VoIP Demystified

Abstract

VoIP tools come in many configurations and have been applied with great diversity in libraries. This chapter outlines the technical foundation and adoption patterns of online voice and video calling, and explores how VoIP provides insight into the library technology cycle on a broader scale.

Why VoIP?

In a 2007 *Librarian in Black* post, Sarah Houghton-Jan described Voice over Internet Protocol (VoIP) as "not a really sexy technology."[1] In terms of the bleeding-edge concepts *Library Technology Reports* tends to focus on, I'd have to agree. Web voice and video are old news: Skype's international popularity is established, voice and video chat proliferate in social media, embedded webcams are commonplace, and many organizations have made the transition to IP phones in offices and classrooms. The rise of mobile technology is another nail in VoIP's nonsexy coffin: international cell subscriptions continue to skyrocket and have already far outstripped landline and Web phones.[2]

Bearing this in mind, you might be wondering why I've chosen VoIP as the subject of this report. When Web calling tools began to emerge several years ago, I took on the de facto role of video reference evangelist. I predicted that applications like Skype could transform how librarians provided public services over the Web. I imagined video consultations and kiosks that could increase service point efficiency and humanize the virtual reference experience. When I worked at Ohio University between 2006 and 2008, my colleagues and I built an interesting, innovative, and frequently hilarious proof-of-concept
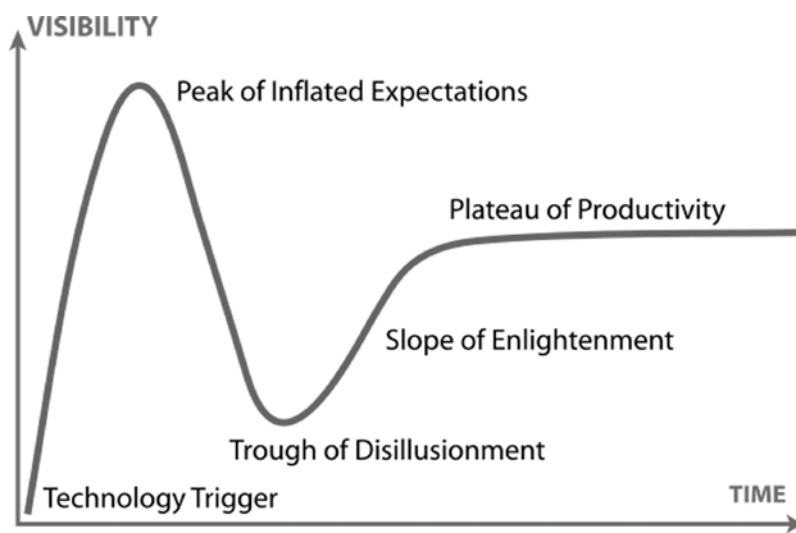

Figure 1
Hilarity ensues.

video kiosk using Skype and a couple of webcams (figure 1). After about two highly instructive years of operation, we (they, actually—by this time I had relocated to California) shut the kiosk down.

The Library Hype Cycle

Why did I have such high hopes for video reference, which I will show to be among lowest impact applications of VoIP that have come to pass? A partial answer is that I was caught up in the overenthusiasm that often accompanies the innovation process, otherwise known as "hype cycle" thinking. When a new tool catches the eye of trend watchers, it initiates an arc of blog and tweet prognostication that spurs people and organizations to adopt the tool. Some expectations pan out while others don't, and lessons are learned and (hopefully) shared in the process. This progression from hype to hope to reality is often bound up in library technology adoption.

Developed by Gartner Research, the hype cycle (more of a curve, really) describes the rise and fall trajectory shared by many emerging technologies, from Second Life to the iPad (figure 2).[3] It begins with a *technology trigger* that creates an upswing of media and user interest leading to a *peak of inflated expectations,* after which a *trough of disillusionment* occurs as expectations are not met or the shine simply wears off. This is followed by a gradual *slope of enlightenment* where more modest assessments are made, culminating in a *plateau of productivity* as the lasting utility of a tool is determined.

Instead of inflating expectations around the next big thing, this *LTR* examines how a once-hyped technology eventually reached its plateau of productivity. In other words, it's not in spite of the shine being off of VoIP that I'm taking it on, but *because* of it. Unlike many up-and-coming tools, VoIP has longevity. Over the last decade, it has come to facilitate much of the one-to-one, one-to-many, and many-to-many voice and video communication that happens over the Web, from Vonage to voice chat, gaming consoles to Web meeting tools. Not only has VoIP underpinned a massive paradigm shift in how people communicate in "fixed" locations, it is beginning to enable free calling and messaging on smartphones and handheld devices. Examining VoIP's library applications—some dismal failures, others raging successes—can inform nascent Web voice and video projects as well as innovation in other areas.

VISIBILITY

Peak of Inflated Expectations

Plateau of Productivity

Slope of Enlightenment

Trough of Disillusionment

Technology Trigger

TIME

Figure 2
Representation of the Hype Cycle (Wikimedia Commons).

Learning to Fail

Piloting Web voice and video in libraries personally taught me an important lesson about working with technology: snafus are going to occur, and a concept rarely performs to expectations. This reality is not often addressed in the discourse of our field—in presentations I have given on the video kiosk, the audience has invariably been surprised when I have spoken about our difficulties with candor. Challenges in experimental initiatives are inevitable, but can be guided by planning and made didactic through reflection. The kiosk program taught me to try and understand my users at least as well as I understand the application itself, to learn from setbacks in order to address problems, and cultivate a perspective that is simultaneously positive and critical. This education did not occur in one fell swoop. Rather, it accumulated over the kind of time that is sorely lacking in the day-to-day whirlwind, the very condition that makes taking a tool at face value so tempting in the first place.

A Lesson in Layers

Successful technology development takes depth of perspective. In this issue, I explore VoIP in the three successive layers of *utility, application,* and *insight,* each of which examines a critical stage in the process.

Layer 1: Utility

Behind every application and platform are practical affordances that translate to library implementations. Skype is the tip of the VoIP iceberg, and in the first two chapters

Search Engine Terms

These are terms people used to find your blog.

Today

Search	Views
"char booth" skype	1
library* (skype and public and (referenc	1
pc tower	1
library design	1

Figure 3
Blog search terms.

I run the gamut of Web calling and conferencing options, functionality, and costs:

- Chapter 1: VoIP Demystified
- Chapter 2: IP Phones, Software VoIP, and Integrated and Mobile VoIP

Layer 2: Application

Those using Web voice and video in public services, education, and professional communication become familiar with the capabilities and quirks of the technology. This familiarity translates to best practices for the rest of us. The next two chapters examine how Web voice and video have been put to work throughout the field:

- Chapter 3: VoIP in Professional Communication, Collaboration, and Development
- Chapter 4: VoIP in Reference, User Services, and Instruction

Layer 3: Insight

It is equally (if not more) instructive to look at where Web calling has proven itself not useful along the library hype cycle. Chapters 5 and 6 critically examine the OU kiosk pilot and the video reference experience. In an era of constant innovation, VoIP's adaptable longevity also merits closer examination. Chapter 7 considers shifting user communication and connectivity paradigms, and closes with an analysis of the implications of knowledge sharing for emerging technology development.

- Chapter 5: Video Kiosk as Hype Cycle
- Chapter 6: Lessons for Library Innovation
- Chapter 7: Knowledge Sharing and the Next-Generation Network

You Asked for It

I have written this LTR for many reasons, but primarily in response to persistent curiosity about VoIP tools in library contexts: people find my blog (info-mational) several times a day by searching for "Skype in libraries" or "video reference" (figure 3). I also wanted to evaluate the assumptions I once made about Web voice and video, and carry my experience with this specific platform through productivity instead of ditching out at inflated expectations. This amounts to a personal exercise in technology literacy, an opportunity to learn deeply about the communication tools I not only take for granted in my working and personal life, but that I once held in irrationally high regard.

Think of this report as a long-range view on how to brace for impact in a culture of perpetual beta. Examining a platform that has for years paradoxically promised, delivered, and disappointed is an excellent way to identify strategic, reality-based, and resource-conscious local decisions. I look critically and creatively at technology "success" and "failure" in order to develop lasting local best practices for pilots and proof-of-concept projects. In VoIP's library lifespan there is evidence of how we anticipate change and adapt to the complex information landscape. By the end of chapter 7 end you may still not find web calling particularly sexy, but you should be able to determine whether or not one of its applications (or something else entirely, for that matter) can be used to achieve cost reduction, productivity, service, or collaboration goals. Now, down to business.

Unequal Access: Phone and Broadband

Personal telephones are almost ubiquitous in the United States. A 2010 FCC report estimated that 95 percent or more of U.S. residents have some type of subscription phone service, a number that is unlikely to decline in coming years.[4] How people use their phones is changing dramatically, however. The demographics of analog, VoIP, and cellular phone use are complex: a growing number of younger, mobile-only consumers are causing a decline in fixed-location service, while many legacy home subscribers are switching to subscription IP phones. Age is by no means the only factor: there are many areas in the United States where analog service is the only option or where other access barriers exist.[5] I encountered this myself while living in rural Ohio—My house had no cellular reception and exorbitant broadband satellite fees. Having

ditched landline for cell half a decade before, this forced me to forego home Web access and grudgingly subscribe to an analog phone service for the first time in years.

This experience is still quite common. Due to Web-based voice and video telephony's reliance on high-speed Internet, it is limited largely to those with access to developed and relatively affordable broadband networks.[6] Broadband (or high-speed) Internet is a DSL, fiber-optic, cable, power line, satellite, or wireless connection that transmits data at greater than 200 Kilobits per second, with speeds reaching to 100 Mbps or more in many Asian and European nations, where network speed and coverage often far exceeds the U.S.[7] While increasingly deployed to urban businesses and institutions, individual high-speed subscriptions in rural and urban areas are far less ubiquitous within the United States than phone subscriptions. As of 2009, fully one third of the U.S. population (not to mention billions internationally) still did not have home broadband. While smartphone use is spreading and initiatives like Google Fiber and the National Broadband Plan seek to give 100 million American homes 100 Mbps access by 2020, VoIP use mirrors the current access divide.[8]

Laying the Groundwork

When I started my research, I sent messages to several e-mail lists asking for examples of VoIP use in libraries. Among the first comments I received was this observation from OhioLINK's Peter Murray:

> One of the things that comes to mind is the need to distinguish between various kinds of VoIP. By way of example, I'm currently using two "VoIP" systems in my office. One is my desk phone—a Cisco-supplied "IP Phone" that is in effect indistinguishable from my previous "hard line" phone. The other is a "software phone"—Skype on my laptop. Both have a "phone number" reachable by any phone, and the person calling probably does not know they are getting to me by VoIP. One is fairly fixed in location (it is only usable on my desk) while the other is portable (where ever my laptop has a network connection). One has chat and file sharing while the other does not.[9]

Much obliged, Peter, for describing the goal of what I previously described as "Layer 1: Utility." VoIP is the foundation of an ever-expanding array of communication tools. Chances are excellent that you are already a VoIP user, whether you realize it or not—if you attend webinars, talk overseas, or basically ever use any phone for any reason, this technology is already a part of your life. In the remainder of this chapter I provide an overview of how VoIP works and outline its main three types (IP phones, software VoIP, and integrated and mobile VoIP), and in the next chapter I examine each in detail.

VoIP Defined

Internet protocols are standardized sets of rules that govern the transfer of information across networks. Voice over Internet Protocol specifies how real-time audio travels between Web-enabled devices: by breaking data into pieces called "packets" that are queued, routed, and reassembled at a destination. When network traffic is high or connections are slow, packets can be held up or lost, causing the slight to severe delay, echo, or "jitter" one sometimes experiences in Web calls.

VoIP's extensibility, or its capacity for ongoing adaptation, is one of its core features. According to one author, "contrary to the traditional telephone system (where the end devices are dumb), VoIP architecture pushes intelligence towards the end devices (i.e., PCs, IP phones, etc.) giving the opportunity to create many new services that could not be envisaged using traditional phone systems."[10] Web calling services have continually conformed to changing technology, moving from dial-up to broadband to third-generation (3G) cellular networks, and onto new devices and delivery methods.

Three Types of VoIP

Many of the products I describe are feature-rich and interoperable, meaning that they can call not only each other but also landlines and cellular phones. Most also incorporate video and other data functions like text messaging and chat to the extent that almost none are actually limited to voice communications. Multimedia VoIP tools are often described as enabling "unified" or "rich" communications, which can also exacerbate the format confusion that Peter described above. Three main categories of VoIP help distinguish its many applications.

IP Phones

IP phones most closely resemble traditional phones. Although carrier VoIP services like Vonage are often presented as an alternative to landlines, the two are not mutually exclusive. VoIP was first used over dial-up, and IP phones frequently rely on broadband wires or cables, effectively creating a newer generation of landline. The difference is in the type of line—whereas the public-switched telephone network (hereafter referred to as the PSTN—think switchboards as in figure 4) used copper wire, IP phones use broadband lines via fiber optic or DSL. IP phones can also operate via satellite, WiMax, or other high-speed connection.

Software VoIP

The best-known type of VoIP services are software VoIP. This category describes online free calling and

conferencing tools like Skype. In addition to voice calling, many provide video, multiparty conferencing, and text chat as well as screen sharing and other features. While Skype is the dominant service, competitors like VoxOx, Jajah, and Google Voice have growing subscriber bases and are poised to gain a larger marketshare in coming years. VoIP also supports Web conferencing tools like Dimdim and ooVoo on the free or open source side, and Adobe Connect, Elluminate, and WebEx on the subscription side.

Integrated and Mobile VoIP

Voice and video are already built-in features of many platforms and gadgets, including massively multiplayer online games (MMOGs) like *World of Warcraft*, virtual worlds like Second Life, and social networks like LinkedIn and Facebook. Such features also fuel conventional and unconventional Internet dating and communication services like ChatRoulette and are being integrated into media products like HDTVs. Mobile VoIP is also on the rise, affording free or inexpensive calling and texting over smartphones and handheld wireless devices.[11]

Rates of Adoption

It is challenging to quantify the true scale of VoIP adoption. It is safe to say that it is widely viewed as the ascendant landline or fixed-location option, in tandem with cellular telephony for mobile communication and connectivity—only traditional telephony is in decline.[12] Global subscriptions to IP phone services like Vonage reached 100 million in 2009—22 million in the United States alone—with VoIP subscriptions capturing up to 38 percent of the fixed-line market in Web-advanced countries such as France and South Korea.[13] According to a 2009 ECAR study, VoIP phones are currently in active use or planned for implementation by 90 percent of American college and university campuses.[14]

These figures do not even take into account Skype, which, by 2009, boasted a staggering 443 million registered users and accounted for 8 percent of all international calls.[15] Skype's popularity has raised awareness of Web calling and video communication, as media figures like Oprah strike high-profile deals to host guests via video call and media outlets like CNN use it for in-field reporting.[16] The multimedia capability of computers is also improving, as laptops, notebooks, and desktops come

Figure 4
Switchboard operators, circa 1943.

equipped with integrated webcams, microphones, and speakers. This makes their application as rich communication and content-creation devices more viable and virtual collaboration, participation, and learning more accessible.

Quality, Stability, and Security

Traditional phones, despite their lack of multimedia features, have long provided clear sound, reliable service, and relative security. Common concerns among VoIP users are quality of service (QoS), security, and the underlying stability of a communication system that is dependent on both a power grid and data network. Among VoIP types these differ greatly: IP phones are considered less susceptible to hacking and spamming because they can be centrally protected like other types of Web services. Furthermore, IP phones don't follow the individual user account archetype that makes software and mobile VoIP providers like Skype widely viewed as privacy and security risks and bandwidth monopolizers.

While it lags behind quality standards set decades ago by analog phones, overall VoIP voice quality continues to improve.[17] QoS issues affecting VoIP result from the underlying instability of networked versus dedicated, one-to-one communication:

- *delay*—also known as *latency*, or time gaps caused by slow networks
- *echo*—users hearing their words repeated back to them, often caused by microphones picking up speaker noise

- *jitter*—audio distortion due to data packets arriving erratically at their destination, caused again by slow or inconsistent network speeds
- *packet loss*—the complete loss of packets of transmitted data, resulting in choppy and incomplete call quality

As next-generation broadband becomes more pervasive, most of these issues will gradually improve and can already be addressed by shoring up speed, stability, and consistency. In general, the faster and more reliable the network, the higher the quality of service—all types of VoIP are currently more stable than wired connections, which tend to have stronger bandwidth and fewer network interruptions than wireless.

Notes

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