

# TELECOMMUNICATION COURSE CONTENT: A COMPARISON OF 1997 AND 2002 DELPHI STUDIES

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*Many colleges and universities teach telecommunication courses at different levels or incorporate telecommunication topics in more than one course. This, along with the difficulty of keeping up with an ever-changing information technology environment, provides a challenge to academicians. This research is a follow-up study to a telecommunication course content Delphi study completed in 1997. The participants were Organizational Systems Research Association (OSRA) members, were self-selected, and met certain criteria. This study identifies the topics that, by either common consent or consensus of the Delphi participants, should make up the content of a telecommunication course at the college/university level. A comparison between the 1997 and 2002 study is explained, and those topics not receiving consensus or common consent are also displayed.*

## BACKGROUND

As the enormous amount of telecommunication products and applications continues to grow and surround us in our daily lives, it is important to keep the telecommunication curriculum current. The information technology environment presents a wide variety of technological challenges. User requirements play a significant part in technological changes and the ever-changing need to provide that successful information systems platform to the user. As the information technology environment rapidly changes, this poses a challenge not only for management information systems (MIS) managers, but also for academicians (Maier, Clark, & Remington, 1998).

Many colleges and universities teach telecommunication courses at different levels or incorporate telecommunication topics in more than one course. One challenge for educators is how to stay current in an ever-changing environment and apply this knowledge to their specific curricula and course development. It is obvious that the need for information systems (IS) workers is growing, but the identification of the specific skills required for the variety of IS positions is not as clear (Noll & Wilkins, 2002). Management information systems managers are challenged to find competent workers for their positions. The proliferation of IS issues

such as the Internet, security, data growth, and data management also pose problems for MIS managers.

This research is a follow-up to a telecommunication course content Delphi study completed in 1997. A modified Delphi technique was used in the follow-up study, as the participants were not provided simply with a "blank page" for course content ideas, but were provided with the common consent course curriculum topics and subtopics provided by the 1997 study. Common consent is identified in this study, and the previous study, as two-thirds of the participants rating topics/subtopics with a 5, Definitely Do Include the Topic. Consensus is identified in this study, and the previous study, as all participants rating the topics/subtopics with a five. The 1997 study resulted in only one topic, local area networks, receiving consensus. Thus, the researchers investigated topics and subtopics that were agreed upon by two-thirds of the participants and thus received common consent. The participants were from the same professional organization, the Organizational Systems Research Association

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(OSRA), as the previous study. The 1997 initial study consisted of 19 participants in round 1; however, 15 participants completed the study through round 4. The number of participants in a Delphi study varies. Delbecq, Van de Ven, and Gustafson (1975) indicated that the number of respondents or panel size is variable and concluded that if a study has a homogenous group of people, ten to fifteen participants might be enough.

The same modified Delphi format was followed for both studies. The 1997 initial study was published in the *Office Systems Research Journal* in the Fall 1998 issue (Crews & Ray, 1998). The 2002 study provided a course content list defined by the Delphi group, which contained more consensus than the 1997 study and included new topics and subtopics. The methodology, research design, findings, and conclusions are discussed throughout this article. This research, like the previous study in 1997, attempted to achieve consensus among telecommunication educators regarding the specific content of a beginning telecommunication course at the college or university level.

#### RELATED LITERATURE

Ten years ago, Trauth, Farwell, and Lee (1993) identified a gap between industry expectations and academic preparation. Curriculum and course updates are necessary to provide students with the essential skills needed upon graduation. Educational institutions must therefore be willing to review their curricula and investigate how to update them to produce the technically competent students who also have the skills necessary to succeed in the business world. "The number of workers in the computer and software industries has almost tripled in the past decade" (Freeman & Aspray, 1999, p. 35). Consequently, academia faces the difficult task of providing an up-to-date curriculum in an environment that is constantly changing. Hoplin (2003) summarizes changes in technology by pointing out that "the rapid proliferation of emerging information technologies drives home the point that IS cannot run in place without losing ground" (p. 1).

Telecommunications is a large part of the information systems environment. Research by Gonzenbach (1998) resulted in the recommendation that most emphasis should be placed on teaching the following: telecommunications, operating systems, systems analysis and design, networks, and business communications. Continued developments in e-commerce, wireless networks, and other advances in technology will only enhance the need to update skills in telecommunications.

Security has been an important element in telecommunications, and will become more important in the future. Network security and the encryption of passwords are gaining more attention as businesses and educational institutions install wireless networks. Due to flaws in network topologies, improved security is necessary. Improved security standards are being developed by the Institute of Electrical and Electronics Engineers (IEEE). Network administrators are learning how to update, maintain, and protect their data, users, and investment in telecommunications environments without wires.

The elimination of interconnection cables in a network environment is not impossible. The Bluetooth (BT) Consortium, founded in 1998, has developed as its main focus the elimination of cabling and the connection of devices via a universal radio link. This type of open system platform will provide for voice and data through a wireless connection. These "virtual" networks are wirelessly connected devices that create a wireless personal area network (WPAN) allowing desktops, mobile phones, pagers, handheld devices, and the like to be connected (Warring, Galli, Kerpez, & Ungar, 2000).

IEEE wireless networking standards 802.11a and 802.11b enhance the ability to exchange data in a wireless environment. 802.11 refers to a group of specifications developed by IEEE. These specifications relate to a connection between two wireless clients or a wireless client and a base station. It involves an over-the-air interface, and the specifications are broken down into 802.11a, 802.11b, and 802.11g. These specifications and the desire for transmitting voice over the Internet are advancing the telecommunications industry.



Voice over IP (VoIP) is basically the ability to send voice using the Internet protocol. The voice is sent in digital form in packets. The major advantage is that it avoids the charges from ordinary telephone services (TechTarget, 2003). The impact these developments are having on the telecommunications industry is enormous.

#### RESEARCH DESIGN

The Delphi method is a set of procedures for eliciting and refining the opinions of a group (Brown, 1968; Dalkey, 1967). This method was used in the previous study; therefore, it was obvious that the Delphi method would be chosen for this study. Linstone and Turoff (1975) summarize the Delphi method best by stating, "Delphi may be characterized as a method for structuring a group communication process, so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem" (p. 3). This allows for a group of educators in the area of information systems to come to consensus on course content topics and subtopics as well as to evaluate the importance of content items.

Two modifications of the standard Delphi technique were employed. First, the participating panel received an initial list of topics from the 1997 study. In round 1, the participants reacted to this course content list by providing suggestions for retention or deletion and by the addition of topics or subtopics. Topics such as network topologies and data signals, for example, are broad categories under which more specific subtopics are identified. The same format was used for round 2. The second modification was that in the final two rounds (third and fourth) the participants evaluated the remaining topics using the following Likert scale:

1. Definitely Do Not Include the Topic
2. Possibly Do Not Include the Topic
3. No Opinion
4. Possibly Include the Topic
5. Definitely Do Include the Topic

Consensus occurred if all participants rated the item with a five, Definitely Do Include the Topic. Common consent was declared, as in the 1997

study, for topics or subtopics for which two-thirds of the panel rated the item with a five. At the completion of the 1997 study, 10 topics and 30 subtopics were identified through common consent. However, consensus was received on only one topic, local area networks. Consensus occurred more frequently in the current study, with consensus reached on twelve subtopics.

#### PANEL SELECTION

To be consistent with the previous study, panel selection was based on the following criteria. Each Delphi panel participant met at least one of the following criteria and was self-selected via a mailing to all OSRA members.

1. Teaches a course that includes business telecommunication concepts and technologies, such as LAN/WAN development and/or management, star/bus/ring network types, TCP/IP, Internet, teleconferencing, conceptual foundations and issues, etc.
2. Has made a professional presentation or authored a professional publication in the area of telecommunications.

The current OSRA membership list was used as the basis for selecting participants for this study. Members were mailed letters that explained the study and criteria for participation and asked for their responses. The members could return facsimile response sheets agreeing to participate, acknowledging that they could not participate, or offering a suggestion of another person in their college or university who could participate. The members could also respond through email. Of the 179 initial letters sent, 5 were returned undeliverable and 23 agreed to participate.

Once round 1 was sent via email to all 23 participants, however, 12 did not feel that they had the knowledge about telecommunication topics or could not participate for various other reasons. Therefore, 11 completed round 1 and continued to respond through round 4. Of these 11 participants, 9 teach at four-year universities and 2 teach at the community college level. Ludwig (1997) states that most Delphi studies have 15-20 participants and the



study typically runs over a period of weeks, but the number of participants is generally determined by the number required to develop a representative pooling of judgments. Taylor-Powell (2002) states that the number of participants in a Delphi study depends not only on the purpose of the study, but the diversity of the targeted population. Ten to fifteen participants may be an adequate number for a Delphi study that is focused and where the participants do not vary a great deal. With the participants in this study all teaching at the post-secondary level and all with membership in OSRA, they are a homogenous group and are expected not to vary a great deal. It is also important to take into consideration that this research is not trying to determine absolute course content, but provide a guideline for course content development.

The initial 1997 study consisted of 15 participants who were also OSRA members. Of those 15, five also participated in the 2002 study. The panel of experts in this study completed this study during the months of February through May 2002 to finalize this research and effectively worked to develop the course content list.

#### PROCEDURES

After the 11 OSRA members agreed to participate and understood the goal of this research, the final list from the 1997 study served as the initial course content list for this study. This course content list consisted of 10 main topics and 30 subtopics. Table 1 provides the common consent telecommunication course content which resulted from the initial 1997 study.

During round 1, each participant was to add and/or delete any topics or subtopics they believed were pertinent and/or not pertinent to a college/university telecommunication course. All rounds were sent via email; however, participants could respond through email or facsimile. Round 1 resulted in the course content list being expanded from 10 to 14 main topics and from 30 to 95 subtopics. Round 2 was also sent via email, and the participants again had the opportunity to add and/or delete topics and subtopics. Round 2 resulted in 10 main topics and 71 subtopics. This list was emailed during round 3 in order to allow

**Table 1: 1997 Final Course Content for a Telecommunication Course: 2002 Initial Course Content for Round 1**

#### 1. COMMUNICATIONS MEDIA

- Laser
- Wire media (twisted pair, coaxial cable, fiber optics)
- Wireless media (radio frequency, infrared)

#### 2. COMMUNICATIONS HARDWARE

- Network hardware components (servers, repeaters, hubs, bridges, routers)
- Modem definition and application
- Modem transmission speeds and formats (duplexing and serial/parallel)
- Protocol
- Multiplexing

#### 3. CONCEPTUAL FOUNDATIONS

- Role of telecommunications in business
- Introduction of network types (LANs, WANs, MANs)
- Basic communications model (sender, encoding, transmission, decoding, receiver)

#### 4. DATA SIGNALS

- Analog vs. digital
- Transmission methods (asynchronous/synchronous)
- Transmission modes (simplex, half-duplex, duplex)
- Modulation

#### 5. TELECOMMUNICATION SYSTEMS

- Electronic mail systems

#### 6. EMERGING TECHNOLOGIES (Local & Global)

- Wireless networks
- Intranets

#### 7. SOCIAL AND ETHICAL ISSUES

- Privacy and information
- Security, crime, etc.
- Legal issues

#### 8. LOCAL AREA NETWORKS (LAN)

- Basic definition and application
- LAN configuration (Internet working LANs: bridges, routers, gateways, etc.)
- Network operating systems (Novell, NT Server, Banyan Vines, etc.)

#### 9. NETWORK TOPOLOGIES

- Ring
- Star
- Bus

#### 10. WIDE AREA NETWORKS (WAN)

- Integrated services digital network (ISDN)
- Transmission speeds and bandwidth
- Integration of networks

Enumerated Items = Topics

Bulleted Items = Subtopics



the participants to evaluate the topics and subtopics using the Likert scale of 1-5.

The results of round 3 allowed the ability to calculate a group mean from the evaluation scores. Round 4 was then emailed to the participants, giving them the opportunity to review not only their ratings from round 3, but also the group mean from round 3. Participants could then change their ratings if desired. The participants were reminded that the goal of this study was to reach consensus on telecommunications topics and subtopics. Weaver (1971) discussed how the Delphi method follows the principle that several heads are better than one and that the experts involved make inferences based upon rational judgment rather than merely guessing.

Round 4 resulted in no main topics in the final consensus course content list, but did result in 12 subtopics in the final consensus course content list. Common consent was reached on several topics and subtopics. Table 2 shows the nine major topics and 45 subtopics, which resulted from round 4 of the 2002 study. Consensus items are notes with a superscript *C* (e.g., Role of Telecommunications in Business<sup>C</sup>). Participants reached consensus on 12 subtopics compared to the initial 1997 study in which only one topic received consensus.

The coefficient of variation (CV) was calculated on the ratings of each topic and subtopic (English & Kernan, 1976). The variation between ratings in rounds three and four were compared to determine whether it would be necessary to continue the Delphi study with a round five. In this study, if the CV is less than or equal to 0.5, an additional round is not necessary. Very few topics or subtopics were in the 0.3-0.4 range, and all were below 0.5. Therefore, a round 5 was not necessary.

## FINDINGS

Table 3 and the following discussion describe the findings of this study, comparing the common consent course content list from the 1997 study with the common consent course content list in 2002. The main topics are organized in column one as listed in the 1997 study. Column two lists the findings of the 2002 study, and column three notes specific similarities and differences.

Note that limitations to this study include a population consisting only of OSRA members and the small number of participants. The participants, however, are academics who met the requirements of either teaching current telecommunication-based subject matter or publishing in the area. Rowe and Wright (1999) noted that the number of Delphi participants and the number of rounds vary from study to study. They investigated 27 Delphi studies and found that the rounds varied between 2 and 7 and the number of participants ranged from 3 to 98.

As hardware and wireless media expand our telecommunications capabilities, the communications media topic expanded from three to five subtopics. The IEEE 802.11x subtopic was an important addition, as was media selection criteria. It is essential for the persons selecting the media to understand why the chosen media for their particular situations are the best choice.

The communications hardware topic actually decreased in the number of subtopics. That decrease was due to two factors. First, two subtopics dealing with modems in the original study were combined into one subtopic in this study. Second, a previous subtopic, protocol, was promoted in the current study to stand as a new topic, protocols and standards. This emphasizes the importance for an understanding of protocols and standards that deal with telecommunications.

Conceptual foundations now includes not only the role of telecommunications in business, but technology's role in communications. With ever-changing technology, this is an important topic for a telecommunications course. The generic wording of these two subtopics should allow for them to continue in future studies. The basic communication model (sender to receiver) was deleted as it may have been seen as common knowledge or knowledge gained in a previous course.

With baseband and broadband becoming more prevalent in telecommunications since 1997, it became a new subtopic under data signals. It became obvious in the current study that it is not only necessary for telecommunications students to understand transmission modes and methods, but how data are converted into signals. As users



**Table 2: 2002 Final Course Content for a Telecommunication Course—Common Consent****1. CONCEPTUAL FOUNDATIONS**

- Technology's role in communication
- Role of telecommunications in business<sup>C</sup>

**2. PROTOCOLS AND STANDARDS**

- Protocols and standards<sup>C</sup>
- OSI Model (7 layers)<sup>C</sup>
- TCP/IP<sup>C</sup>

**3. DATA SIGNALS**

- Analog vs digital<sup>C</sup>
- Converting data into signals
- Transmission methods (asynchronous/synchronous)<sup>C</sup>
- Transmission modes (simplex, half-duplex, duplex)<sup>C</sup>
- Modulation
- Error detection and control
- Baseband vs. broadband<sup>C</sup>

**4. COMMUNICATIONS MEDIA**

- Wire media (twisted pair, coaxial cable, fiber optics, Category 5, 5e, 6, 7)<sup>C</sup>
- 802.3, 802.4, 802.5, etc.
- Wireless media (laser, radio frequency, infrared, cellular, microwave, satellites, etc.)
- 802.11a, 802.11b, 802.11g, etc.
- Media selection criteria

**5. COMMUNICATIONS HARDWARE**

- Network Interface Card (NIC)<sup>C</sup>
- Network hardware components (servers, repeaters, hubs, bridges, switches, routers)
- Modem definition, application, transmission speeds and formats (duplexing and serial/parallel)
- Multiplexers

**6. LOCAL AREA NETWORKS (LAN) AND TOPOLOGIES**

- Basic definition and application<sup>C</sup>
- LAN configuration (Internet working LANs: bridges, routers, gateways, etc.)<sup>C</sup>
- Network operating systems (Windows NT, 2000, XP, Unix, Linux, Novell, etc.)
- Network administration and support
- Ring
- Star
- Bus
- Access methodologies (CSMA/CD and token passing)
- Logical topology (broadcast or sequential)
- Mesh
- Hybrid

**7. WIDE AREA NETWORK (WAN)**

- Digital data services or digital network services (ISDN, DSL, ADSL, frame relay, ATM, Sonet, T1, T3, etc.)
- Transmission speeds and bandwidth
- Remote access
- IP addressing
- Broadband
- Routing

**8. TELECOMMUNICATION SYSTEMS/APPLICATIONS**

- Telephone systems, public network, and Telecommunications Act of 1996
- Voice processing
- Internet, Intranet, Extranet
- TCP/IP

**9. SECURITY/LEGAL**

- Privacy and information
- Security (firewalls, VPNs, public and private key encryption, digital signature)
- Encryption techniques

Enumerated Items = Topics

Bulleted Items = Subtopics



**Table 3: Common Consent Course Content List Comparison (1997 and 2002)**

1997 Final Course Content for a Telecommunication Course: Common Consent	2002 Final Course Content for a Telecommunication Course: Common Consent	Noted Similarities/Differences Between 1997 and 2002 Studies
<b>COMMUNICATIONS MEDIA</b>	<b>COMMUNICATIONS MEDIA</b>	Topic remained with same name in 2002
<ul style="list-style-type: none"> <li>• Wire media (twisted pair, coaxial cable, fiber optics)</li> <li>• Wireless media (radio frequency, infrared)</li> <li>• Laser</li> </ul>	<ul style="list-style-type: none"> <li>• Wire media (twisted pair, coaxial cable, fiber optics, Category 5, 5e, 6, 7)</li> <li>• Wireless media (laser, radio frequency, infrared, cellular, microwave, satellites, etc.)</li> <li>-----</li> <li>• 802.3, 802.4, 802.5, etc.</li> <li>• 802.11a, 802.11b, 802.11g, etc.</li> <li>• Media selection criteria</li> </ul>	<ul style="list-style-type: none"> <li>⇒ Expanded list developed in 2002</li> <li>⇒ Expanded list developed in 2002</li> <li>⇒ Laser not a subtopic by itself, but included in Wireless Media expanded list in 2002</li> <li>⇒ New subtopic in 2002</li> <li>⇒ New subtopic in 2002</li> <li>⇒ New subtopic in 2002</li> </ul>
<b>COMMUNICATIONS HARDWARE</b>	<b>COMMUNICATIONS HARDWARE</b>	Topic remained with same name in 2002
<ul style="list-style-type: none"> <li>• Network hardware components (servers, repeaters, hubs, bridges, routers)</li> <li>• Modem definition and application</li> <li>• Modem transmission speeds and formats (duplexing and serial/parallel)</li> <li>• Multiplexing</li> <li>• Protocol</li> </ul>	<ul style="list-style-type: none"> <li>• Network hardware components (servers, repeaters, hubs, bridges, switches, routers)</li> <li>• Modem definition, application, transmission speeds and formats (duplexing and serial/parallel)</li> <li>-----</li> <li>• Multiplexers</li> <li>-----</li> <li>• Network Interface Card (NIC)</li> </ul>	<ul style="list-style-type: none"> <li>⇒ Expanded list developed in 2002</li> <li>⇒ Expanded list developed by combining two subtopics from 1997 study into one subtopic in 2002</li> <li>⇒ Combined in subtopic above in 2002</li> <li>⇒ Wording change to reflect hardware component in 2002</li> <li>⇒ 1997 study as a subtopic was raised (with standards) to its own topic in 2002 study.</li> <li>⇒ New subtopic in 2002</li> </ul>
<b>CONCEPTUAL FOUNDATIONS</b>	<b>CONCEPTUAL FOUNDATIONS</b>	Topic remained with same name in 2002
<ul style="list-style-type: none"> <li>• Role of telecommunications in business</li> <li>• Introduction of network types (LANs, WANs, MANs)</li> <li>• Basic communications model (sender, encoding, transmission, decoding, receiver)</li> </ul>	<ul style="list-style-type: none"> <li>• Role of telecommunications in business</li> <li>-----</li> <li>-----</li> <li>• Technology's role in communication</li> </ul>	<ul style="list-style-type: none"> <li>⇒ Subtopic remained the same in 2002</li> <li>⇒ 1997 subtopic deleted in 2002</li> <li>⇒ 1997 subtopic deleted in 2002</li> <li>⇒ New subtopic in 2002</li> </ul>
<b>DATA SIGNALS</b>	<b>DATA SIGNALS</b>	Topic remained with same name in 2002
<ul style="list-style-type: none"> <li>• Analog vs. digital</li> <li>• Transmission methods (asynchronous/synchronous)</li> <li>• Transmission modes (simplex, half-duplex, duplex)</li> <li>• Modulation</li> </ul>	<ul style="list-style-type: none"> <li>• Analog vs. digital</li> <li>• Transmission methods (asynchronous/synchronous)</li> <li>• Transmission modes (simplex, half-duplex, duplex)</li> <li>• Modulation</li> <li>• Converting data into signals</li> <li>• Error detection and control</li> <li>• Baseband vs. broadband</li> </ul>	<ul style="list-style-type: none"> <li>⇒ Subtopic remained the same in 2002</li> <li>⇒ Subtopic remained the same in 2002</li> <li>⇒ Subtopic remained the same in 2002</li> <li>⇒ Subtopic remained the same in 2002</li> <li>⇒ New subtopic in 2002</li> <li>⇒ New subtopic in 2002</li> <li>⇒ New subtopic in 2002</li> </ul>



**Table 3: Common Consent Course Content List Comparison (1997 and 2002) (Continued)**

<u>TELECOMMUNICATION SYSTEMS</u>	<u>TELECOMMUNICATION SYSTEMS/APPLICATIONS</u>	<u>Topic name change in 2002</u>
<ul style="list-style-type: none"> <li>Electronic mail systems</li> </ul>	<ul style="list-style-type: none"> <li>Telephone systems, public network, and Telecommunications Act of 1996</li> <li>Voice processing</li> <li>Internet, Intranet, Extranet</li> <li>TCP/IP</li> </ul>	<p>⇒ 1997 subtopic deleted in 2002</p> <p>⇒ New subtopic in 2002</p> <p>⇒ New subtopic in 2002</p> <p>⇒ New subtopic in 2002</p> <p>⇒ New subtopic in 2002</p>
<u>EMERGING TECHNOLOGIES</u> (Local & Global)		<u>1997 topic deleted in 2002</u>
<ul style="list-style-type: none"> <li>Wireless networks</li> <li>Intranets</li> </ul>		<p>⇒ 1997 subtopic deleted in 2002</p> <p>⇒ 1997 subtopic deleted in 2002</p>
<u>SOCIAL AND ETHICAL ISSUES</u>	<u>SECURITY/LEGAL</u>	<u>Topic name change in 2002</u>
<ul style="list-style-type: none"> <li>Privacy and information</li> <li>Security, crime, etc.</li> <li>Legal issues</li> </ul>	<ul style="list-style-type: none"> <li>Privacy and information</li> <li>Security (firewalls, VPNs, public and private key encryption, digital signature)</li> <li>Encryption techniques</li> </ul>	<p>⇒ Subtopic remained the same in 2002</p> <p>⇒ Expanded list developed in 2002</p> <p>⇒ 1997 subtopic deleted in 2002</p> <p>⇒ New subtopic in 2002</p>
<u>LOCAL AREA NETWORKS (LAN)</u>	<u>LOCAL AREA NETWORKS (LAN) AND TOPOLOGIES</u>	<u>Topic name change in 2002</u>
<ul style="list-style-type: none"> <li>Basic definition and application</li> <li>LAN configuration (Internet working LANs, bridges, routers, gateways, etc.)</li> <li>Network operating systems (Novell, NT Server, Banyan Vines, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>Basic definition and application</li> <li>LAN configuration (Internet working LANs, bridges, routers, gateways, etc.)</li> <li>Network operating systems (Windows NT, 2000, XP, Unix, Linux, Novell, etc.)</li> <li>Network administration and support</li> </ul>	<p>⇒ Subtopic remained the same in 2002</p> <p>⇒ Subtopic remained the same in 2002</p> <p>⇒ Expanded list developed in 2002</p> <p>⇒ New subtopic in 2002</p>
<u>NETWORK TOPOLOGIES</u>		<u>Topic combined with LAN topic above in 2002</u>
<ul style="list-style-type: none"> <li>Ring</li> <li>Star</li> <li>Bus</li> </ul>	<ul style="list-style-type: none"> <li>Ring</li> <li>Star</li> <li>Bus</li> <li>Access methodologies (CSMA/CD and token passing)</li> <li>Logical topology (broadcast or sequential)</li> <li>Mesh</li> <li>Hybrid</li> </ul>	<p>⇒ Subtopic remained the same in 2002</p> <p>⇒ Subtopic remained the same in 2002</p> <p>⇒ Subtopic remained the same in 2002</p> <p>⇒ New subtopic in 2002</p> <p>⇒ New subtopic in 2002</p> <p>⇒ New subtopic in 2002</p> <p>⇒ New subtopic in 2002</p>
<u>WIDE AREA NETWORKS (WAN)</u>	<u>WIDE AREA NETWORK (WAN)</u>	<u>Topic remained with same name in 2002</u>
<ul style="list-style-type: none"> <li>Transmission speeds and bandwidth</li> <li>Integrated services digital network (ISDN)</li> <li>Integration of networks</li> </ul>	<ul style="list-style-type: none"> <li>Transmission speeds and bandwidth</li> <li>Digital data services or Digital network services (ISDN, DSL, ADSL, frame relay, ATM, Sonet, T1, T3, etc.)</li> <li>Remote access</li> <li>IP addressing</li> <li>Broadband</li> <li>Routing</li> </ul>	<p>⇒ Subtopic remained the same in 2002</p> <p>⇒ Expanded list developed in 2002</p> <p>⇒ 1997 topic deleted in 2002</p> <p>⇒ New subtopic in 2002</p> <p>⇒ New subtopic in 2002</p> <p>⇒ New subtopic in 2002</p> <p>⇒ New subtopic in 2002</p>
	<u>PROTOCOLS AND STANDARDS</u>	<u>New topic in 2002</u>
	<ul style="list-style-type: none"> <li>Protocols and standards</li> <li>OSI Model (7 layers)</li> <li>TCP/IP</li> </ul>	<p>⇒ New subtopic in 2002</p> <p>⇒ New subtopic in 2002</p> <p>⇒ New subtopic in 2002</p>



demand more data more frequently, error detection and control are essential to include in this type of course.

The original telecommunications systems topic was expanded to telecommunications systems/applications. This allowed for a variety of subtopics to be included in this area. Although the email systems subtopic was deleted, perhaps seen again as common knowledge, the subtopics expanded to include voice processing and TCP/IP. With voice over IP (VoIP) gaining ground in the telecommunications area, these subtopics allow for the inclusion of VoIP in the classroom as well. As businesses develop intranets and extranets, and obviously use the Internet, these topics were aligned as one subtopic. It is important for students to acknowledge the differences, but also note the overlap between the three.

Emerging technologies was the only topic from the initial study that was deleted. The two subtopics, wireless networks and intranets, continue as subtopics in other areas, however. As they were not seen as emerging in 2002, but rather in place in existing telecommunications, they were removed as emerging but continue to serve as important subtopics.

The social and ethical issues topic took a turn toward security/legal issues. Privacy and information remained a staple subtopic; however, security and encryption was expanded. As more information is becoming electronic, privacy and security have become more important topics for the classroom setting as well. Teaching encryption techniques only emphasizes the importance of trying to keep those who should not have access out of private areas.

Local area networks (LANs), the only area that received consensus in the initial study, was combined with the topic of topologies in 2002. These topics interrelate in several ways. Obviously, students need to know the basic definition of a LAN, but also common topologies such as bus, ring, and star. Once this basic understanding is achieved, the subtopics in this area are numerous. This combination of subtopics resulted in the largest number of subtopics, 11, in any area. The basic understanding of LAN and topologies leads to

hybrids, LAN configuration, and networking operating systems.

The wide area networks (WANs) topic expanded just as WANs have expanded in today's society. Telecommunications students should move beyond ISDN and learning about transmission speeds and bandwidth to digital data services and networks. Managers in the telecommunications area need remote access and IP addressing capabilities. These are therefore essential topics for the classroom as well.

Two participants did not feel comfortable rating the main topics themselves, as they were too broad to rate. None of the main topics therefore received consensus. Nine of the ten topics, however, did receive common consent. The one main topic that did not receive common consent was name resolution, which included subtopics such as DNS, NetBEUI, WINS, and ARP. This topic was introduced in the current study. The subtopics that

**Table 4: Subtopics Not Receiving Common Consent**

Subtopic	Mean
Electronic mail systems (POP, POP3, SMTP, MIME, IMAP, LDAP)	4.64
Cellular systems	4.64
Integration of networks	4.55
DNS	4.55
Data codes	4.45
Legal issues	4.45
Careers in communication technology	4.36
Special WAN hardware devices (CSU/DSU, DTE, DCEs, bridges, switches routers, etc.)	4.36
Electronic data interchange	4.36
Network design/Systems life cycle	4.27
Subnetting and supernetting	4.27
Teleconferencing	4.27
WINS	4.27
ARP	4.27
Virtual private networks and virtual circuits	4.18
Voice recognition, artificial intelligence, intuitive systems	4.18
PDA technology	4.18
Telecommuting	4.09
NetBEUI	4.00
Future of and certification levels in telecommunication	3.91
RARP	3.91
HOSTS	3.82
LMHOSTS	3.82
AppleTalk	3.64
Telematics for the automobile industry	3.18



did not result in common consent are listed in Table 4. The subtopics are listed with their Likert means.

One main topic and 25 subtopics did not receive common consent. Seven of those subtopics were included in the one main topic that did not receive common consent. A few of the participants included some commentary as they returned their ratings from round 3 and round 4. These comments offered justification for their choices by noting that the subtopic may be taught in another course or is no longer relevant.

## CONCLUSIONS

Based on the findings of this study, 9 main topics and 45 subtopics have emerged through common consent and represent the group decision of what should comprise the core body of knowledge for a college or university course in telecommunications. It should also be noted that consensus was reached on 12 subtopics. Since consensus is established when all 11 participants rated that item a 5, it is important for those teaching a beginning telecommunication course to investigate their own curricula to see if these subtopics are included.

A review of the IS 2002 Model Curriculum (Gorgone et al., 2002) also assures that the participants in this study provided up-to-date information. The IS 2002 Model Curriculum includes four knowledge areas that IS graduates would be expected to have grasped. Technology is one of those knowledge areas. In the technology area, several topics in the IS 2002 Model Curriculum are also included in the common consent course content list in this study. Some examples include computer systems hardware, networking (LAN/WAN) and telecommunications, systems software, system administration, and security.

The main topics and subtopics that resulted from this study can provide a basis on which new instructors of telecommunications can construct their courses. This course content list can also serve as a basis for those who have taught telecommunication courses to check or update their curricula. As noted through participants' comments, it is obvious that beginning telecommunication courses are taught at different

levels and taught differently at various college and universities. Some colleges and universities may offer more than one course in this area or the topics may be incorporated in one or more courses. It is important, however, that the content be updated and reviewed as the telecommunication technologies change in society. Therefore, the common consent course content list developed in this study will help in that endeavor.

## FUTURE RESEARCH

The following are recommendations for future research.

1. Complete a follow-up study in five years. There would then be a sequence of course content lists from 1997, 2002, and 2007. This would show the movement of technology and how important it is to keep up with changing technologies in the classroom.
2. Complete similar studies in other areas of business education and information systems. There is a wide variety of courses taught in these areas, and it is necessary to stay current with topics to include in coursework. This type of research provides that opportunity.
3. Complete a similar study with Information Technology (IT) professionals. This will allow educators to investigate what those currently in IT careers also believe should be included in a telecommunication course at the college/university level.

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