DEFINING VOIP
VoIP is a technology — not a service. VoIP technology converts analog voice signals to packets, which are routed as data over an Internet Protocol (IP) network without ever having to rely on traditional circuit-switching. By doing so, the voice conversation does not tie up a dedicated path or channel. With traditional circuit-switching, a dedicated circuit is required. In fact, circuit-switching requires the circuit to remain open until the phone call is terminated.

Packets consisting of voice conversations can be sent over the same path as other data or voice packets. Due to the efficiencies of multiplexing inherent in an IP network, a common infrastructure can carry multiple services, including VoIP-based telephone, along with data and video.

FOREWORD

In February 2003, Cox Communications published “Preparing for the Promise of Voice over Internet Protocol (VoIP),” its first whitepaper on the subject. At that time, VoIP technology was still in its infancy and the need still existed to educate industry analysts and media, as well as our peers, on several fronts, including: the state of VoIP technology and its applications; Cox’s VoIP strategy in relation to the circuit-switched technology Cox has deployed since 1997; the anticipated economics associated with VoIP; and the company’s time-to-market plan.

In Cox’s widely published whitepaper, it clearly stated that VoIP held great promise as an upcoming technology, yet it was not quite ready for prime time deployment. Yet, the paper stated, when VoIP is ready for deployment, it would be well-positioned to launch VoIP based on its significant circuit-switched telephone experience. This experience would allow Cox to leverage its telephone back-office operations, network platform and knowledge — without stranding any deployed circuit-switched capital.

Since publication of the first whitepaper, Cox continued its thorough approach to developing VoIP technology. During that time, Cox worked very closely with its vendors in the lab and in field trials to drive the technology toward a quality level that Cox deemed suitable for customers. This effort also involved discussions on the regulatory front with the Federal Communications Commission (FCC), the National Cable & Telecommunications Association (NCTA) and various state regulatory agencies to ensure that the regulatory landscape would meet the needs of Cox customers and the business needs of Cox.

Cox believes that VoIP is now ready for prime time as a complement to its circuit-switched deployments. This whitepaper will provide an update on Cox’s successful deployment of VoIP technology and the company’s telephone strategy.
EXECUTIVE SUMMARY

Cox, the 12th largest telephone company in the United States, has developed significant telephony infrastructure, operations, expertise and experience during its seven successful years of providing Cox Digital Telephone service, which is now available in 13 markets. Cox’s success with circuit-switched technology is evident with more than 1 million satisfied residential customers and more than 100,000 Cox Business Services customer locations. Cox continues to demonstrate strong telephony growth; the company grew its residential telephone customer base by 38 percent in 2003. The fact that Cox is already a major telephone provider clearly distinguishes the company from many of its peers and competitors.

For more than two years, Cox tested and trialed VoIP technology in its laboratories and in field trials. Recently, Cox successfully launched the technology to residential customers in Roanoke, Va., and the company is preparing to launch additional VoIP telephone markets in 2004. Cox’s commitment to customers has driven the development of a more robust VoIP technology that clearly differentiates Cox’s VoIP architecture from many other VoIP offerings currently available in the marketplace. Regardless of the technology Cox provides — circuit-switched or VoIP — the company is committed to providing high-quality, full-featured telephone service to its customers. Indeed, as the competitive, regulatory and technological environment continues to evolve, Cox will leverage the flexibility it has built into its network to remain a customer-driven, efficient and successful provider in the telephone marketplace.

Based on extensive experience with both circuit-switched and VoIP technology, Cox expects the following distinct advantages as the company expands its telephone footprint with VoIP:

- As a successful telecom provider with solid customer growth in 12 circuit-switched markets and our first VoIP market, Cox will continue to extensively leverage its back-office systems, experienced people and processes for further VoIP market launches.

Cox Communications VoIP Whitepaper • May 2004 2
The Cox advantage, in terms of architecture, rests in the fact that it owns and operates its own end-to-end network infrastructure, including a nationwide OC-48 IP backbone network — a key differentiator from Cox’s peers and competitors. This allows us to own and manage the complete end-to-end customer experience including sales, provisioning, transport, billing and quality-of-service (see “Architecture Variations” diagram, page 10).

The regionally distributed architecture provides for an efficient deployment of the technology and its associated back-office operations. It also allows Cox to introduce phone services to customers in markets where the economics do not support the cost of a circuit-switched architecture (see “VoIP vs. Circuit-Switched Cost Comparison,” page 11).

The inherent flexibility already built into Cox’s infrastructure will enable the company to remain a successful provider in the highly competitive, ever-changing regulatory world of telecommunications.

Cox will not abandon its circuit-switched business. Rather, it will leverage the circuit-switched experience to launch new VoIP telephone markets — without stranding the capital it has invested in its circuit-switched operations. Moreover, Cox will have the capability to add capacity in circuit-switched markets via IP transport technology in relation to subscriber growth, when the existing circuit-switch capacity is exhausted.

Cox will expand its phone service footprint via VoIP to commercial customers, thereby furthering its leadership position in voice among its peers in the commercial telecom marketplace.

VoIP will help enable the company to reach its goal of providing a three-product bundle of services in all of its markets. Cox also looks forward to the future integration of video, voice and data into a series of unified communications products and services.

Cox’s decision to use a number of different vendors for its VoIP architecture provided a significant integration challenge. For example, consider the number of equipment types (i.e. softswitch, gateways, CMTSs and MTAs) multiplied by numerous configuration variations multiplied by constantly shifting software versions.

One key to Cox’s successful integration testing was the strong stance it took on software version control. By greatly reducing the number of “moving parts” and only allowing new software versions when it was deemed absolutely critical, Cox was able to make continuous progress towards a deployable solution.

LESSON LEARNED

Cox Communications VoIP Whitepaper • May 2004
INTRODUCTION

Voice over IP technology has arrived. Cox Communications first launched and marketed it as Cox Digital Telephone in Roanoke, Va. in December 2003 — bringing the same high-quality, full-featured telephone service to residents in Roanoke that it delivers to 12 other Cox telephone markets via circuit-switched technology.

Both the technical and operational foundations that Cox has deployed today have been for the sole purpose of providing high-quality, full-featured telephone service — a strategy that differentiates Cox from other competitive VoIP telephone providers. More so, as described within this whitepaper, Cox had the foresight to build flexibility into its architecture. As a result, Cox will have the capability to adapt its telephone product, if deemed necessary by competitive, regulatory and/or technological advancements.

With VoIP, voice calls are digitized into Internet Protocol (IP) data packets and transported in that form over Cox’s managed IP network. Cox’s VoIP solution is based on the technical and operational requirements of an end-to-end, private, managed IP network transport system with full Quality of Service (QoS) that provides telephone service
with enhanced 911 services, directory assistance, operator services, local phone number portability, equal access long distance and compliance with CALEA (Communications Assistance for Law Enforcement Act). This product direction is based on significant market research and Cox’s proven success in providing a quality telephone solution.

COX’S EARLY ENTRY INTO TELEPHONE

No discussion of Cox’s success with VoIP can start without first exploring the company’s success as a circuit-switched telecom provider. Cox has grown from a single-service cable television company into a multi-service broadband communications provider. Via its flexible and powerful broadband delivery network, Cox now offers a number of communications and entertainment services, including analog and digital cable television, high-speed Internet, telephone and high-definition television in most of its residential and commercial markets. Cox has not only leveraged the power of its broadband platform to create multiple revenue streams, but has also created more profitable, longer-term customer relationships by offering bundled services to customers. Cox customers continually validate the company’s strategies, as evidenced by the impressive growth of these new services.

Cox’s telephone business, in particular, has distinguished the company from its peers. In the mid 1990s, Cox began installing switches and other telecom equipment in select markets, preparing to capitalize on the Telecommunications Act of 1996 which officially opened the telecom market to competition. Cox first launched local phone service in 1997 in Orange County, Calif. Today, Cox Digital Telephone has more than 1 million residential customers and more than 100,000 Cox Business Services customer locations across 13 telephone markets. In 2003, Cox received the highest honor in J.D. Power and Associates’ 2003 Residential Local Telephone Customer Satisfaction Study in the Western Region.

“Cox pioneered cable telephone via circuit-switched technology,” notes Chris Bowick, Cox’s Chief Technical Officer. “In doing so, we amassed more than seven years of in-the-trenches experience as a telecom provider.
We navigated the complexities of the business, built a tremendous technological and operational base on which to distribute phone service and have already delivered significant financial results. Above all, we proved to both residential and commercial customers that they can depend on Cox for their phone services — for multiple services, in fact."

Cox attributes much of its success with launching VoIP technology to its pragmatic approach. “We reached the point where VoIP technology made good business sense from a technical, financial and operational perspective,” said Bowick. “Today, the technology is robust and reliable and it integrates seamlessly with our circuit-switched operations. Importantly, we were not forced to abandon our circuit-switched technology in favor of VoIP because the two technologies are complementary. Cox’s telephony strategy is a win-win scenario, one in which we control our destiny and our customers experience, thanks to our end-to-end managed network infrastructure and back-office functions, as well as our tremendous base of telephone expertise.”

**MAXIMIZING ALL OF THE PIECES**

Key elements of Cox Digital Telephone with a VoIP architecture include:

- **Network** — Cox attributes much of its success to its powerful network. Over the past decade, the company has extensively upgraded the HFC network in its local markets to deliver a very high capacity, reliable and extremely flexible platform on which to layer advanced services. Presently, more than 92 percent of the company’s homes-passed are at least 750Mhz and two-way activated. With fiber optic nodes serving an average of less than 700 homes passed, Cox continues to effectively manage spectrum for ample capacity for all of the services it delivers now and for future growth.

- **Back-office** — Just as important as the power of the network is the complex system of back-office functions and processes that must be perfected in order to effectively deliver telephone services. These
functions include call processing, enhanced 911 services, billing, phone number administration, local number portability, operator services, directory assistance, directory listings, interexchange agreements with other phone companies, calling cards and numerous other requirements. For many years, Cox has dedicated teams exclusively to perfecting support and delivery processes for telephone service. These teams develop methods, procedures, audit processes and measurements that impose discipline and efficiency on the delivery and support of all of video, voice and data services.

Indeed, Cox’s back-office systems and processes are leveraged extensively for VoIP roll-outs. Thereby, Cox did not have an extensive learning curve for its first VoIP launch. Cox already had the processes and experienced people in place to provision services, manage data and integrate information about multiple services into one central location. This provides extraordinary value that Cox continues to reap every day.

A key asset is Cox’s ability to manage the back-office functions of delivering phone service with its integrated customer management system. Cox is the only major broadband company that operates 100 percent of its field locations and all of its video, voice and data services on a single back-office platform. The vast capabilities of this system help provide a smooth experience for Cox customers at all stages of the relationship. Cox’s system ensures seamless flow of functions, including order entry, scheduling, installation, billing and service provisioning. The value of this integration is extraordinary, allowing Cox customer care representatives to sell efficiently and activate all services utilizing a single platform at one time with one phone call and one view of all relevant customer data. Cox is also able to offer customers the flexibility of receiving one billing statement for multiple services, choosing a single bill for each or selecting a combination of those options. Lastly, the back-office integration supports a high degree of flexibility and automation, eliminating paper and manual processes that erode margins, cause errors and lead to customer dissatisfaction. Moreover, it eliminates the need to coordinate with third party companies, which can lead to delays in activating and servicing customers.
• Backbone — Cox’s nationwide OC-48 IP backbone network was created in 2001. Today it transports Cox High Speed Internet, Cox Business Internet services, VoIP and more than 25 percent of Cox’s long distance traffic.

The backbone interconnects all Cox markets and connects other major metropolitan hubs including Chicago, Dallas, Los Angeles, San Francisco and New York. This extremely flexible and powerful network includes 14 regional data centers (RDCs) and three services data centers (SDCs). The SDCs serve as hosting locations for VoIP soft-switch technology for nationwide telephony coverage in addition to hosting and sharing mail, news, web space and other components of Cox High Speed Internet. These centers provide Cox with a national presence well beyond the local-only networks typical in the cable business and an attractive economic foundation for significant geographic efficiencies enabled by the network. Instead of replicating
equipment in every data or VoIP market, Cox regionalizes some components of service delivery into these centers. This architecture enables Cox to further leverage its backbone to integrate data and telephony services.

COX’S VoIP ARCHITECTURE

Cox’s architecture is PacketCable™ compliant and purpose-built to provide nothing less than high-quality, full-featured telephone service. The network’s primary components include DOCSIS 1.1 cable modem termination systems (CMTSs), media terminal adapters (MTAs), media gateways and a soft switch.

The highly distributed nature of Cox’s VoIP architecture creates numerous leverage points throughout the network. The ability to leverage local, regional and national infrastructure, as well as processes and procedures, enables the operation to efficiently scale in size and scope.

Local. The media gateway and CMTS reside at the local (metro) network level. The existing CMTS equipment provides a key infrastructure leverage

---

**Cox VoIP Architecture**

---

Cox Communications VoIP Whitepaper • May 2004
point since it is already deployed to support Cox High Speed Internet services. In addition, many of the back-office functions typically performed locally in decentralized circuit-switched markets are consolidated at the regional level, thereby eliminating the need to replicate operations groups for newly launched markets.

**Regional.** The Dynamic Host Configuration Protocol (DHCP), Domain Name Server (DNS) and provisioning functions are located at the regional level. In the traditional circuit-switched model, Cox’s local markets maintain responsibility for many of the back-office functions. However, Cox’s regional design enables the consolidation of many back-office functions, including directory assistance, E-911 and local number portability. “The regional back-office support structure can support multiple markets,” said Bowick. “As a result, Cox has realized true efficiency gains by eliminating the need to train and staff employees for local telephone operations. This creates downward pressure on what is typically a steep learning curve, given the complex nature of the telephony business.”

**Architecture Variations**

- **Cox** Headend or CO  |  Gateway  | PSTN
  - HFC  |  Cox IP Backbone  |  No control over the ‘last mile’, QoS, Integration
  - End-to-End control of QoS, Provisioning, Integration, Back-Office, & Operational Support

- **Provider A** Headend  |  Gateway  | PSTN
  - HFC  |  Backbone  |  No control of Provisioning, Integration, Back-Office, Operational Support

- **Provider B** Headend  |  Gateway  | PSTN
  - DSL, HFC  |  Backbone  |  No control of Provisioning, Integration, Back-Office, Operational Support

**National.** The soft switch resides at the national level of the architecture. The technical expertise required to support the soft switch is also maintained at this level, thereby creating a centralized technical
support structure. With this configuration, Cox’s local markets do not have to develop the technical expertise necessary to support the soft switch. More so, the ability to have a single view of the whole network to facilitate efficient troubleshooting techniques and problem resolution is the true benefit of centralizing knowledge of the entire system architecture and diagnostics. Moreover, a single group within the Cox organization maintains secure, controlled access to the soft switch to produce inherent quality control.

THE ECONOMICS OF VoIP

Cox anticipates the cost of VoIP technology will continue to improve over time, much more rapidly than circuit-switched costs. Any comparison of the cost of VoIP versus circuit-switched should be done by evaluating similar telephone service components, including:

CPE, Switching and other Peripheral Headend/MTC Equipment.

In these telephone-specific costs alone, VoIP potentially offers a capex advantage of almost 40 percent per customer when compared to an equivalent circuit-switched primary line replacement service. This significant cost advantage can largely be attributed to the lower cost of the MTA versus the NIU. Also, VoIP does not require the equivalent of a dedicated Headend Interface Terminal (HIT) for interface between the network and the switch. Instead, Cox’s VoIP technology leverages the existing CMTS to support Cox’s high-speed Internet platform. Further cost advantages for VoIP could be realized if Cox customers purchased the embedded MTA at retail locations (similar to the DOCSIS model) or if Cox provided a non-embedded MTA (one without a DOCSIS modem) to customers that already own a cable modem.

Network Readiness. Additional plant-related capex costs that could be attributed, at least partially, to the deployment of VoIP or circuit-switched telephone service include activities such as minor drop replacement and capitalized connect costs (to connect the NIU or MTA to the inside whole-house telephone wiring) and improved plant status monitoring and standby power. Regardless of VoIP, most of these activities would still be accomplished over time. In addition, these activities improve service quality and reliability for all of Cox’s products – not just
telephone service. In these cost models, Cox assumes at least four hours of standby power in the HFC plant for both technologies, with in-home battery back-up for the VoIP MTA and network-supplied power for the circuit-switched NIU. Inclusion of these costs in the analysis will increase VoIP’s per customer cost advantage to approximately 50 percent when compared to circuit-switched technology.

Cox has regionalized many of the functions and much of the equipment associated with delivering Cox High Speed Internet and VoIP, spreading the costs across multiple markets for savings and efficiencies. The following factors also contribute to the efficiency of its VoIP architecture:

• Regional and National Scalability — Cox’s distributed VoIP architecture will drive savings in both operational and capital expense when compared to circuit-switched telephone. For instance, circuit switches are usually geographically restricted based on serving distance; therefore installed and maintained within each local circuit-switched market. With VoIP technology, Cox installs and maintains soft switches at the national level, serving multiple markets with only limited equipment and operations required locally. Current long-term plans are to deploy soft switches in three locations to serve all Cox markets. For Cox, this is particularly beneficial in smaller markets, where the potential customer base doesn’t justify the cost of a circuit switch and associated infrastructure. This regional approach to scalability will also help the company defray the significant up-front investment in personnel and recoup its capital investment faster.

• Quality of Service (QoS) — Cox is complete in its upgrade to DOCSIS 1.1 software on its cable modem termination systems, a prerequisite for QoS. Cox believes that QoS is a requirement for providing high-quality, full-featured service and to prevent packets from suffering degradation during peak traffic periods or other periods of network congestion. Overall, Cox believes that end-to-end QoS also reduces operating costs by minimizing the number of customers who otherwise would be unsatisfied with the quality of their service. Cox’s end-to-end QoS control is yet another inherent advantage of owning and controlling its network.
• Powering — Cox’s research has found that consumers are more likely to choose a telephone service with power back-up than one without, thereby contributing to higher penetration rates. In Roanoke, Cox currently provides back-up powering of the in-home multimedia terminal adapter (MTA) using an internal battery that supplies several hours of back-up service. In the future, should market conditions and research indicate the need, Cox has the flexibility to provide customers with the option of taking telephone service without battery back-up for the MTA.

MARKETING VoIP

Cox has long enjoyed excellent relationships with its customers, which the company accurately predicted would translate into customer loyalty. According to Cox research, customer churn in two-product households is 18 percent lower than one-product, while three-product customer churn is 48 percent lower.

Cox’s belief is simple: Prove to customers that you’re capable of delivering traditional cable service and high-speed Internet efficiently and with high value. Without this, they’ll never trust you to deliver high-quality, full-featured phone service. Many companies seem to underestimate the critical importance of this fact. It’s one thing to have a network and technology in place, but entirely different and more difficult to also possess the know-how and track record of actually serving customers’ many needs effectively. Indeed, Cox received the highest honor in J.D. Power and Associates’ 2003 Residential Local Telephone Customer Satisfaction Study in the Western Region.

In marketing VoIP, it’s important to remember that VoIP is an architecture — not a product. Company research shows that most customers are not interested in the technology behind their telephone service, so Cox prefers to focus on the benefits and features that customers truly care about, such as value, bundled savings, convenience, rich features and attractive packages.
In Roanoke, the company positions, packages and prices its VoIP technology as high-quality, full-featured residential telephone service, branded as Cox Digital Telephone and sold in an identical fashion as in Cox’s switched telephony markets. Cox’s marketing strategy and tactics used in Roanoke are similar to the successful approach used in markets where a circuit-switched telephone architecture was implemented. In contrast to Internet Telephony, a subscription to Cox’s high-speed Internet service is not necessary to receive telephone service served by Cox’s VoIP architecture. This enables Cox to serve voice customers who do not wish to subscribe to Internet service.

CONCLUSION

The inherent flexibility of Cox’s end-to-end network infrastructure, from the CPE to transport and back-office functions, as described in this whitepaper, will enable Cox to remain a successful provider in the highly-competitive and uncertain regulatory world of telecommunications and to readily adapt and expand its telephone operations into new markets and to more customers.

In summary, Cox foresees the following:

- VoIP technology permits efficient geographic expansion of Cox’s phone services, allowing the company to launch telephony in markets where the economics didn’t justify the cost of a circuit-switched architecture. The company will launch several new Cox Digital Telephone markets utilizing VoIP in 2004.

- Cox will expand its phone service footprint via VoIP to commercial customers, thereby furthering its leadership position in voice among its peers in the commercial telecom marketplace.

- Cox’s VoIP architecture provides the flexibility to expand service in existing circuit-switched phone markets with either a circuit-switched-only approach, or with a complementary VoIP overlay (once existing circuit-switch capacity is fully exhausted).
• VoIP technology enables Cox to introduce phone services to customers the company isn’t currently reaching, without stranding the capital it has invested in its circuit-switched operations. The company will not abandon its circuit-switched business. Cox will completely utilize the capacity of existing switches.

• VoIP technology enables Cox to deliver long distance (LD) traffic over its own IP backbone network. Currently, more than 25 percent of Cox’s long distance customer calls are transported via the company’s national backbone, reducing its reliance on third-party wholesale LD providers.

• VoIP provides an economically efficient method to provide high-quality telephone service in Cox markets, enabling the company to reach its goal of providing a three-product bundle of services in all of its markets.

• Regulatory agencies are only now beginning to examine appropriate treatment of VoIP technology. To date, it is not yet known how the technology will ultimately be classified. New and varied approaches to VoIP by traditional telephony providers and new market entrants further complicate the regulatory environment. Notwithstanding, Cox’s flexible VoIP architecture and back-office infrastructure will continue to position the company well and enable Cox to adapt quickly and as necessary to this dynamic environment.

"As the leading provider of cable telephony services, we take great pleasure in the growth of our telephone customer base," said Bowick. "We’ve proven that cable providers can be successful as telephone providers and we look forward to continuing our leadership position by offering the service to a broader segment of our customer base in 2004."