An Affordable Infrastructure for the Information Age

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Information Technologies

http://www.cit.cornell.edu/oit/oitreports.html
The Communications Enterprise

Program Costs
1999

- 6.46% CIT Costs allocated to P2k
- 54.08% Communications
- 0.37% Computer Policy and Law
- 0.25% Contracted Services
- 0.41% Desktop & LAN Technologies
- 0.50% Distributed Support Services
- 17.50% Data Processing Systems
- 0.19% Electronic Publishing
- 0.42% Evangelism
- 0.40% Other Programs
- 6.70% Learning/Teaching Technology
- 0.89% Net Print
- 5.19% Network Services
- 0.40% Publications and Information
- 0.40% Research Support
- 1.94% Security
- 0.55% Software Licensing & Resale
- 1.54% Training
- 1.83% Warehouse Reporting-Data
Vision Statement

Communications technology is a means to an end, not the driving vision. The driving vision is:

• Cornell’s IT facilities and services should enable our academic and outreach priorities
• Cornell’s faculty, students and staff expect best-in-class service
Enterprise Goals and Objectives

• Services should be competitive with those at peer institutions
• Fees should be competitive with those of other providers
• Should offer a range of service levels and prices
• Capacity and capability should be grown “just in advance” of need
• User fee structure should be clear and understandable
• Fees should accurately reflect true costs of services
How Did We Get Here?

• 1984: Telephone & cabling project (structured cat 3). Cornell was a leader then.
• 1990: Agreement for cross-subsidies to build data network
• 1999: Existing cable plant, electronics and wiring closets will not fully support switched 10/100mb service
• 2000: Backbone/internet enhancement
• 2000: Telephone switch replacement
• Escalating growth in backbone/internet traffic
How Did We Get Here?
(cont’d)

Commodity Internet Usage Trends & Capacity

- NYSEERnet T3 (5.5 MB) April 1995
- NYSEERnet two T3 (11 MB) February 2000
- NYSEERnet OC-3 (19 MB) September 2000
- Next step? Two OC-3 (39 MB)

Date

MB

45
40
35
30
25
20
15
10
5

1/1/94 7/1/94 1/1/95 7/1/95 1/1/96 7/1/96 1/1/97 7/1/97 1/1/98 1/1/99 1/1/00 1/1/01 1/1/02 1/1/03

capacity
traffic
traffic trend
State of the Network
State of the Network

- Backbone is in excellent shape for expected life of equipment
- Internet capacity appropriately scaled, but demand is growing rapidly
- HOWEVER....
State of the Network

• HOWEVER….
  - Edge electronics are old, slow, and obsolete
  - Edge wire plant is insecure and limits full 10/100mb performance
  - Wiring closets not secure, environmentally controlled, or properly located
State of the Network
Elements of Infrastructure Enhancement

- Replace the obsolete PBX
- Electronics in buildings
- Growth in backbone capacity
- Growth in internet capacity
- Wiring closets
- Modern cable plant in buildings
- Asbestos removal
What Happens If We Don’t Do Enhancements?

- Increasing hardware failures
- Diminishing service quality
- No high quality audio/video
- Insecure technology and media
- Poor capacity planning limited by tools
- We’ll be the slowest network in any top research institution
What Does New Building Electronics Give Us?

- Less equipment failure downtime
- Switched 10mb service
- Switched 100mb service where cat 5 wire is installed
- Enables quality video, VoIP, and conferencing
- Improved security
- Improved tools = better service
What Would Rewiring Add to These Benefits?

- Creates “world class” infrastructure for research and teaching
- Long life (at least 15 years)
- Security
- Very high speeds (100mb> 1gb)
What Happens if We Don’t Do New Wiring?

- 100 mb service won’t work
- A udit will continue to write us up
- We’ll have to do some of it for sure...will cost more...eventually will have to do it all
Two Parts to the Puzzle

- Sorting out the beans into the right buckets
- Incremental cost for enhancements
Sorting Out the Beans...

<table>
<thead>
<tr>
<th>Data</th>
<th>FY 00 Actual</th>
<th>FY00 Rates Without Cross Subsidies</th>
<th>Steady State Rate (FY00 $’s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rates FY00</td>
<td>Income (in $M)</td>
<td>Rates</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Income (in $M)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Change (in $M)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Rate</td>
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<tr>
<td>10/100 MB Ethernet (monthly)</td>
<td>$ 10</td>
<td>$ 1.9</td>
<td>$ 18</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>$ 3.0</td>
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<td></td>
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<td>$ 47</td>
</tr>
<tr>
<td>10Mb Single Port Gateways (monthly)</td>
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<td>$ 284</td>
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<td></td>
<td></td>
<td></td>
<td>$ 0.3</td>
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<td></td>
<td></td>
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<td>$ 0.2</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>$ 626</td>
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<td>100Mb Single Port Gateways (monthly)</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>$ 1,866</td>
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<td>Voice</td>
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<td>Analog (monthly)</td>
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<td>$ 3.8</td>
<td>$ 24</td>
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<td></td>
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<td></td>
<td></td>
<td>(1.4)</td>
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<td></td>
<td></td>
<td></td>
<td>$ 27</td>
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<tr>
<td>Digital (avg. monthly)</td>
<td>$ 56</td>
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<td>$ 47</td>
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<td></td>
<td></td>
<td></td>
<td>$ 1.6</td>
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<td>$ 51</td>
</tr>
<tr>
<td>Long Distance (domestic/min.)</td>
<td>$ 0.17</td>
<td>$ 3.1</td>
<td>$ 0.15</td>
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<td></td>
<td></td>
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<td>$ 2.9</td>
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<td></td>
<td></td>
<td></td>
<td>(0.2)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>$ 0.13</td>
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<tr>
<td>Other Enterprise Services</td>
<td>Various</td>
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<td>Various</td>
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<td>$ 2.7</td>
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<td></td>
<td></td>
<td></td>
<td>$0.0</td>
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<tr>
<td>Student Services</td>
<td></td>
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<td></td>
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<tr>
<td>ResNet (yearly)</td>
<td>$ 165</td>
<td>$ 0.8</td>
<td>$ 335</td>
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<td></td>
<td></td>
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<td>$ 1.6</td>
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<td></td>
<td>$ 0.8</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>$ 822</td>
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<tr>
<td>ResPhone (monthly)</td>
<td>$ 27</td>
<td>$ 1.3</td>
<td>$ 24</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>$ 1.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$ 27</td>
</tr>
<tr>
<td>Total Enterprise</td>
<td>$ 15.8</td>
<td>$ 15.8</td>
<td>$0.0</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>$ 26.4</td>
</tr>
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</table>
Sorting Out the Beans….

Elements of Current Academic/Administrative Avg. Monthly Costs (Includes Cross Subsidies)=$61

Elements of Steady State (FY04-06) Academic/Administrative Avg. Monthly Costs (Includes Infrastructure Renewal)=$85 (FY01'S)
Sorting Out the Beans….

ResNet Summary
FY 00–02

Proposed Charge FY02 $527
(per subscription)
Charge FY00 $165
Difference $362

Difference Due To:

1. Loss of Subsidies
   Student Telephones $34
   Student LD $51
   Academic/Admin Tel & LD $90
   Total Subsidy $175

2. New Infrastructure $189

Total Subsidy and Infrastructure $364
Sorting Out the Beans….

Elements of FY00 Analog Phone Charge = $36

- Maintenance: Contractual, Plant Maintenance, Other ($9)
- Debt Service (Refinancing of Original Phone Switch) ($6)
- Line Charges ($3)
- Network Operations Center ($3)
- Billing, CIT and Univ Overhead, Service Teams, Other ($3)
- Subsidy to Data Services ($12)

Elements of Steady State (FY04-FY06) Analog Phone Charge (Includes New Infrastructure) = $27 (FY01 $’s)

- Maintenance: Contractual, Plant Maintenance, Other ($8)
- Debt Service-Wiring Project/PBX ($10)
- Line Charges ($3)
- Network Operations Center ($2)
- Billing, CIT and Univ Overhead, Service Teams, Other ($4)
Sorting Out the Beans….

Elements of FY00 Basic Ethernet Port Charge = $10

- Network Operations Center ($1)
- Backbone ($2)
- Building Electronics ($3)
- Internet ($2)
- Billing, CIT and Univ Overhead, Service Teams, Other ($2)

Elements of Steady State (FY04-FY06) 10/100 Port Charge (Includes New Infrastructure) = $47 (FY00$'s)

- Network Operations Center ($2)
- Backbone ($10)
- Building Electronics ($11)
- Internet ($14)
- Billing, CIT and Univ Overhead, Service Teams, Other ($2)
- New Wiring ($8)
Sorting Out the Beans….

### Elements of FY00 10Mb Single Port Gateway Charge = $60

- Network Operations Center ($7) 12%
- Backbone ($34) 56%
- Building Electronics ($1) 12%
- Internet ($11) 18%
- Other Costs ($7) 2%

### Elements of Steady State (FY04-FY06) 10Mb Single Port Gateway Charge (Includes New Infrastructure) = $626 (FY01$'s)

- Network Operations Center ($30) 48%
- Backbone ($239) 38%
- Building Electronics ($13) 5%
- Internet ($305) 5%
- Other Costs ($29) 2%
- New Wiring ($10) 2%
## Proposed Rates for FY02

<table>
<thead>
<tr>
<th></th>
<th>Fully Costed Rates Including New Infrastructure (in 2001$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FY 01</td>
</tr>
<tr>
<td><strong>Data</strong></td>
<td></td>
</tr>
<tr>
<td>10/100 MB Ethernet (monthly)</td>
<td>$24</td>
</tr>
<tr>
<td>10 Mb Single Port Gateways (monthly)</td>
<td>$402</td>
</tr>
<tr>
<td>100 Mb Single Port Gateways (monthly)</td>
<td>$1,184</td>
</tr>
<tr>
<td><strong>Voice</strong></td>
<td></td>
</tr>
<tr>
<td>Analog (monthly)</td>
<td>$18</td>
</tr>
<tr>
<td>Digital (average monthly rate)</td>
<td>$35</td>
</tr>
<tr>
<td>Long Distance (domestic per minute)</td>
<td>$0.12</td>
</tr>
<tr>
<td><strong>Student Services</strong></td>
<td></td>
</tr>
<tr>
<td>ResNet (per year)</td>
<td>$443</td>
</tr>
<tr>
<td>ResPhone (per month)</td>
<td>$18</td>
</tr>
</tbody>
</table>
Proposed Rates for FY02

• Sort out the beans
• Fund start of electronics replacement
• Fund telephone switch replacement
• Fund evaluation of wiring/closet options
• Assume renovations and new construction fund improvements
Are These Rates Competitive?

Single User Residential Connections:

<table>
<thead>
<tr>
<th>Organization/Service</th>
<th>Monthly Charges</th>
<th>Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time-Warner RoadRunner</td>
<td>@ $40-45</td>
<td>10 Mbs ethernet port, shared ethernet fabric (27 Mbs, up to 500 users);</td>
</tr>
<tr>
<td>Telery ADSL</td>
<td>@ $35-45</td>
<td>1.28 Mbps for downloads and 320 Kbps for uploads</td>
</tr>
<tr>
<td>Verizon DSL</td>
<td>@ $40</td>
<td>768Kbps downloads and 128Kbps uploads</td>
</tr>
</tbody>
</table>
Are These Rates Competitive?

<table>
<thead>
<tr>
<th>Organization/Service</th>
<th>Monthly Charges</th>
<th>Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time-Warner Business LAN</td>
<td>@ $400— 1000</td>
<td>10 Mbs ethernet port, connected to a shared ethernet fabric (27 Mbs, up to 500 users);</td>
</tr>
<tr>
<td>Clarity Connect Business LAN X3 DSL</td>
<td>@ $199 and up</td>
<td>128Kbs— 7Mbs</td>
</tr>
<tr>
<td>Yale</td>
<td>@ $325</td>
<td>NA</td>
</tr>
<tr>
<td>MIT</td>
<td>@ $1000— 4000</td>
<td>10Mb— 100Mbs</td>
</tr>
<tr>
<td>Various Vendors T1</td>
<td>@ $1000— 1600</td>
<td>1.5 Mbs</td>
</tr>
</tbody>
</table>
Are These Rates Competitive?

<table>
<thead>
<tr>
<th></th>
<th>FY02</th>
<th>Steady State with Infrastructure</th>
<th>Verizon Commercial</th>
<th>AT&amp;T</th>
<th>Sprint</th>
<th>MCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Analog (/month)</td>
<td>$24</td>
<td>$25</td>
<td>$51 ($24-31)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic Digital (/month)</td>
<td>$47</td>
<td>$50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long Distance (domestic/min)</td>
<td>$0.14</td>
<td>$0.12</td>
<td></td>
<td>$0.8- .16</td>
<td>$1.5-1.00</td>
<td>$0.9- .79</td>
</tr>
</tbody>
</table>
Incremental Costs of Enhancements

- PBX Replacement ($3.8M)
- Modern cable plant in buildings ($58.5M)
- Wiring closets ($23.5M)
- Electronics in buildings ($3.25M/yr)
- Growth in backbone capacity ($1.25M/yr)
- Growth in internet capacity ($300K+/yr)
- Asbestos removal ($8M)
Options to Fund Enhancements

- Don’t do them
- Fund electronics, backbone, and internet enhancements through fees because they are ongoing
- Fund wiring/closets
  - Also as part of rates
  - User paid as needed
  - University capital funding
  - Depending on analysis of cost/benefit
What Do We Need to Do Now?

- Endorse FY02 rate proposal
- Participate in evaluation of options for wiring/closet remediation during this year
What Are Our Peers Doing?

MIT: Mixed installation of Category 3, Category 5 and other wire standards. Currently developing a limited pilot to understand the cost ramifications of installing a Category 5 plant throughout campus.

Duke: Category 5 installation. Duke installed structured a wire plant after the Category 5 standard finalized.

Dartmouth: Category 5 Installation. Dartmouth installed a structured wire plant after the Category 5 standard was finalized.

Brown: Majority Category 5, residual Category 3. Category 5 installed as part of building renovations or where wire was owned by local teleco's.

Yale: Mix of Category 3 and Category 5. Installed base of Category 3 being replaced “over time” with building renovations.

Columbia: Mix of Category 3 and Category 5. Installed base of Category 3 being replaced “over time” with building renovations.

Indiana University: Mix of Category 3 and Category 5. Installed base of Category 3 being replaced “over time” with building renovations.

University of Chicago: Category 5. Chicago installed structured a wire plant after the Category 5 standard finalized.
What Are Our Peers Doing?

### SUNY Campuses

<table>
<thead>
<tr>
<th>Status of Edge Cable Plant</th>
<th>Number of Campuses*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mainly cat 3; some cat 5</td>
<td>3</td>
</tr>
<tr>
<td>Completely or mainly cat 5</td>
<td>32</td>
</tr>
<tr>
<td>Unknown</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>39</strong></td>
</tr>
</tbody>
</table>

*Several of them noted plans to replace existing CAT 3 over the next 1-2 years.
Emerging Consensus

1. The principles underlying proposals are endorsed
2. We should straighten out the beans
3. We’re generally in agreement with plan for FY02
4. We want to understand cost/benefit of cable replacement before approving that
Policy Questions

1. Should cable costs be recovered through rates?
2. Who owns cable at Cornell?
3. How many different rates do we want to have?
4. How to fund increased ResNet costs?
5. Who should pay for connections (single/multiple) in classrooms?
6. Will winners balance out losers?
The Financial Policy Committee met September 21, 2000 and has voted to support the following statement.

“The Committee believes that Cornell’s information technology facilities and services should enable our academic and outreach priorities. In attaining this objective, the Committee endorses the following positions:

1. Services should be competitive with those at peer institutions
2. Fees should be competitive with those of other providers
3. A range of service levels and prices should be available
4. Capacity and capability should be grown in advance of need
5. User fee schedules should be clear and understandable
6. Fees should accurately reflect the true costs of service

While we did not analyze the numbers in detail, strong support was given for the initial steps (through ’02) of the presentation, and for the basis underlying those suggested steps.”

* This statement was also endorsed by FA BIT on October 2, 2000.