

Ten Technical Attributes of Communication and Information Technologies

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There are ten (10) primary attributes of telecommunications technology that underlie the workings of all communication and information technologies (CIT). While not necessarily an exhaustive list, a brief definition and discussion of these attributes of technology will aid in any discussion or comparison of CIT.

Type of Content

There are only five basic types of content carried on electronic CIT today: text, audio, still image, moving image, and raw data. Text includes all alphanumeric characters—letters, numbers, graphical characters, and punctuation.

Audio content includes all voice and vocal communication, as well as music, sound effects, and any other content that can be carried and output as sound. Moving image includes video, film, animation, and other forms of apparent motion. Voice and moving images share an important attribute the other types of content do not have: voice and moving images are **timed** communication, while all other forms are **untimed** (one of two key components of temporality). Still image includes all forms of graphics, including facsimile, or fax.

Finally, raw data can be defined as anything not covered under the other types of content. This would include any content requiring a computer program to process it at the other end. For example, financial institutions often transmit raw data and computers interpret the data at the other end. As will be seen in the discussion of the common dimensions of CIT below, these basic types of content go a long way toward determining the types of messages people will send, and information people will process, when using any particular CIT.

Directionality

Communication and information technologies can be one-way or two-way. A two-way system allows messages to travel in both directions, while a one-way system allows no direct feedback from receiver to sender, only indirect feedback through another CIT. While this basic attribute of the communication system has traditionally distinguished mass (one-way) from interpersonal (two-way) communication, today distinctions between one-way and two-way communication are more difficult to make, as time is factored in with directionality.

For example, while any individual e-mail message only provides one-way communication, an e-mail system is a two-way system: messages can travel in both directions. The non-simultaneous nature of e-mail confuses many people who then will describe e-mail as one-way. What they are doing is confusing directionality with simultaneity.

Degree of Non-Simultaneity

All communication is either simultaneous or non-simultaneous. This attribute is not a continuum from simultaneity to non-simultaneity. On the contrary, simultaneity/non-simultaneity is a dichotomy, and then there are varying degrees of non-simultaneity.

Simultaneous communication implies that the message is created and presented at the same time. Examples include face to face interactions, telephone conversations, and live radio or television.

All forms of stored messages are, by definition, non-simultaneous communication. In fact, with the exception of brief delays caused by very large distances, half-duplex connections, or other variations/delays in simultaneous transmissions, non-simultaneous communication implies that the message creation and presentation processes are separate and that the message was made available in some storage medium.

Type of Conduit

The two primary types of conduit are wired and wireless. Wired transmissions travel over copper wire, coaxial cable, or fiber optic cable. Wireless transmissions use a particular frequency and bandwidth within the electromagnetic spectrum, or, in the case of sound waves, vibrations in the atmosphere.

Many CIT use combinations of both wired and wireless, including broadcast and cable television, radio, and cordless and cellular telephones. While technically this makes these systems “hybrids” of wired and wireless, people normally still speak of these technologies as wired or wireless, depending on the predominant type of conduit.

Analog / Digital Representation

This representation can come at any or all of the three stages that the content passes through: message creation, message presentation (including transmission), or message preservation. Content stored digitally has several advantages, the most important of which is ease of access. The use of digital representation for the creation and presentation of messages provides a variety of modest space and time savings in content storage and transmission, and provides substantially more user control over message presentation.

However, the biggest difference between analog and digital representations comes at the stage of message preservation. First, digital content, from e-mail messages to airline reservations, can be easily accessed and most of it is easily searchable. Second, preserving the content of information technologies in digital format is quickly providing a market in meta-information—information about information. Precise records about the information processing that each of us engages in allows for more than market segmentation and crude targeting of mass media messages; it is spawning a new and ubiquitous era of direct marketing, through pointcasting.

Number of Access Points

Every communication and information system has a certain number of access points, or nodes. Researchers typically view the communication process as falling into one of three categories: one-to-one, one-to-many, or many-to-many communication. The capacity of the system should not be confused with the ability of people to use the system. For example, it is now possible to hold audio conference calls among hundreds of people. Yet experience indicates that conference calls with more than eight to ten people generate confusion over turn-taking, and larger conference calls prove quite unwieldy for group discussion.

Type of Connection

There are three basic types of connections: switched, networked, and broadcast. Switched connections, such as telephone and data calls, require that the sender and receiver be connected at the same time. Fax calls are a variation on this that require the sending and receiving terminal devices to be connected at the same time.

Networked connections, such as e-mail, pass information from one node in a network to another, but the sender and receiver's terminal devices are typically never connected to each other.

Finally, broadcast connections, such as cable television, over-the-air television, and radio, are "direct" connections if the intended recipients of messages have their receivers turned on, or result in no connection if the receiver is off. Broadcasting simply puts the signal out there to be received—there is no guarantee it will be, and typically no direct confirmation back to the sender, since these systems are usually one-way.

Bandwidth

Bandwidth in the world of wireless connections represents a portion of the **electromagnetic spectrum**. The spectrum is partitioned and allocated by governments and can vary from very narrow channels to very wide channels. For example, in the United States AM radio stations broadcast on a 10 kilohertz (kHz) channel. In contrast, FM radio's channel is 20 times that, at 200 kHz, and television stations get 6 megahertz (MHz), or 6,000 kHz—600 times the bandwidth of an AM radio station.

The primary bandwidth distinctions made in **wired** telecommunications links are narrowband, broadband, and baseband. The differences among these are somewhat vague, or have changed as the bandwidth capabilities of fiber optics cable have changed. But typically narrowband refers to the bandwidth required for telephone calls, broadband refers to cable television conduit, and baseband refers to single-channel local area network connections. Bandwidth is directly related to the dimension of capacity.

Storage

Storage has long been a multi-faceted attribute of information technologies. Today most CIT have some ability to store content. Capabilities relating to content storage include:

- **Content Preservability.** The type of content preserved (the form and format, temporary vs. permanent storage, messages vs. information, etc.), the procedures for preserving it, and who is empowered to preserve it (end users, specialists, etc.) are all key components of content preservability.
- **Content Retrieveability** refers to the ability to retrieve existing stored content. The format of such content is tied to the next two components of storage.
- **Content Searchability** refers to the flexibility available in accessing stored content. Many CIT today provide a range of search and presentation options.
- **Content Modifiability.** Not all content that can be retrieved or searched can be modified by that same user. The ability to update content usually indicates ownership of that content.

User Interface

The user interface is a component of every CIT, but also varies tremendously from system to system. The complexity of the user interface is typically related to the complexity of its capabilities. Sophisticated CIT, such as the personal computer, have complex user interfaces. But all user interfaces share the following characteristics:

- Type of mediation (text, voice, still image, moving image, raw data)
- Input / output devices
- System navigation
- Feature richness (the number and type of features)

- Feature use