

TITLE: Recommendations for Classroom Networking

STATUS OF DRAFT:

This document has been approved by the CITS Standing Committee on Academic Computing. The recommendations in this draft are subject to revision and have not been adopted for implementation by CITS.

ABSTRACT:

The use of computer networks in classrooms is growing. The University needs to coordinate these activities to insure a steady increase in the number of networked classrooms and to insure that these classrooms meet high standards of reliability.

Coordination and University level support are particularly important for shared classrooms--- those rooms that are used by a variety of colleges and which do not appear on the room inventory of any particular college.

An older and related technology is the use of projection equipment in classrooms. The projection needs of the faculty are currently more pressing than the computer networking needs. Computer networking in shared classrooms needs to move forward, but we should not lose track of fundamental needs for classroom projection.

Executive Summary

Networking classrooms requires a high degree of cooperation, coordination and support. The following basic requirements have been identified:

1. Physical standards. The University must adopt a classroom standard for physical networking in shared classrooms to insure instructors that their equipment and software will operate in shared classrooms.
2. Protocol standards. The University must adopt a set of protocol standards for shared networked classrooms that instructors can be sure will work properly for teaching.
3. Clear lines of responsibility. The network service provider for the classroom must be clearly known to the instructor. Centralized support for shared classrooms is required.
4. Reliability. The goal for classroom networking is zero downtime. All network maintenance must be performed outside University scheduled class times.

5. Response time. Should a problem occur with networking in a classroom, the problem must be resolved in 10 minutes or less. Class periods are short and a faculty member must have assurances that the network will function correctly within the allotted class period.
6. Inventory. A networked classroom is a special educational resource. The inventory of classrooms must reflect the presence of network access and inventory information must be available to the departments. The inventory must include the technical details of network access in the classroom. The classroom inventory should also contain information regarding the presence of fixed projection equipment in classrooms.
7. Scheduling. Instructors who require network access in classrooms must have the means to be scheduled into such classrooms.
8. Once a physical networking standard is adopted, classrooms that are designated as shared, and do not conform to the standard should have additional taps deployed as needed to conform to the standard.

The following additional recommendations are made:

1. Means of response. The instructor must have the means to notify the network service provider should a problem occur. A phone in every networked classroom is recommended.
2. As an interim measure, inventory information regarding classroom networking should be stored in UFINFO. This information should eventually become part of the classroom inventory and scheduling database.
3. Security. Network access from classrooms must meet Internet security standards. We must be able to verify the user of the classroom access points and prevent unauthorized access to the net from classrooms.

1. Background

1.1 A Context for Networked Classrooms

Classroom networking is an emerging technology in the classroom. As networking grows on campus, the desire for instructors to use computers in the classroom to access home department computing resources, college computing resources, University host computer resources and Internet resources is growing.

Classroom networking is first put in a larger context of classroom technology. Little can be done with a networked classroom if the instructor is incapable of using equipment in the classroom, or is incapable of displaying the networked computer's screen in a way that is

visible to the class of students. Projection is typically a prerequisite to using networking in class. Physical preparation of classrooms for projection (lighting, screens) is a prerequisite to projection.

Physical networking and network protocols are discussed briefly to indicate how classroom networking can be done at UF. This is certainly not a definitive technical treatise. Technical details, where useful, have been relegated to footnotes.

Notes on several current implementations are also presented. These indicate how networked classrooms are being created at UF today, and what might be done to improve the process of creating additional networked classrooms.

1.2 Models of Classroom Computing

The table below lists the combinations of projection and networking that must be considered in classroom computing.

Table 1. Models of Classroom Computing

Model	Projection	Networking	Purpose
A	No	No	Traditional instruction. Not discussed in this report.
B	Yes	No	Use of computer for presentation or demonstration without the need for network connection. Multimedia is often done this way. This is likely to be a more popular combination than the networked classroom, but is not discussed in this report.
C	No	Yes	Some rooms are small enough that projection is not required. In these rooms, a computer monitor may be sufficient.

D	Yes	Yes	Most classrooms will need projection equipment to show the contents of the networked computer monitor to the students.
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The table does not show a third dimension that plays a role in the actual deployment of services. Who provides the equipment for projection and computing in the classroom? There are several popular choices.

1. The faculty member provides the equipment. A faculty member may come to the classroom with a notebook computer from his or her office. The advantage is familiarity. The disadvantages are price and transportation.
2. The equipment is borrowed. It may be supplied by the department, the college, OIR, LRC or others. The advantage is maintenance and price. The disadvantages are familiarity, features and availability.
3. The equipment may be permanently stationed in the classroom. The advantage is availability. The disadvantages are maintenance, features, and familiarity.

The considerations for networking are similar for each of the above means of having equipment in the classroom. The remainder of this paper will discuss models C and D without regard to the source of the equipment.

We are not considering classrooms with computers for each student. Such classrooms are typically called computer labs and have their own special networking considerations that are typically addressed and designed on a case by case basis.

2. Physical Networking

- *Physical standards. The University must adopt a classroom standard for physical networking in shared classrooms to insure instructors that their equipment and software will operate in shared classrooms.*
- *Once a physical networking standard is adopted, classrooms that are designated as shared, and do not conform to the standard should have additional taps deployed as needed to conform to the standard.*

- *Means of response. The instructor must have the means to notify the network service provider should a problem occur. A phone in every networked classroom is recommended.*

UF currently uses several popular physical wiring systems for computer networking. Most academic buildings use ethernet on either 10BaseT or thinnet wiring systems. Some academic buildings (College of Business) are wired using IBM's Token Ring system. Currently, classrooms reflect the physical wiring system that predominates in the building. In most cases this will be ethernet 10BaseT.

Adoption of a campus physical wiring standard for shared classrooms is important for several reasons:

1. **Reliability.** It is imperative that a standard be adopted which is capable of supporting the reliability requirements for classroom networking.

Such a standard must provide a service with minimal downtime and must recognize that in a classroom, the network faceplate is likely to be used many times during a day. The physical nature of the jack must support such repeated use and misuse without failure.

2. **Purchasing.** By adopting a standard, instructors will be able to purchase network equipment for their department computers which will work in networked classrooms.
3. **Support.** Campus support of multiple standards is not economically feasible at UF.
4. **Performance.** A campus standard which supports a clear migration path to improved network performance positions UF for future cost effective deployment of improved network services.

3. Protocols

- *Protocol standards. The University must adopt a set of protocol standards that instructors can be sure will work in shared networked classrooms.*

Faculty have the right to expect that the network protocols they use in their office will be usable from a classroom, and that the classroom network jack will have full access to services across campus and the world. Faculty may make use of computers anywhere on campus or in the world from a classroom network jack.¹

Popular protocols that should be available from every classroom jack include:

TCP/IP Internet protocol. Used to converse with computers across the Internet. Also used for gopher, Mosaic, and many email systems. While UNIX computers use TCP/IP primarily, the

protocol is used on Mac and PC computers as well. TCP/IP can be used to communicate with VAX and IBM host computer systems.

IPX Novell, Inc.'s Netware protocol. IPX is used to connect a PC to a Netware server.

Appletalk Apple Computer Inc.'s protocol used by Macintosh computers to do AppleShare and print.

DECnet Digital Equipment Corporation's protocol used by VAX and PC computers to provide basic communication and file sharing.

Other protocols are not well supported on campus and instructors should know that they may not be available from classroom network jacks.

4. Support

- *Clear lines of responsibility. The network service provider for the classroom must be clearly known to the instructor. Centralized support for shared classrooms is required.*
- *Reliability. The goal for classroom networking is zero downtime. All network maintenance must be performed outside University scheduled class times.*
- *Response time. Should a problem occur with networking in a classroom, the problem must be resolved in 10 minutes or less. Otherwise the presentation can not be presented.*
- *Security. Network access from classrooms must meet Internet security standards. We must be able to verify the user of the classroom access points and prevent unauthorized access to the net from classrooms.*

Consider the case of a faculty member goes into a classroom to teach and the network jack does not respond. Who can be called? Given the time frames involved in teaching, the jack must be restored to operation within minutes to be useful. This is not likely to happen given UF's distributed support structure. A centralized authority for managing shared classroom networking is required to provide the level of reliability and response needed to use network access in a classroom setting. To achieve this level of reliability and response, proactive testing of network facilities in classrooms will be needed.

Luckily, such events are rare, and becoming increasingly rare each month. Most failures are catastrophic and effect large parts of campus² Service is not typically restored in the time frame necessary for classroom instruction. Instructors must be prepared to deal with the unavailability of the network, much as they must already cope with the potential failure of AV equipment.

Faculty and support staff must have access to technical details of the network implementation in each room. Gopher is an ideal system for providing such information. As classrooms are added to UFNET, entries can be made detailing the network characteristics (subnets, etc) of the room as well as the people to call regarding SNMP³ management and/or troubleshooting network problems.

A third level of support involves assisting faculty with the details involved in moving network applications from one network (in one's office) to another network (in the classroom) is necessary.⁴ In some cases, minor reconfiguration will be unavoidable. Scripts, batch files and utilities for simplifying the switching of subnets can be developed by support organizations.⁵ Teaching faculty the details of subnet switching is not the right approach. Developing good tools to simplify switching or avoiding switching altogether (see the notes) is preferable.

Support also includes insuring security. Support organizations must be able to prevent unauthorized access to the network from classroom access points.

5. Inventory and Scheduling

- *Inventory. A networked classroom is a special educational resource. The inventory of classrooms must reflect the presence of network access and inventory information must be available to the departments. The inventory must include the technical details of network access in the classroom. The classroom inventory should also contain information regarding the presence of fixed projection equipment in classrooms.*
- *Scheduling. Instructors who require network access in classrooms must have the means to be scheduled into such classrooms.*
- *As an interim measure, inventory information regarding classroom networking should be stored in UFINFO. This information should eventually become part of the classroom inventory database.*

The current information systems used to track classroom resources require modification to support classroom networking and the use of fixed projection classrooms. Databases of classroom size and location must be augmented to house and provide information regarding the presence of network access and/or fixed projection facilities.

6. Some current implementations

Classroom networking has not led the deployment of networking infrastructure into buildings that are not already on the campus network. Most academic buildings now have a network

point of presence and a vertical riser⁶ system, or are in the process of acquiring these basic elements.

Physical networking of the classrooms, in the short term, is likely to proceed under the direction of the most interested parties. Departments in control of particular rooms who have seen the need for networking are proceeding.

Resources for physical networking are not a major concern⁷ Individual departments operating in buildings with network infrastructure can arrange to provide network connections in classrooms of their choice. Several examples of current efforts are presented below.

In the Health Science Center, the HEALTHNET will provide a working network drop consisting of a 10BaseT faceplate with level 5 wire back to an SNMP managed hub port on the building system for a fixed price of \$300 per drop. Several network jacks have been provided in the Communicore and other academic areas of the complex.

In the College of Engineering, DDF works with departments to provide network drops in Engineering buildings.

In Liberal Arts and Sciences, departments can provide drops in Turlington Hall for \$150 per drop. The College office coordinates these efforts and provides and manages the hubs. Griffin-Floyd Hall and Turlington Hall have networked classrooms. Other buildings with large volumes of CLAS teaching are being considered by the college office for near-term networking.

7. Authors

Gerald Bennett
College of Law
gtbenne@nervm.nerdc.ufl.edu

Roy Bolduc
College of Education
roy_bolduc@qm.server.ufl.edu

Dale Canelas
UF Libraries
dbcudla@narvm.nerdc.ufl.edu

Mike Conlon (Chair)
Dept. of Statistics
mconlon@stat.ufl.edu

Mark Hale
CIRCA
mphale@nervm.nerdc.ufl.edu

Gary McGill College of Business
College of Business
gary@nervm.nerdc.ufl.edu

Jim Mueller
Dept. of Religion
jmuller@nervm.nerdc.ufl.edu

Michael Levy
Dept. of Psychology
levy@psych.ufl.edu

Richard Rathe
College of Medicine
rrathe@nervm.nerdc.ufl.edu

Tom Walker
Dept of Entomology
tjw@gnv.ifas.ufl.edu

Jeannine Webb
OIR
jwebb@nervm.nerdc.ufl.edu

Joe Wilson
Dept of Computer and
Information Sciences
jnw@cis.ufl.edu

¹This is quite different from the access that might be acceptable from a student workstation in a public lab. These might be restricted. Classroom jacks cannot be restricted.

²The most common form of catastrophic failure is the failure of one of the central routers. These machines pass network packets through parts of the network. If the central router connecting your building to UFNET fails, due to hardware (or more likely software) problems, there is little a user can do but sit and wait. Problems are typically corrected in half an hour or less. Other reasons for central router failure are power problems and HVAC problems with the routers. All have occurred in the past, but with decreasing frequency.

³SNMP is the Simple Network Management Protocol, a system whereby network jacks can be controlled remotely.

⁴In some cases, no adjustments to configurations will be needed. Faculty who teach in classrooms on the same subnet as their office (typically in the same building) will not need to reconfigure software to move a computer from their office to the classroom and "go on the net." In cases where subnets must be changed, it is possible that if both subnets involved have bootp servers and the faculty member's machine is registered with both servers, then no changes will need to be made. This solution is being implemented in the College of Liberal Arts and Science for buildings predominately occupied by college faculty.

⁵There are some tricks here. Some effort will need to be expended. Major platforms must be supported --- start with Netware for PCs, then Apple, then either TCP/IP for UNIX machines, or DECnet-based PC connectivity. This is roughly population size ordering.

⁶Network jargon. The point of presence is the place in the building where the network cables come from the ground into the building. This is usually in the basement. UFNET responsibility often ends there. The point of presence is typically a closet containing network electronics. A vertical riser system is a collection of wires that lead from the point of presence up into the building's various telecommunication closets.

⁷Other barriers to physical networking exist. Some buildings have no infrastructure. Some academic units have no technology advocates to deal with service providers and arrange connections.