—focus on achieving integration rather than replacing voice or data staff.

Organizational structure recommendation:

46. Networking divisions should be integrated to maximize the synergies of staff working toward common institutional goals. Implement organizational changes before developing an institutional VoIP strategy

Relationship management: regulatory, legal & external forces

Significant relationship issues enter the discussion as the meaning of an ICS strategy begins to become apparent. The item most commonly to this point has been Emergency 911. However, it is likely that universities will find themselves discussing a number of related issues. Examples include the question of becoming a regulated entity (the state network providing telephone services, for example); the question of whether there are legal requirements or liabilities to our institutions that currently apply to voice carriers; whether or how to deal with federal regulations, and things such as wiretaps and security -- with an involvement in a problem dealing with national security not at all out of the question. Current models for interconnectivity with other networks at levels contemplated by an ICS might well include discussions settlement, interoperability, and exchange.

Open networks encourage hacking, with rampant examples based on the Internet. There is little doubt that there will be questions about the hacking issue once constituencies understand the basic technologies underpinning multi-services networks, and hackers who will want to further exacerbate the problem.

Even if all of the above issues are somehow not “real,” and growing consensus suggests that they are, at the least the carrier community will mount the uneven playing field argument – their perceived need to operate under one set of rules while their competition does not.

Relationship management recommendations:

47. Learn about these issues, and engage legal counsel in the process. Contact the FCC for policy documents in these areas. As with the discussions about reliability and availability, insure that people are engaged who have and understanding of legal and regulatory issues, and their implications for a university community.

48. Develop an issues list, including those points appearing not to be issues, but which might require attention.

49. Develop strategies to reduce the perception of threats to external organizations.

50. Spend quality time understanding the new relationships that will impact your services – campus, local, regional and national.

Appendices

A. List of Summit participants
B. Comments on a case study at Colorado State University
C. Comments on uninterruptible power systems

Appendix A
List of Summit participants

Participants List **Snowmass, Colorado**
Summer Workshop on VoIP **August 4-5, 2000**

Institution	Full Name	Email
American Museum of Natural History	Francis C. Lees	fcl@amnh.org
Arizona State University	John S. Babb	john.babb@asu.edu
Arizona State University	Darel D. Eschbach	darel.eschbach@asu.edu
Georgia Board of Regents	Thomas L. Maier	tom_maier@oit.peachnet.edu
Colorado State University	Jose J. Valdes, Jr.	jose.valdes@colostate.edu
Cornell University	Douglas Carlson	dc21@cornell.edu
Dandin Group	Steven Bible	steveb@dandin.com
Dandin Group	Dewayne Hendricks	dewayne@dandin.com
EDUCAUSE	Victoria Beth Fanning	vfanning@educause.edu
EDUCAUSE	Mark A. Luker	mluker@educause.edu
EDUCAUSE	Garret Sern	gsern@educause.edu
EDUCAUSE	Dave A. Staudt	dstaudt@educause.edu
EDUCAUSE	James E. Williams	jwilliams@educause.edu
Georgetown University	H. David Lambert	lambertd@georgetown.edu
Iowa State University	George F. Covert	covert@iastate.edu
Macon State College	E. Michael Staman	mstaman@mail.maconstate.edu
MOREnet	William A. Mitchell	bill@more.net
Nortel Networks	Andrew Thomas	awt@nortelnetworks.com
Northwestern University	Holly King	h-king@northwestern.edu
NYSERNet, Inc.	Benjamin E. Chi	bchi@nysernet.org
NYSERNet, Inc.	Timothy Lance	tlance@nysernet.org
Rice University	Farrell E. Gerbode	farrell@rice.edu
The Ohio State University	Harpal Chohan	chohan@net.ohio-state.edu
The Ohio State University	Russell Morrison	russ@net.ohio-state.edu
University of Iowa	Steve Fleagle	steve-fleagle@uiowa.edu
University of Kentucky	Doyle N. Friskney	doyle@email.uky.edu
University of Maryland	Mark Katsouros	mark@dcs.umd.edu
University of Michigan-Ann Arbor	Cheryl Munn-Fremon	cmfremon@umich.edu
University of Virginia	James A. Jokl	jaj@virginia.edu
University of Washington	Scott Mah	scottm@cac.washington.edu
Yale University	Joseph Paolillo	joseph.paolillo@yale.edu

Appendix B
Comments on an ongoing study at Colorado Statue University
By Jose Valdes
Colorado State University

Colorado State University has several comments based on our current VoIP trial. Please note that although Cisco Systems equipment is being used for the trial, we continue to investigate Nortel Network's VoIP/Convergent strategies. We can ill afford to forget about a $6+ million dollar investment on Nortel equipment. Further, Nortel has a different architectural approach that Cisco that is worth investigating.

Comments:

Services and Support:

We completely support statements on the enhanced mission critical status of the data network, once voice is introduced. We are feeling much more vulnerable carrying voice traffic over the data network than on the legacy voice transport network. The reliability build into the legacy telephone network is time tested and "bullet proof". The data network elements, although supported by UPS devices, have several single points of failure. The most critical single point of failure is the "VoIP server", in our case a Media Convergence Server (MCS) hosted on a Compaq platform. Cisco is recommending either a load sharing or redundant server to enhance availability of the VoIP server.

The VoIP management tool, Call Manager, is functional and "easy" to navigate because of its web-based interface. However, the documentation, especially when compared to that provided in support of the voice legacy systems, is incomplete. There has been a fair amount of trial and error and searching pull down menus to understand the Call Manager functionality. Clearly the approach used is based on the "data network" view of the world versus the telephony view. We have yet to implement a help desk function for VoIP and it is likely that it will remain on the telephony "side of the house".

However, it is clear that NT support will be required from the data networking "side of the house". Although we concur with the integrated organizational approach, that will not happen before deployment of the VoIP technology. Frankly, it is a financial issue affected by the method in which each technology group is funded.

The use of feature codes is nonexistent in the VoIP installation. Features are based on the mode of operation and are accessed using soft keys that are mode dependent. For example, we cannot replicate the Call Pickup feature code in the VoIP environment.

QOS issues have been overcome by setting priority on the switch ports and supporting “nailed” 100 Mbps FDX connections to the IP telephones. Bandwidth does make a difference to performance.

Safety and Security

We are preparing to test E-911 over the VoIP “network” in mid-October. No plans for wireless integration at this time. We discussed the liability to the University and the department in case of an emergency. The University attorney and the police department agreed that 20-30 minutes backup on the VoIP elements is sufficient to report an emergency. We believe that this premise is yet to be tested under “real life” conditions.

Gateway to PSTN

We have elected not to explore a PSTN connection. However, we are interested in Internet2 connective to other early adapters of VoIP. That will happen early in 2001 after completion of the trial phase.

Costs and Cost Recovery

Initial capital costs have been less than for supporting an equivalent number of legacy telephones. However, the VoIP telephones are twice as much as a Meridian (Nortel) feature telephone. Certainly, space and power requirements are less for the VoIP equipment. The “meter” is still running, however, due to the redundancy that we will require to “bullet proof” the data network. The incorporation of power to the IP telephones in the Cisco switches reduces the requirement for an external power adapted and its associated costs. It is the elegant way to power the IP telephones.

We are proposing a MAC address based model for cost recovery. Initially, it will focus on data devices on the network. However, the IP telephones also have identifiable MAC addresses. Thus, we suspect that the long term cost recovery model will be based on MAC addresses. The idea is to ascertain the network services provisioning costs and divide that by the number of MAC addresses per client.

However, we are provisioning only data and voice services under this model. Video services are delivered differently and are charged based on the network backbone connection. We suspect that this model resembles the Plant Maintenance and Operations model. Although not considered utilities, we hope that network services evolve to that stage.

We could expand the model to add “premium services” on top of the basic MAC service charges. We had a difficult time gaining support for the bandwidth charge approach and found the metering methodology ineffective.

Transition Planning

A key factor in a successful migration to the integrated services model. The cultural factor is as important as the technical and/or financial factors. For example, there is genuine concern about the reliability of VoIP and the department staff continues to “make a case” for the unreliable nature of the data network. Just today an outside plant technician reminded me that yesterdays campus power outage did not affect the telephone service but brought down the data network after 20 minutes. “You could have still called mom on the telephone”, was his comment. We estimate a 3 - 5 year migration toward a significant integrated services campus architecture.

Training

Nonexistent!!

We cannot send a technician to Call Manager training and the documentation is “light”. A key miscalculation on Cisco’s part. Even the VoIP telephone user manual is “light” on instructions. Cisco relays overwhelmingly on the online Help utility. However, searching by keywords is not always effective. For example, searching under Speed Dial netted nothing. A search on Services finally netted the details on how to activate Speed Dial service. The users were directed, by the user’s reference manual, to the systems administrator.

We are flying on instruments!

Reliability

All dependent on the amount of redundancy build into the data network and a change in perception on how long dial tone will be available under “emergency” situation. To replicate the “5 9”s will be an interesting architectural and financial exercise that we are just beginning to undertake.

Appencix C
Comments on Uninterruptible Power Systems
By Andy North
Nortel Networks

Today most PBX systems have a series of wet cell batteries (automotive batteries) that provide power to the switch. The normal power source then recharges the batteries so the PBX stays up in cases where the normal power source is disrupted. These batteries not only provide power to the PBX but provide power to the Telephones as well. This power is distributed using an unused pair of wires in the telephone wiring plant. This power is adequate to support the basic features of the telephone, ring, dial, etc. but is not adequate to power speakerphones or other external attachments to the telephone.

There is currently no standard means to power devices such as IP Telephones across the LAN. The standards body is working on a recommendation (today they are entertaining two alternatives-power on the unused pair and power across the used pair) and is expected to reach a conclusion sometime next year. For Universities and enterprises as well, the power on the LAN causes infrastructure problems. In the PBX model power is in a single location and distributed across the wiring plant. This wiring in most cases is a single run from the MDF (Main Distribution Frame-punch down block) in the switch room to the IDF (Intermediate Distribution Frames) in the wiring closets near the phones. There are generally no active devices along the way so it the run is equivalent to a single wiring run from the switch all the way to the phone.

In the LAN case, there is no equivalent single wiring run from the server to the IP Telephone as there are switches, routers and hubs along the way. This then means that you need the equivalent of the wet cells (an Uninterruptible Power Supply) in every wiring closet on every floor of each building that has IP telephones if you want to provide equivalent levels of service. The University of Kentucky has suggested that issue represents an investment of nearly $1M just to acquire the UPSs. Add to this, the need for adequate power in the closet to charge the UPSs and the need to monitor and manage them as elements of the network and you have added more complexity to the data network just to provide service that is at parity with the current PBX.