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# ADOPTING IP TELEPHONY TECHNOLOGY: WHY WOULD CONSUMERS WANT IT?

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## Abstract

*Success in today's global economy requires improvements in technology innovation and product adoption processes as new technologies are transformed into new products and services. It is not enough to simply introduce new innovations in the form of products and services. Companies must be able to manage existing products and services even as they innovate and create new ones. This research study evaluates the adoption of an innovative IP telephony service through a field study of consumer-level early-adopters at an east coast technology university. The study will refine the technology acceptance models by investigating the effect of moderating variables of technology type and perceived technology associated risks as well as perceived usefulness and perceived ease of use contribute to information technology research in several ways. This research will also study the acceptance and adoption of synchronous telephony communications media. Finally, results from this study should provide a general understanding of consumer perceptions of and needs for IP telephony leading to a predictive model of consumer-level technology adoption that can then be tested in the market place.*

**Keywords:** Technology acceptance model, diffusion of innovation, Internet protocol (IP) telephony, synchronous telephony communications media

## Introduction

Success in today's global economy requires improvements in technology innovation and product adoption processes as new technologies are transformed into new products and services. It is not enough to simply introduce new innovations in the form of products and services. Companies must be able to manage existing products and services even as they innovate and create new ones (Rogers 1983; Roberts 1988; Tushman and O'Reilly 2002). The innovation process starts with the conception of new technology and it ends with the acceptance of the new technology in the market place. Successful companies then start the process over again. This research study focuses on the introduction of an innovative IP telephony service in an environment that is seen as containing early adopters of new communications technology.

The adoption of this new type of IP telephony service is being researched through a field study of consumer-level early-adopters at an east coast technology university. This goal of this study is to refine 'technology acceptance model' theories (Davis 1989; Hong et al. 2000-2001; Chau 1996) by evaluating additional moderating variables including technology type and perceived technology risks. This study will also use 'technology diffusion theory' (Rogers 1983; Ansoff 1987; Pelkie 1989) to evaluate why consumers adopt a technology that potentially could become a mass-market technology, in this case a new integrated IP telephony service. This study will also attempt to answer questions concerning which is the driving force for IP telephony technology development, market pull or technology push, and how to improve the adoption process of this new information technology in the marketplace.

The information obtained by evaluating the users' initial experiences and reactions with the new IP telephony service will provide answers to specific questions about the features and capabilities of the new IP telephony service including what is useful with the current service as well as generating ideas for future development.

## Background

When do people adopt a technology and when do they not? This simple question is of enormous importance to the field of information systems where researchers and managers often need to know how best to introduce new products into an organization or market place. New products and services are introduced and adopted by users at different stages in the technology life-cycle depending on the type of technology and the needs of the users (Roberts 1989; Rosenkopf and Tushman 1994). Also, it not clear why some technologies may be widely adopted even though they may not have the robust features and capabilities of similar or competing technologies. For example, Microsoft's operating system and office package is of more value than Linux to many users, because of the extent of Microsoft's market penetration (Gallaugher and Wang 1999).

### *IP Telephony Technology*

IP Telephony allows users to transmit voice and fax over the Public Switched Telephone Network (PSTN) using Internet Protocols (IP). IP telephony is broader in scope than earlier versions of Internet telephony, which were a PC-to-PC form of communications. IP telephony includes PC-to-PC, phone-to-PC, and phone-to-phone communications over the Internet, Intranets, Extranets, and the PSTN (Patten 2000). Early adopters of technology motivated the early introduction of Internet telephony, in the mid-1990s. The initial benefit was the perception of free telephone callings over the Internet.

IP telephony until recently had little to offer Internet-literate users who may consider switching to IP telephony from other communications media. The main problems concerned quality of service issues and small price differentials. Early adopters were not concerned with the quality issues, however, to become a mass-market service, the quality of service issues needed to be resolved. The initial motivation of the earliest users was to lower telephone calling costs. In actuality, IP telephony, when used with regular telephone numbers or special telephone gateway numbers, does lower marginal costs, however there are still costs of hardware, flat-rate Internet service provider (ISP), and telephone usage (Vugrinec and Tomazic 2000). However, despite recent improvements in basic IP telephony technology and marginal costs, the rate of consumer adoption is still low (Vugrinec and Tomazic 2000).

IP telephony has the potential to become a "must-have" consumer service by delivering a variety of novel and feature-rich services besides traditional telephony services (i.e., call forwarding, call waiting, and caller ID.) Newer enhanced services include call conferencing, call control, multimedia, and mobility services as well as the capability to integrate Web, email, presence, and instant messaging with telephony (Schulzrinne and Rosenberg 1999). It is expected that consumers will more readily adopt IP telephony when these enhanced capabilities become part of the general service offerings. Although this study focused on consumers, IP telephony has the potential to become a critical enterprise communication technology because common business applications such as groupware, conferencing, and messaging can be combined on a converged voice and data IP network. Employees will be better able to respond to customer needs because they will be more flexible and mobile (Blanco 2003). IP telephony benefits for business will include 1) reduced costs, 2) changes in functional/technical requirements, 3) voice and data management in a single network, and 4) increased productivity (Street 1999).

As this technology evolves, telecommunications engineers expect that IP telephony technology will transform the current circuit-switched telecommunications network infrastructure to a packet-based infrastructure (IDC 1999). However, IP telephony technology is still relatively immature, and because of the reluctance to discard the billions of dollars that have been sunk into the existing circuit-switched network, it will take many years to transition to a purely packet-based environment. As a result, new IP telephony products and services must today interconnect with the existing PSTN in the forms of IP telephony "islands" if they are to have commercial value (Polyzois et al. 1999).

### *Technology Acceptance Models*

Several different research streams provide theories to explain people's acceptance of technologies. The 'theory of reasoned action' (Fishbein and Ajzen 1975) and the 'theory of planned behavior' (Ajzen and Fishbein 1980) are early theories about people's

general behavior. Based on these two theories, the ‘technology acceptance model’ (TAM), introduced by Davis et al. (1989) is one of the most widely cited theories of users’ acceptance of a technology. The TAM theory posits that users’ *behavioral intention* (BI) to use a technology is affected by their *perceived usefulness* (PU) and *perceived ease of use* (PEOU) of the technology. Other researchers have modified Davis’ original TAM theory by adding or deleting constructs to the original model. For example, Hong et al. (2000-2001) added two categories of external variables to the TAM – *individual differences* and *system characteristics*. Chau (1996) expanded the original TAM model by defining two types of *perceived usefulness* – *long-term* and *short-term* – to go along with the *perceived ease of use* (PEOU), as they affect the user’s *behavioral intention* (BI) to use.

Researchers have extended the TAM theory by applying it to different technologies including off-the-shelf software packages (i.e., word processing, spreadsheets, database management systems, and graphics (Igbaria et al. 1997)), different types of hardware (i.e., mainframe, mini, and small systems (Tam and Hui 2001)), web-based systems (i.e., the Internet (Moon and Kim 2001)), and digital libraries (Hong, et al., 2000-2001). The TAM theory has also been extended across different countries (Straub, et al., 1997) and industries (Hu, et al., 1999).

Some studies have conflicting results about the magnitude of the effects of *perceived usefulness* (PU) and *perceived ease of use* (PEOU) (Gefen and Straub 2000; Adams et al 1992). These differences may occur within the context of the studies.

For example, the type of technology could have significant effect on the user’s adoption of the technology. Also, the users’ experience with the technology may impact its adoption rate (Davis, 1989). Previous studies did not compare the effects of the variables across different types of telephony products and services. Further, the technologies examined empirically were not typically technologies that would be able to reach a critical mass, or tipping point, which would result in widespread adoption. Also, in previous TAM studies, it was implicitly assumed that the technologies are similar in terms of type and uncertainty/risk involved in the adoption of the technology. The uncertainty or perceived risk of using a technology may have impact on adoption as well (Featherman 2001; Lee et al. 2001; Magal and Mirchandani 2001).

### **Diffusion of Innovation**

‘Diffusion of innovation’ (DOI) theory also affects technology adoption (Rogers 1983). DOI theory posits that there are five variables that affect diffusion of an innovation – *relative advantage*, *compatibility*, *complexity*, *trialability*, and *observability*. Ansoff (1987) described two driving forces for innovating existing technology – market pull or technology push. Market pull is where development is based on the needs of the users requiring continuous technical effort to develop products and services to meet the user needs. Technology push is when the provider develops a new product that requires a marketing effort to find potential users (Pelkie 1989). The driving force for the innovation thus impacts the diffusion of that innovation. At this stage of the research study, it is expected that the driving force for the new IP telephony service is a ‘technology push’. However, this assumption will be evaluated during the course of the study.

### **Proposed Research Field Study**

This field study will focus on the consumer-level user adoption of IP telephony at an east coast technology university. The purpose of the study is threefold. First, to refine the TAM by investigating the effect of moderating variables of *technology type* and *perceived technology associated risks* as well as *perceived usefulness* and *perceived ease of use*. This will broaden our understanding of how to promote new technologies by identifying critical factors in consumer technology acceptance decisions. Second, to gain a general understanding of consumer perceptions of and needs for IP telephony. This will produce a predictive model of consumer-level technology adoption that can then be tested in the market place. Third, to develop an objective understanding of IP telephony product usability.

### **Hypotheses**

Hypotheses for this study will be developed and refined based on literature survey and interviews with the potential users and technology developers. The following preliminary hypotheses will be refined and tested.

- H1.** Users’ perceived ease of use (PEOU) has a positive effect on users’ intention to accept the technology (BI).
- H2.** Users’ perceived usefulness (PU) has a positive effect on users’ intention to accept the technology (BI).

- H3.** Users' self-efficacy (SE) has a positive effect on users' perceived ease of use (PEOU).
- H4.** Users' personal innovativeness (PI) moderates the effect of perceived usefulness (PU) on users' intention to accept the technology (BI).
- H5.** Users perceived risk (PR) moderates the impact of users' perceived ease of use (PEOU) on users' intention to accept the technology (BI).
- H6.** Users perceived risk (PR) moderates the impact of users' perceived usefulness (PU) on users' intention to accept the technology (BI).
- H7.** Exposure to the technology (trialability and observability) will increase users' perceived ease of use (PEOU) and perceived usefulness (PU).
- H8.** Exposure to the technology (trialability and observability) will decrease users' perceived risk (PR).

## Research Plan

The following describes the study technology and methodology, subjects and data collection for this search-in-progress. It is expected that we will have some preliminary data analysis by the time of the conference.

### *Study Technology*

The IP telephony technology investigated in this field study is an innovative type of integrated IP and PSTN telephony service, provided to the east coast university community as a commercial offering. The service providers, anticipating that a university environment is the natural place to introduce this new communications medium, are offering this service on a limited basis as a market trial. This new integrated IP telephony service investigated in this field study combines 1. the connection of an IP handset to a PC through the USB port, 2. client software for the PC, 3. local voice services including inbound and outbound dialing, domestic and international service, 4. selected line features, and 5. IP termination to other study users. The basic service will be available for a fixed monthly fee plus international calling charges. This new service allows the management and operation of the telephone from the PC as well as the ability to log all incoming and outgoing calls. The IP handset allows the user to call others with traditional telephones, PC-based telephones, and dedicated IP telephones.

This new IP telephony service is considered a "breakthrough" next generation of IP telephony service expected to meet the needs of the general consumer IP telephony market. One of the goals of this field study is to evaluate the specific technical features of the service and compare it to the needs of users identified during the field study.

### *Study Methodology, Subjects and Data Collection*

The data for this study will be collected from a series of surveys, semi-structured interviews, and focus groups of potential users who first trial the new IP telephony service for two weeks. These users then either choose to sign-up for the commercial service or decide not to sign-up for the service. The surveys will use sections of previous TAM research questionnaires plus additional survey questions based on the semi-structured interviews and focus groups. User characteristics will be identified in the initial survey. A second group of non-users will be identified with similar characteristics to the user group and will also be invited to participate in the field study to act as a control group.

The users' experiences and evaluations of the IP telephony services will be tracked using a longitudinal study approach (Venkatesh and Davis 2000). Williams, et al., (1988, p. 65) recommended using longitudinal research so that "researchers studying new media use theories, designs, and methods that take change over time into account will improve the meaningfulness of their results and capture the social dynamics of the new media."

### *Study Stages and Size*

Since new users of the IP telephony service will sign-up on a staggered basis once the service is introduced to the university community, potential study subjects will also sign-up on a staggered basis. For this reason, we plan to approach the field study in four stages. The service provider of the IP telephony technology under investigation plans to cap their market trial at 300 users, which will then be the maximum study size for this field study. Table 1 outlines the Study Stages.

**Table 1. IP Telephony Study Stages**

Stage	Purpose	Size (users)	Study Instruments	Comments
1	Pilot	15	Semi-structured interviews, 2 questionnaires (before and after)	Identify user expectations and needs, refine questionnaires
2	Initial	35	Focus groups, 4 questionnaires <sup>(1)</sup>	Identify user expectations and needs, refine questionnaires
3	Summer	100, 30 non-users	4 questionnaires <sup>(1)</sup>	
4	Fall	150	4 questionnaires <sup>(1)</sup>	
Follow-up	At end	15 random	Semi-structured interviews	Evaluate study methodology,, prepare final reports

<sup>(1)</sup>Questionnaires distributed at beginning and at the end of two-week trial, and then at the three month, and six month time frames.

### **Additional Study Goals**

Another goal of this field study is to measure the effect of marketing variables such as price, type of service, product (design, feature, and usability), and brand, on user acceptance decisions. The effect of these marketing variables will be examined using statistical techniques such as ‘conjoint analysis’ (Kohli 1988; Zufryden 1988).

### **Research Contributions**

This field study will contribute to information technology research in several ways. The application of ‘technology acceptance models’ and ‘diffusion of innovation’ theories to the new IP telephony service adoption will have two major impacts. First, the theories will be tested using a new technology that has the potential to become a mass-market consumer service. Secondly, while much research has been conducted in the area of computer-mediated communications media, little research has been conducted in the acceptance and adoption of synchronous telephony communications media. This study will also increase our understanding of IP telephony product usability as well as broaden our understanding of critical factors in consumer technology acceptance decisions resulting from the effect of variables, such as *technology type* and *perceived technology-associated risk*.

Finally, results from this study should provide a general understanding of consumer perceptions of and needs for IP telephony leading to a predictive model of consumer-level technology adoption that can then be tested in the market place. We will be collecting data from users who decided to continue the IP telephony service after a two-week trial and also from the users who decided not to continue the service after the trial.

### **References**

- Adams, D.A., Nelson, R.R., and Todd, P.A. “Perceived Usefulness, Ease of Use , and Usage of Information Technology: A Replication,” *MIS Quarterly* (16:2), June 1992, pp. 227-248.
- Ajzen, I., and Fishbein, M. *Understanding Attitudes and Predicting Social Behavior*, Prentice Hall, Englewood Cliffs, NJ, 1980.
- Ansoff, H. I. “Strategic Management of Technology,” *IEEE Engineering Management Review* (15:3), 1987, pp. 2-13.
- Blanco, J., “IP Telephony: Not Just Voice Over IP,” *Internet Telephony*, February 2003, <http://www.tmcnet.com/it/0203/0203avay.htm>.
- Chau, P.Y.K. “An Empirical Assessment of a Modified Technology Acceptance Model,” *Journal of Management Information Systems* (13:2), 1996, pp. 185-204.
- Davis, F. D. “Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology,” *MIS Quarterly* (13:3), 1989, pp. 319-340.
- Davis, F. D., Bagozzi, R. P., and Warshaw, P. R. “User Acceptance of Computer Technology: A Comparison of Two Theoretical Models,” *Management Science* (35), 1989, pp. 982-1003.
- Featherman, M.S. “Extending the Technology Acceptance Model by Inclusion of Perceived Risk,” *Proceedings of the Americas Conference on Information Systems*, Boston MA, 2001, pp. 758-760.

- Fishbein, M., and Ajzen, I. *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*, Addison-Wesley Publishing Company, Reading, MA, 1975.
- Gallaugh, J., and Wang, Y. "Network Effects and the Impact of Free Goods: An Analysis of the Web Server Market," *International Journal of Electronic Commerce* (3:4), 1999, pp. 67-88.
- Gefen, D., and Straub, D. "The Relative Importance of Perceived Ease-of-Use in IS Adoption: A Study of e-Commerce Adoption," *J AIS* (1:8), 2000, pp. 1-28.
- Hong, W., Thong, J.Y.L., Wong, W. M., and Tam, K.-Y. "Determinants of User Acceptance of Digital Libraries: An Empirical Examination of Individual Differences and System Characteristics," *Journal of Management Information Systems* (18:3), 2000-2001, pp. 97-124.
- Hu, P.J., Chau, P.Y.K., Liu Sheng, O.R., and Yan Tam, K. "Examining the Technology Acceptance Model Using Physician Acceptance of Telemedicine Technology," *Journal of Management Information Systems*, (16:2), Fall 1999, pp. 91-112.
- "IDC 1999 Factsheet: IP Telephony," [http://www.idc.com/Factsheets99/99Services/Internet/ipt\\_hm](http://www.idc.com/Factsheets99/99Services/Internet/ipt_hm).
- Igarria, M., Zinatelli, N., Cragg, P., and Cavaye, A.L.M. "Personal Computing Acceptance Factors in Small Firms: A Structural Equation Model," *MIS Quarterly*, 1997, pp. 279-302.
- Kohli, R. "Assessing Attribute Significance in Conjoint Analysis: Nonparametric Tests and Empirical Validation," *Journal of Marketing Research* (25), 1988, pp. 123-133.
- Lee, D., Park, J., and Ahn, J. "On the Explanation of Factors Affecting e-Commerce Adoption," *Proceedings of the Twenty-second International Conference on Information Systems (ICIS)*, New Orleans LA 2001, pp. 109-120.
- Magal, S.R., and Mirchandani, D.A. "Validation of the Technology Acceptance Model for Internet Tools," *Proceedings of the Americas Conference on Information Systems*, Boston MA, 2001, pp. 496-501.
- Moon, J., and Kim, Y. "Extending the TAM for a World-Wide-Web Context," *Information & Management* (38), 2001, pp. 217-230.
- Patten, K. *Data Networking Made Easy*, Aegis Publishing, Newport RI, 2000.
- Pelkie, J. E. "Technological Innovation: Regaining the Competitive Edge," *Engineering Management Journal*, (1:4), December 1989, pp. 31-36.
- Polyzois, C.A.; Purdy, K. H., Yang, P., Shrader, D., Sinnreich, H., Menard, F., and Schulzrinne, H. "From POTS to PANS: A Commentary on the Evolution to Internet Telephony," *IEEE Internet Computing*, (3:3), May/June, 1999, pp. 83 -91.
- Roberts, E. B. "Managing Invention and Innovation," *Research-Technology Management*, (31:1), 1988, pp. 12-13.
- Rogers, E. M. *Diffusion of Innovations*, The Free Press, New York, 1983.
- Rosenkopf, L., and Tushman, M. "The Coevolution of Technology and Organization," in *Evolutionary Dynamics in Organizations*, edited by Baum, J., and Singh, J., Oxford University Press, New York NY, 1994.
- Straub, D.W., Keil, M., and Brennan, W. "Testing the Technology Acceptance Model Across Cultures: A Three Country Study," *Information & Management* (33), 1997, pp. 1-11.
- Street, V. S., "IP Telephony: The End of the World as We Know IT," *Cause/Effect Journal*, (22:3) 1999.
- Schulzrinne, H., and Rosenberg, J. "The IETF Internet Telephony Architecture and Protocols," *IEEE Network Computing*, (3:3), May-June 1999, pp. 18-23.
- Tam, K. -Y., and Hui, K.L. "A Choice Model for the Selection of Computer Vendors and Its Empirical Estimation," *Journal of Management Information Systems* (17:4), 2001, pp. 97-124.
- Tushman, M. L., and O'Reilly, C. A. III, *Winning through Innovation*, Harvard Business School Press, Boston MA, 2002.
- Venkatesh, V., and Davis, F.D. "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies," *Management Science*, (46:2), February 2000, pp. 186-204.
- Vugrinex, A. and Tomazic, S. "IP Telephony from the User Perspective," *Proceedings from the 10<sup>th</sup> Mediterranean Electrotechnical Conference, MEleCon 2000*, pp. 344 -347.
- Williams, F., Rice, R., and Rogers, E. M. *Research Methods and the New Media*, New York Free Press, 1988.
- Zufryden, F.S. "Using Conjoint Analysis to Predict Trial and Repeat-Purchase," *Decision Sciences* (19:1), 1988, pp. 55-71.