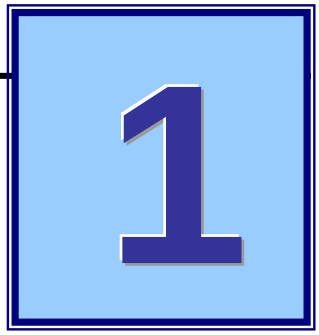

1. Introduction and General Requirements

This section describes the circumstances leading to the CSU's development and promulgation of this Telecommunications Infrastructure Planning Standards (TIP Standards or TIPS) document.

1.1 The TIP Standards Concept

1.1.1 Intent

The California State University system has committed itself in recent years to a very large investment in technology infrastructure, hardware and software to serve perceived system-wide mission-critical needs. Prudent management of that investment of public resources requires that all possible strategies be adopted to assure its long-term viability. Among those strategies, a principal focus is, and will continue to be, assurance that the products and services being acquired are of the highest possible quality. This TIPS document is only one of numerous specific statements of the University's commitment to that goal.

It must be emphasized that the technical material inorporated in this document should be regarded by the planning and design personnel considering them as *minimum standards* governing the development of technology resources across the CSU system. At the same time, it is also recognized that that system incorporates more than a score of campuses of varied sizes, widely differing physical and climatic environments, and quite diverse academic objectives. Given that situation, it may sometimes be

necessary for local planning and design personnel to depart from strict adherence to these TIP Standards—but no departure from the implicit *minimum level of quality* is expected. Further, absolutely nothing in this document is intended to relieve design consultants of their basic professional and contractual obligations for careful project analysis, strict adherence to sound design principles and best practices, and responsible oversight of construction and installation activities.

1.1.2 Purpose of the TIPS Document

As was true of its several predecessor documents, TIPS continues to incorporate input from a diverse group of CSU system and campus staff, engineering consultants, and product vendors. Its primary purpose is to provide a standardized approach to developing intra- and inter-building campus telecommunications infrastructure physical plant systems essential to achieving mission-critical CSU goals: facilitating teaching and learning, improving productivity and efficiency, enhancing research and scholarship, and increasing the efficiency of institutional management. A further pupose of the TIP Standards is to ensure the necessary development of intra-campus infrastructures adequate to support high-speed linkages with other CSU sites, with various telecommunications providers, and with the Internet. TIPS is not intended to be the sole source of CSU technology physical plant planning and design information; it is, rather, a tool for defining and explicating the specific telecommunications-related infrastructure requirements common to CSU facilities.

This document provides direction for information technology managers, facility planners, architects, and other design professionals in the design and technical integration of telecommunications media, pathways, and spaces. The objectives of the TIP Standards are to:

1. Provide a universal framework for inter/intra-building infrastructure design, development, and deployment in the CSU;

2. Define minimum standards for the spaces, pathways, and telecommunicaions-related infrastructure that must be programmed into either new building construction or retrofit projects;

3. Outline specific media selection and design criteria;

4. Highlight technical issues that must be incorporated into a campus design and procurement process; and

5. Delineate methods and procedures for installing, testing, and documenting cable and related infrastructure.

This TIP Standards document is not intended to provide all the answers to information technology-related infrastructure design issues encountered within the CSU. The document's nature is such that, while providing topical information regarding certain specific solutions or design methods, it also serves to identify the range of components and issues covered by the telecommunications distribution requirements in a typical University building construction or renovation project. Most of the TIP Standards content is based upon various national standards and guidelines for telecommunications systems, such as those developed by the Electronic Industry Association (EIA), Telecommunications Industry Association (TIA), Institute of Electrical and Electronics Engineers (IEEE), and Building Industry Consulting Services International (BICSI). Great emphasis is placed herein on the idea that taking guidance from such sources is generally more desirable than using specific manufacturer's proprietary designs which may quickly become outdated or may be incompatible with other needed equipment.

1.2 Foundations of the TIP Standards

1.2.1 History

In the past sixteen years the California State University (CSU) has prepared a variety of planning documents, position papers, sample specifications, and guidelines to assist campus managers and design professionals in developing a standards-based approach to the deployment of a flexible and cost-effective telecommunication infrastructure.

In 1987, the CSU published the *Systemwide Cable Plan* to establish a guideline for planning, installing, and maintaining telecommunications wire and cable in a uniform manner across its campuses. In 1993, the document

was revised and expanded to include information on telecommunication support infrastructure and became the first version of the *Telecommunications Infrastructure Planning (TIP) Guidelines*. Since that time the TIP Guidelines have been updated, sample specifications prepared, and new funding and planning guidelines developed.

While previous TIP documents were certainly successful at addressing portions of the telecommunications infrastructure issue, some provisions must almost continually be revised to encompass changes in technology and in CSU system strategies currently being implemented. These updates reflect the introduction of new alternatives, changes in the cost-effectiveness of others, a greater emphasis on "standard" models within the CSU system, and the evolution of true national standards. This edition of TIP is intended to move further toward the replacement of earlier "recommended" guidelines with a true CSU standards document which establishes the minimum requirements for telecommunications infrastructure within the CSU system.

1.2.2 Strategic Approach

1.2.2.1 The Integrated Technology Strategy

Learning in today's environment is based to a considerable degree upon access to various information resources. Students expect information technology to support both the instructor's need to communicate and their own need to gather, store, and disseminate ideas. To meet this expectation, the technology must support links at all levels of the campus, system, nation, and world in a wide variety of formats. In response to this demand, the CSU has developed an Integrated Technology Strategy (ITS). This system-wide plan outlines methods and goals for the development and distribution of technology within the framework of the CSU's mission. That mission is built on three basic goals:

- Provide quality programs;
- Provide access to an expanding number of learners; and
- Ensure affordability to those learners.

For the last several years the CSU has been successfully implementing specific initiatives in support of the ITS. These initiatives are based upon a pyramid (building block) model that encompasses the need for a strong, flexible, and cost-efficient infrastructure on which the technology can be constructed.

The ITS pyramid represents the framework process, benefits, and outcomes that have been designed into the Integrated Technology Strategy – "Building the Future for Learners."

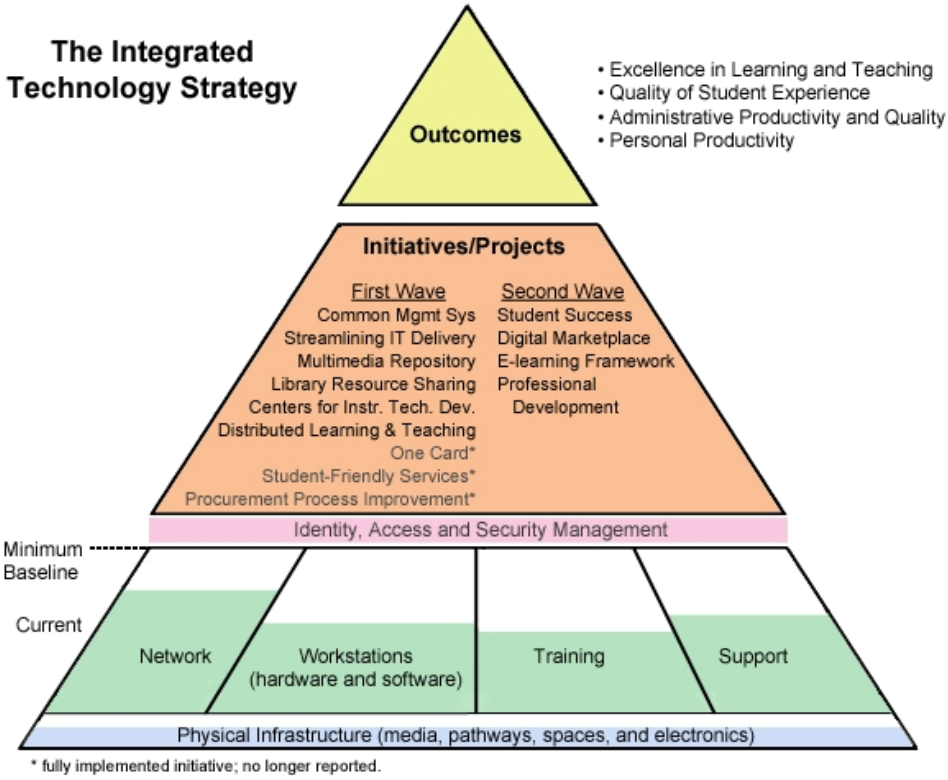

Figure 1 – 1
The ITS Pyramid

The CSU is committed to the continued deployment of instructional technology at all levels within the system. This includes student, faculty and staff computing resources; state-of-the-art display and delivery systems; and easy access to remote information sources at any time and from any place.

1.2.2.2 The CSU's Commitment to Technology Infrastructure:

The foundation layer of the ITS pyramid is physical infrastructure (media, pathways, spaces and electronics). Reflecting the importance such infrastructure has on all aspects of the University's mission, a system-wide program of major telecommunications infrastructure retrofit projects valued in the many millions of dollars is currently being implemented at CSU campuses. Because of the extreme size and complexity of that retrofit initiative (commonly referred to in the CSU as the Telecommunications Infrastructure Initiative, or TII), estimated to cost nearly $300 million, it has been implemented as a multi-phase, dual-stage program extending over nearly a decade from conception to completion. During that period, the campuses have been grouped into three successive annual phases of six to eight sites each for purposes of design and construction, and the work at each site has been planned in two identifiable stages.

Stage 1 of the infrastructure upgrade initiative has involved major improvements to the campus telecommunications physical plant (pathways, spaces and cabling) through individual projects primarily funded from State capital outlay resources and managed by local facilities personnel; and Stage 2 has focused on the acquisition and installation of network electronics equipment and related management systems through a University-wide systems integration contract. The product at each campus is a sophisticated, high-performance LAN designed to meet local needs but meeting stringent CSU standards for quality, performance, dependability and security. As of January 2007, a majority of the University's institutions have fully completed the retrofit process, with entire completion of the TII program expected during the calendar year.

However, the CSU's system-wide focus on providing campuses with high-quality technology infrastructures will not end with TII program completion, as telecommunications networks must be regarded as "living" entities, subject to degradation unless solidly maintained, intelligently operated and cyclically refreshed. The large investment in physical resources represented by TII implementation clearly must be so protected. For the University, these needs will be met in large part through the centrally-managed and funded Infrastructure Terminal Resources Project II (ITRP 2). ITRP 2 is essentially the

first refresh cycle for the network infrastructure installed as a part of Stage 2 of the technology infrastructure build-out project. The program is intended to enable campus networks to stay current with network technology and address evolving requirements—further, it is expected that such efforts will be ongoing through projected future refresh cycles.

ITRP 2 will include four technology areas of focus:

1. Routing and switching (providing network connectivity and data transfer);

2. Wireless networking (providing users with connectivity without having to "plug in" to a jack);

3. Network security (preventing unauthorized network access); and

4. Network management systems (allowing monitoring of network performance).

To provide a vehicle for system-wide technical consultation with campus personnel, the Network and Technology Alliance (NTA) was formed in 2001 as an advisory body to the Information Technology Services - Technology Infrastructure Services (ITS-TIS) section of the Chancellor's Office. The NTA's principal focus is on the development and improvement of campus network infrastructure and services. NTA provides technical expertise and input in support of TIS staff activities and the activities of the Information Technology Advisory Council (ITAC), which is comprised of campus Chief Information Officers. The organization's contributions have been invaluable in pursuing ITRP network provisioning during the TII program, and NTA working groups are already addressing the technology areas defined for ITRP 2.

It is important to note that, while the material presented in this document is primarily oriented toward CSU campus LANS, those local networks are linked across the University and to the electronic world in general by a more than robust WAN. By virtue of its membership in the Corporation for Education Network Initiatives in California (CENIC), the CSU utilizes the services provided by CENIC's California Research & Education Network (CalREN). The TIS section of the Chancellor's Office serves as the liaison to CENIC, representing the Chancellor's Office and the campuses on system-wide initiatives pertaining to

video, internet, and WAN services. The Campus Access Infrastructure (CAI) project now in progress under the aegis of TIS will further enhance connectivity between the CSU campuses and the CalREN backbone.

There seems little doubt that the general quality of the technology network fabric available to CSU campuses is presently superior to that of most systems of higher education across the United States. The University's concern now is to maintain that quality and to assure that the equipment and applications that depend upon the basic network facility for their functionality are judiciously selected and managed to support the academic missions of its campuses. Such technology not only must be made ubiquitously available to all users on each campus, but also must facilitate services extending between campuses and even into the communities those institutions are designed to serve. This *Telecommunications Infrastructure Planning Standards* (TIP Standards or TIPS) document constitutes an important tool in achieving such goals, inasmuch as it continues to define the CSU's minimum standards for technology physical plant retrofitting and new construction.

1.3 Design Implications

Although architectural planning must be based on defined needs, the cumulative impact of changes in instructional technology and of the increasing use of information technology services must be viewed as a rapidly moving target. It is not reasonable to assume that anyone can predict, with absolute certainty, the specific systems that will be installed in a building three to four years in the future. However, by taking a long-term view of the structure and focusing on the provision of a comprehensive system of pathways and spaces for telecommunications technologies, the facility planner can limit the number of modifications that must be made during or shortly after construction.

The following sub-sections review the evolving circumstances in a number of the spaces in the university environment that have been impacted by the expansion of information technology services.

1.3.1 Classrooms

All classrooms must now be equipped with voice, data, and video services in a wide variety of configurations. Increased use of multimedia-generated displays requires new techniques for providing technical interconnection (power and signal) between the instructor's location and room displays and beyond. Significantly improved methods of lighting, acoustical treatment, and heating and cooling must be adopted to permit the successful integration of technology into the traditional classroom learning environment.

1.3.2 Laboratories

In addition to "standard" classroom technology services, many laboratory spaces now require conditioned power and communications to every student workstation. This is especially important in those spaces with built-in counters and free-standing laboratory benches. If adequate pathways are not provided for these components during initial construction, the addition of future information technology improvements could well prove prohibitively expensive. In particular, computer laboratorys must obviously be designed to support the constant evolution of technology, equipment, and student stations. In some cases these facilities must provide dedicated space to house stand-alone computing and network equipment, with an associated increase in electrical, cooling, and security services.

1.3.3 Libraries

Library facilities play a central role in the use and application of electronic information, and are now often referred to as “information centers.” Extensive support for both technology users and equipment is required at all levels, including public electronic access areas, image and other multimedia access points, and group research and study areas. In addition, library buildings frequently act as centers for: instructional media production, television headends, and distribution services; centralized and distributed computing; specialized computing and/or training labs; and teleconferencing resources.

1.3.4 Common Areas

Common areas throughout the university (such as lobbies, student unions, large hallways, and registration areas) must now be equipped to provide expansive voice, data, and video services. Wall phones for internal use within the university may be at least as important as coin telephones and should be just as accessible; however, as cellular phones and wireless data access become ever more pervasive, the utility of wired instruments in general has become subject to question. Wired phones still do often provide emergency communications, links to the campus voice mail system, or access to automated systems such as registration. Video monitors may be used to display the status of class registration, campus news or event announcements, or items of local or national interest. Information kiosks and electronic card access points may be required throughout a campus to support on-going information, security, and purchase applications. However, the increasing use of wireless technologies and remote on-line services is currently producing major shifts in the nature and configuration of such devices.

1.3.5 Conference Rooms

All conference rooms should now have the capability to be utilized as teleconference or videoconference facilities and should be connected to the campus network. The increased use of voice and data communications for a variety of meetings suggests that conference rooms must support all forms of communications from multiple sources. For rooms likely to be designated as specific teleconferencing locations, particular attention must be paid to lighting, sound, room design, and HVAC parameters in order to establish an environment suitable to effective use of technology.

1.3.6 Office Spaces

Office spaces must be designed to support multiple technology configurations and provide multiple media and communications outlets. The technology infrastructure concept must focus on workspace support rather than simply “how many jacks are located in each room.” If the basic infrastructure makes it costly or difficult for an office occupant to operate a

new type of information device shortly after that infrastructure is installed, the design obviously did not reflect adequate planning for the use of technology.

1.4 Document Overview

The remainder of this document is divided into sections embracing related topics of interest to facil;ities planners and designers. The CSU expects that design consultants retained by the University will give careful cognizance to the requirements, guidelines and practices presented in those sections.

Section 2. - Facilities Planning and Programming, defines the types of technology and information system-related spaces and distribution services that are in use or must be planned for in CSU construction projects (new or retrofit). The focus of this section is on the information required by architects and space and facility planners.

Section 3. - Infrastructure & Pathway Design, identifies specific design and construction requirements that must be followed as the minimum acceptable level of CSU building infrastructure support. This section provides details on sizing of rooms and pathways, the electrical and mechanical services required, and other building construction (as opposed to technology-specific) materials and considerations.

Section 4. - Media Systems Design, outlines specific media (i.e., copper, fiber optic, and coaxial cable) configurations and hardware support systems requirements intended to satisfy the current and future distribution technology needs of the University.

Appendix A – Reference Materials, identifies a range of resource materials and documents which may impact upon the design of CSU technology infrastructures, either as accepted technical standards or as related industry publications.