Northern Michigan University

Wireless Network & Broadcast Technology

Michigan House of Representatives
Energy and Technology Committee
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Community Profile

- Rural mining/Logging/tourist blue collar community
- Limited communications infrastructure/broadband availability
- Median household income in Marquette County for 2004 (based on U.S. Census data) was $38,419 (lower than U.S. average)
- Small city (22,000) in the midst of undeveloped wilderness
- Largest community in 150-mile radius

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University Profile

- NMU is a comprehensive, masters-level university.
- Offers 180 programs emphasizing technology. Largest are:
  - Nursing
  - Teacher Education
  - Art & Design
  - Business/Computer Information Systems
- Currently:
  - 9,500 undergraduate/graduate students with over 1,100 faculty/staff.
  - Over 1,600 hybrid and web-based on-line courses.
  - 6,000+ students live off campus.
  - 82% of NMU students receive financial aid
  - Need-based: 35% – 40% are Pell eligible
  - All University teaching, learning, and business services require access to broadband communications.

Technology Goals

Access

- Provide access to teaching, learning, and communication anytime, anyplace.
- Ensure equal student access to mobile computing and communication technology.

Support services

- Deliver high quality, timely computing and academic support services.

Technology Goals *(continued)*

Cost

- Provide affordable computing through leveraged support, acquisition and deployment costs.

Standardization

- Facilitate learning through the use of integrated technology
- Deliver high quality support
- Quicker, easier adaptation of new technology including:
  - ✓ Next generation wireless networking
  - ✓ New software
  - ✓ Mobile hardware

Technology Goals (continued)

K-16 Partnerships

- Develop of new initiatives that enhance and expand service to teachers and students in public education.

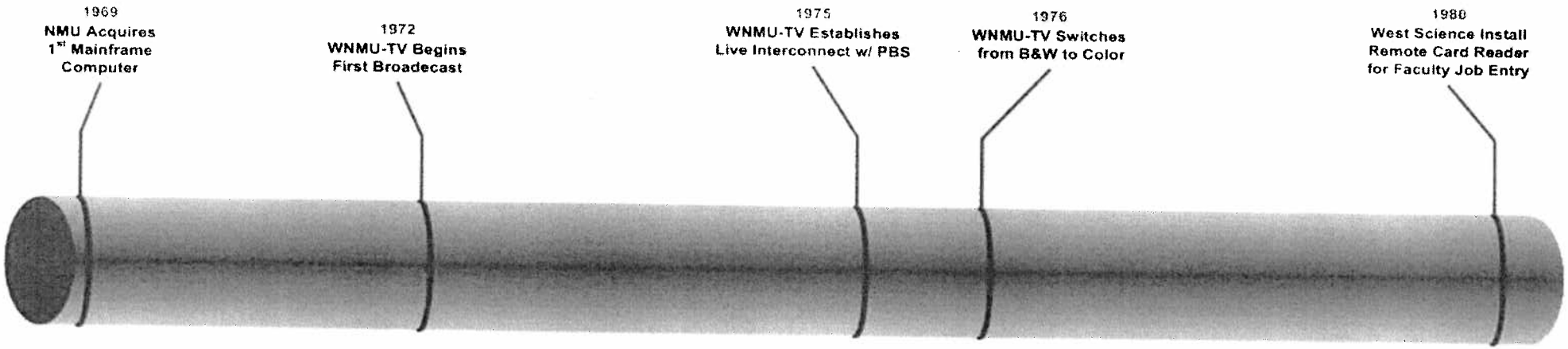
Economic Development

- Refine and enhance local township and city government services that attract new business and improve services to residents at lower cost.

Zeeland Public Schools

New technology connects students to old world of lumberjacking

NMU Technology – 1970's



1970

1980

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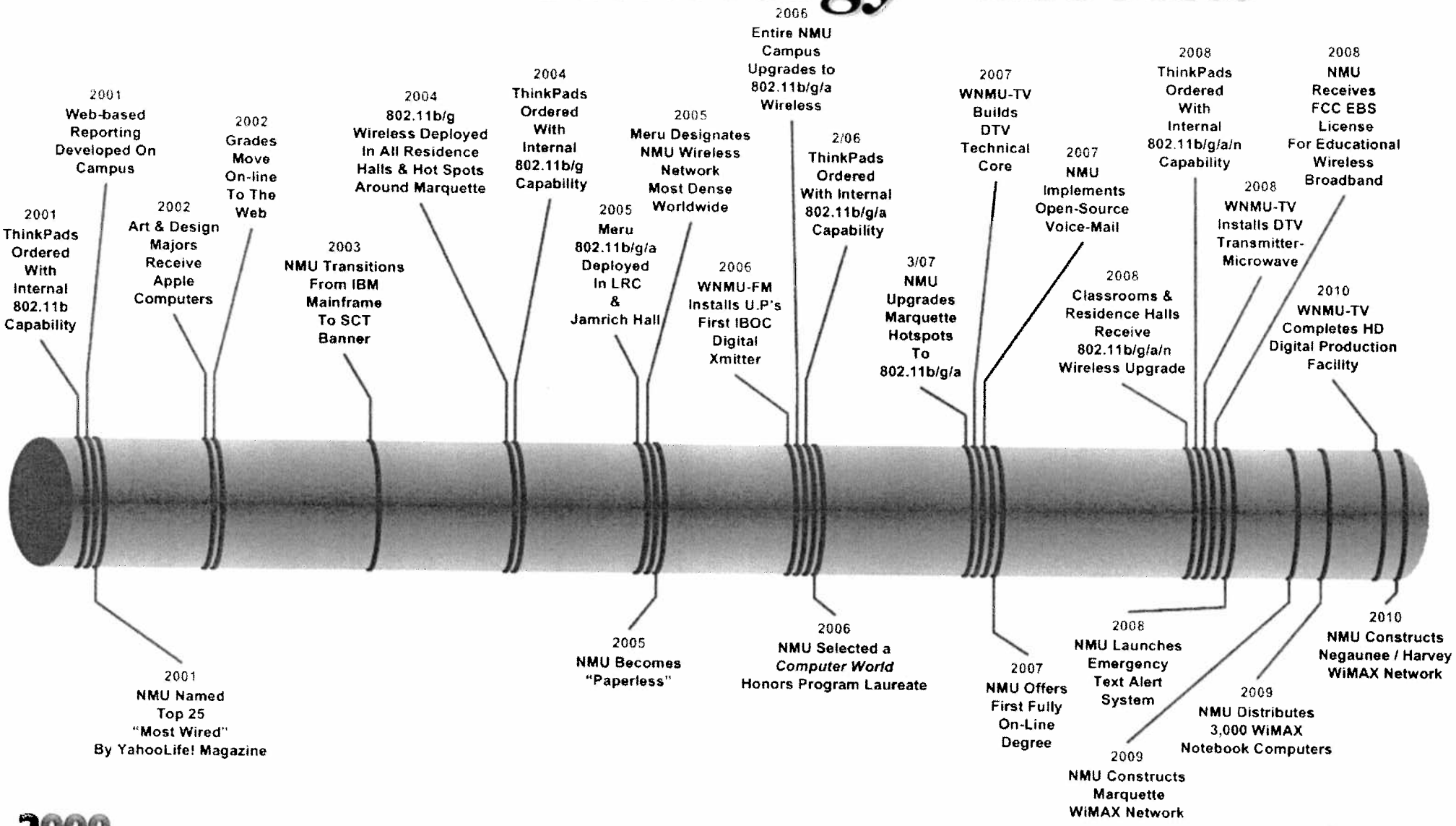
NMU Technology - Recent



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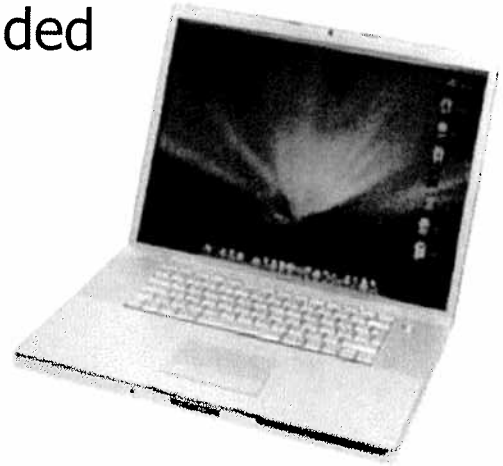
Technology Summary

- ✓ All faculty and students equipped with notebook computers
- ✓ Software included
- ✓ Repairs, maintenance, support & insurance included
- ✓ Gigabit hard-wire connections in all buildings
- ✓ Includes internet access
- ✓ Wireless throughout campus & community
- ✓ The majority of campus courses and business activities use web-based services

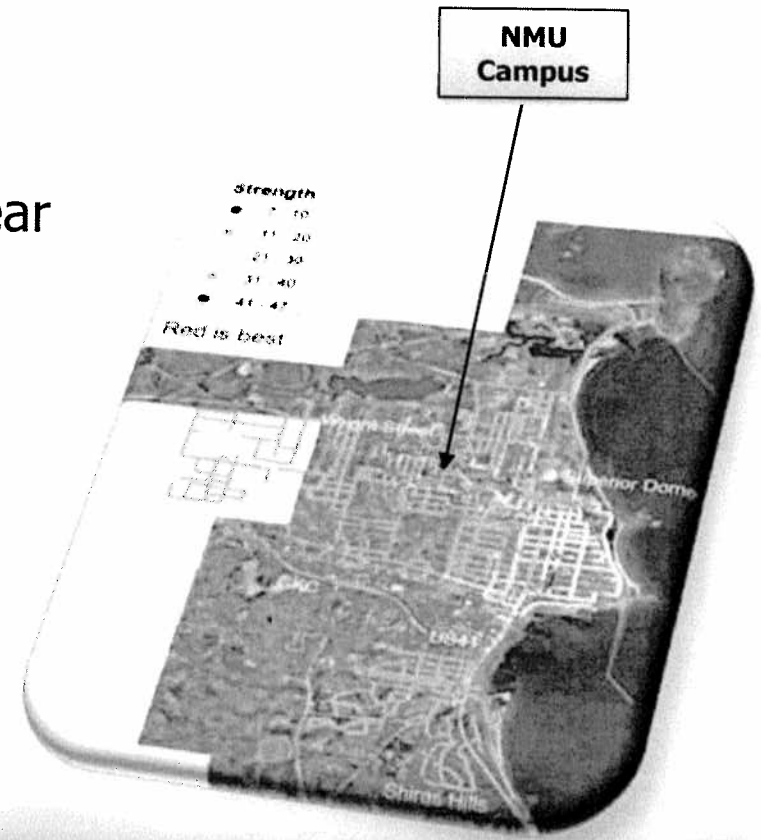


Experimental Community WiFi

In 2003, NMU experimented with off-campus community Wi-Fi network access to meet growing broadband needs

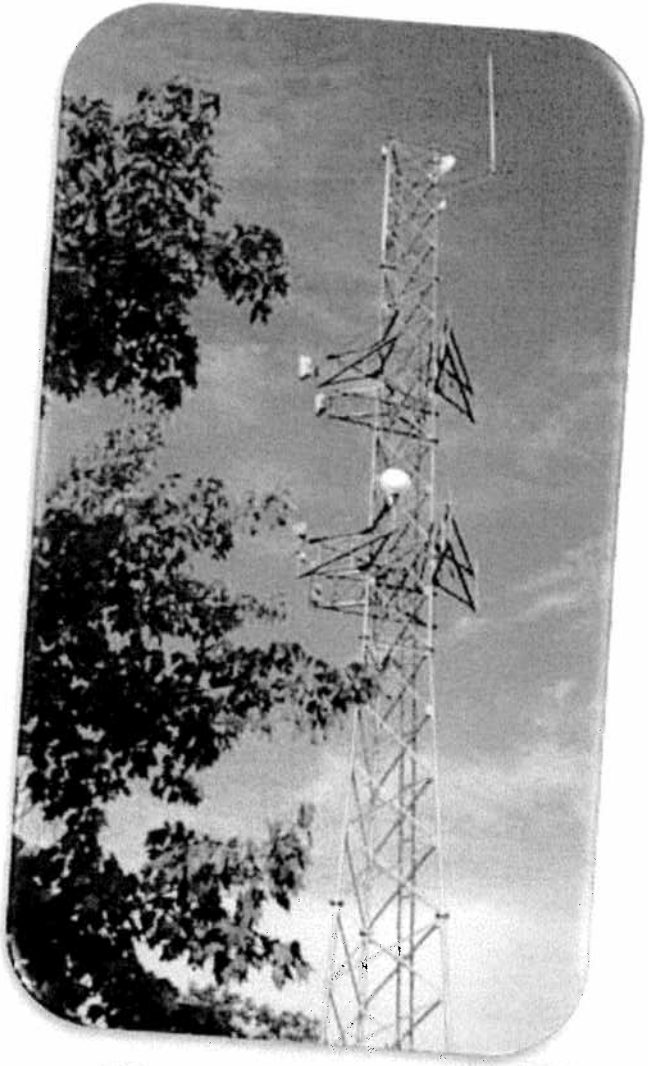
<u>What We Learned:</u>

- RF power and line-of-sight limits restrict students' ability to connect – even when near an access point
- Wi-Fi fails to provide adequate building penetration
- City-wide coverage not practical or cost effective
- Maintenance issues abound, especially in severe winter climates



Wi-MAX Technology

A fourth generation (4G) wireless internet service that provides broadband connectivity to large numbers of network enabled clients.



Essential Components:

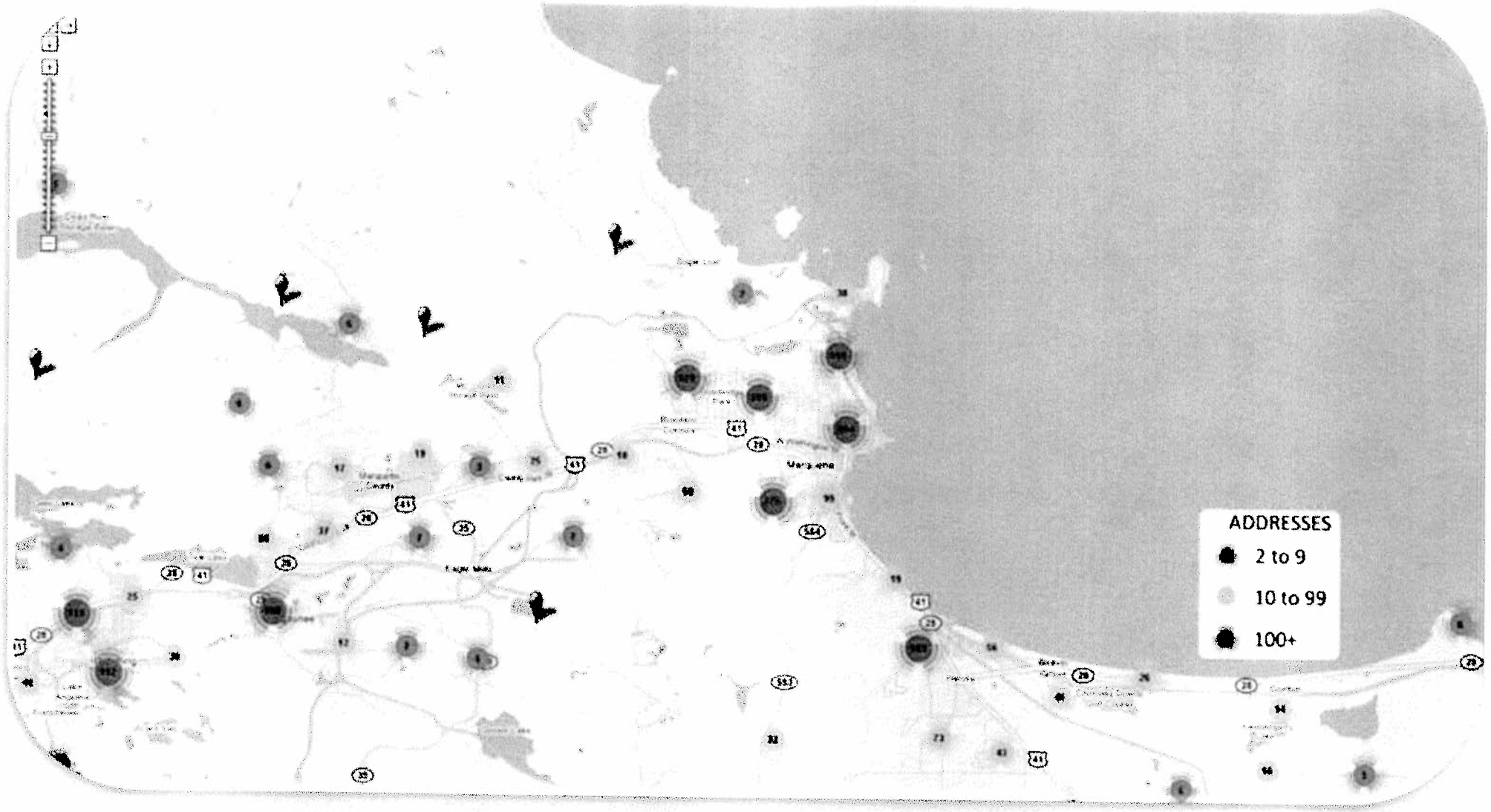
- Strategically placed transmitters on towers or high points within a community
- High-bandwidth back-haul service to enable internet access

WiMAX vs. Wi-Fi

- Coverage measured in miles
- FCC licensed with guaranteed interference protection
- 4th generation technology still in development
- Provides for excellent building penetration
- Carrier-grade service designed for large numbers of clients

- Coverage measured in feet
- Unlicensed service prone to interference
- Mature technology with little room for growth or enhancement
- Weak signals do not penetrate trees or structures well
- Access points quickly overwhelmed with multiple users

NMU Off-Campus "Heat Map"



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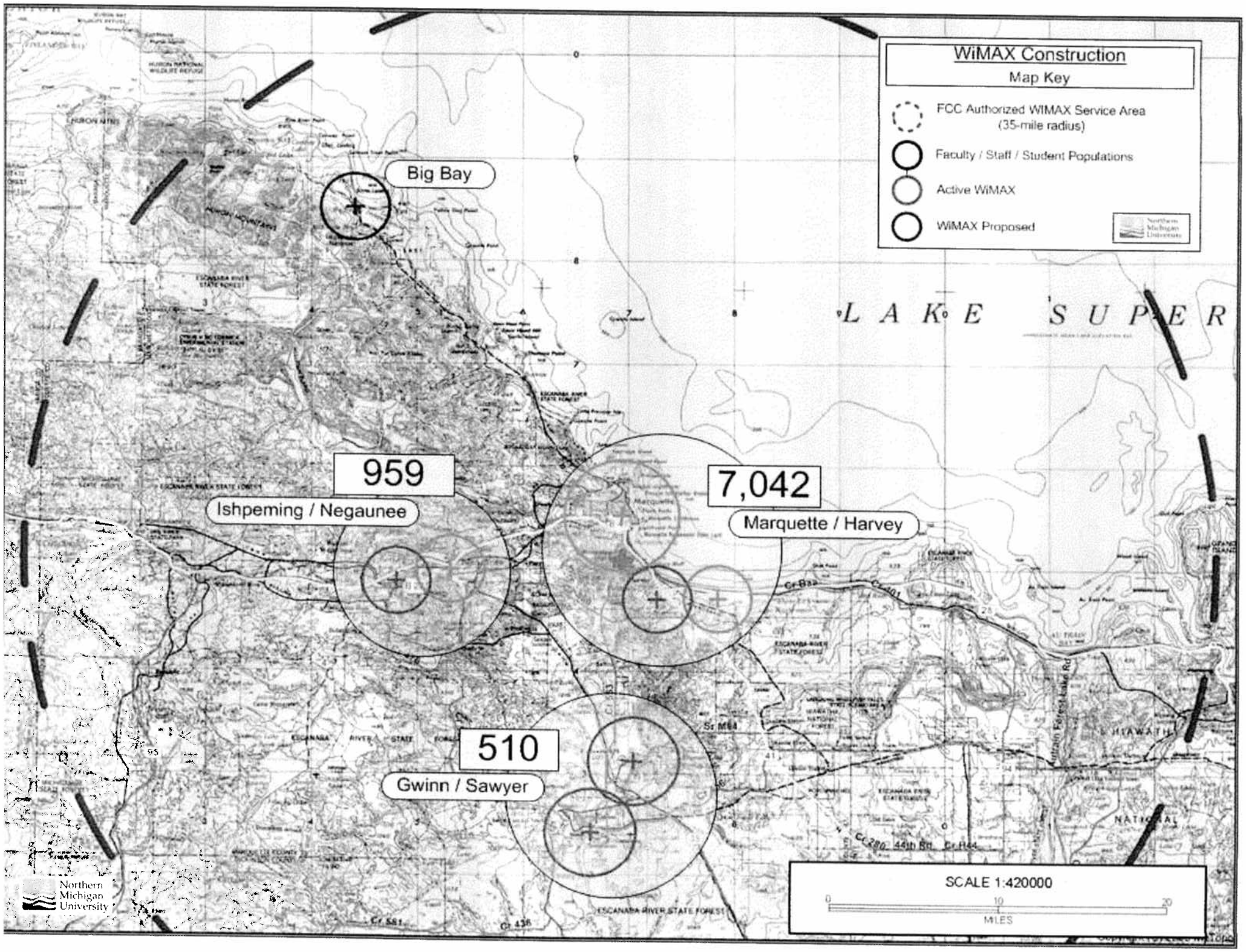
WiMAX Construction
Map Key
FCC Authorized WiMAX Service Area (35-mile radius)
Faculty / Staff / Student Populations
Active WiMAX
WiMAX Proposed
Northern Michigan University
Big Bay
959
Ishpeming / Negaunee
7,042
Marquette / Harvey
510
Gwinn / Sawyer
LAKE SUPER
SCALE 1:420000
0
10
20
MILES
Northern Michigan University

Mqt Twp Fire Tower
Cohodas
Pine Ridge
Mountain Tank
Morgan Meadows
Mount Mesnard
Negaunee Water Tower
Range Tower Ishpeming
Cliffs C shaft
Golf Course
Sawyer Water Tower
Gwinn Water Tower
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Big Bay Demonstration Project

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RESA Marquette-Alger Regional Educational Service Agency

Big Bay Demonstration Project

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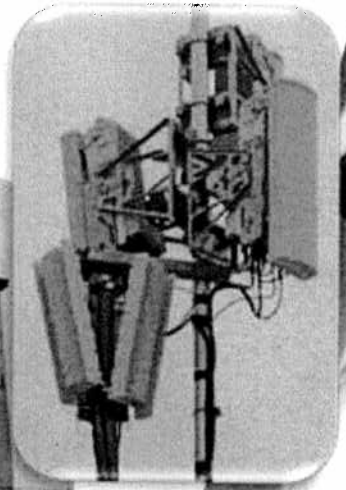
Community Partnerships



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Public / Corporate Partnerships

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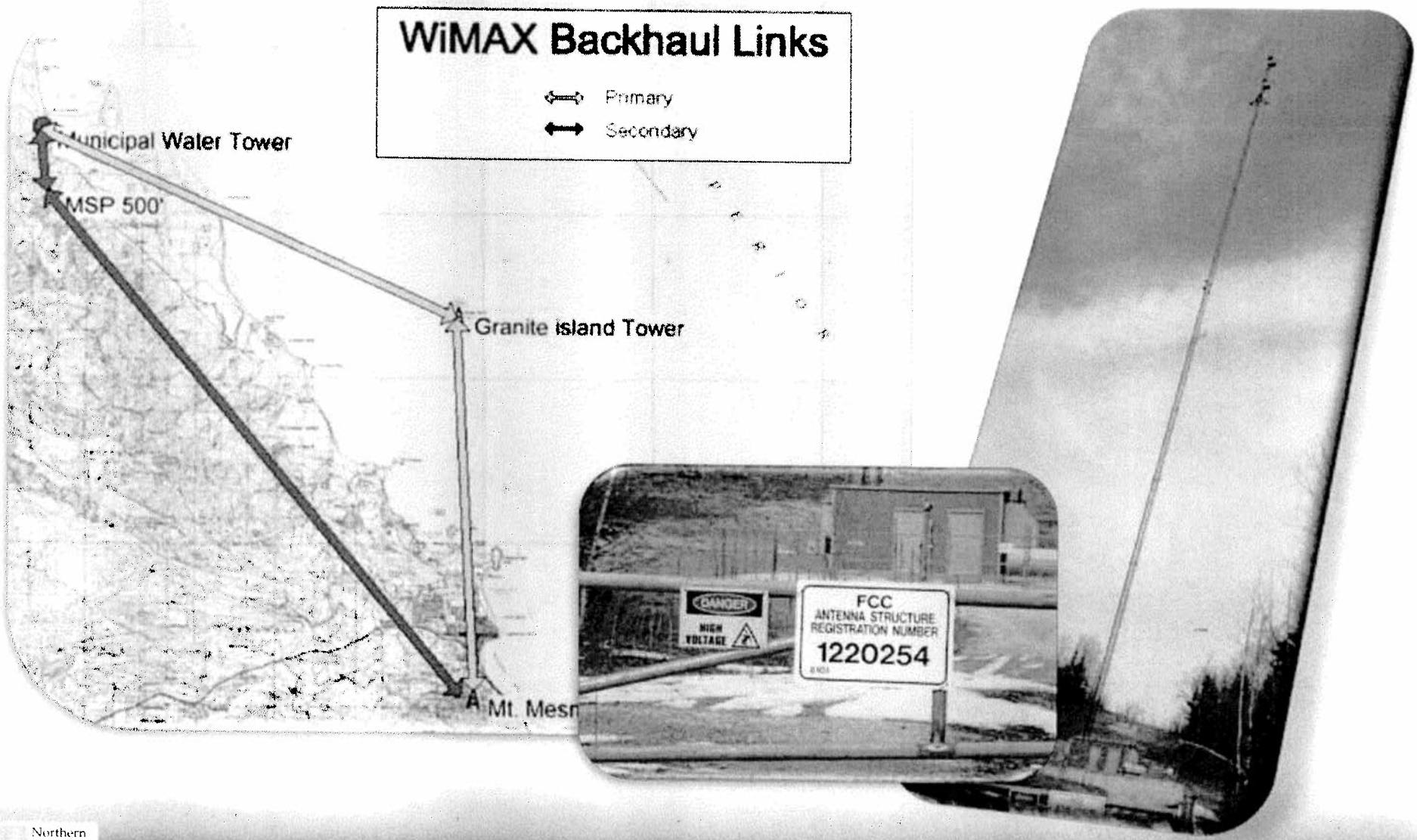
intel Leap ahead

MOTOROLA intelligence everywhere

lenovo

Critical Partnerships



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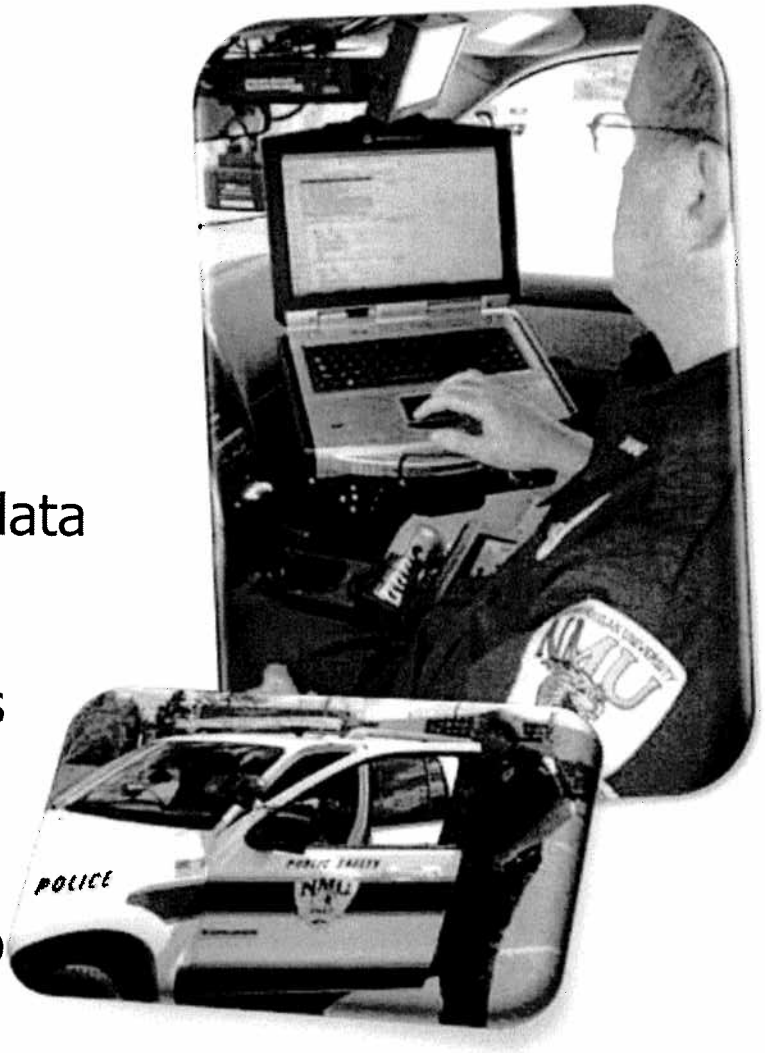
WiMAX Benefits

- ✓ Low cost LEIN access for law enforcement
- ✓ Network service to unserved city buildings
- ✓ Utility monitoring and remote control access
- ✓ Mobile GPS capabilities for city operations
- ✓ Emergency services access to maps, MSDS data and control systems
- ✓ Student home access to educational services
- ✓ Interactive multi-media access for education
- ✓ Middle college and dual enrollment access to area colleges and universities



K-12 Connection

Assistance to public and charter schools in need of advanced broadband technology services

- New opportunities for advanced students in need of college courses while still in high school (dual-enrollment)
- Virtual field trips
- Access to career pathway presentations available from specialized industrial, health-care, education and government service providers
- Universal access to basic web-based school services such as student record databases, research content and testing services

Upper Peninsula
Distant Learning Network

Painesdale/Jeffers
Adams Township
Calumet
Chassell
Dollar Bay
Hancock
Houghton
L'Anse
Lake Linden
Finlandia University
Ojibway Community College

Michigan Technological University

Eben
Munising
Marquette
Negaunee
Gwinn
Ishpeming
West Ishpeming

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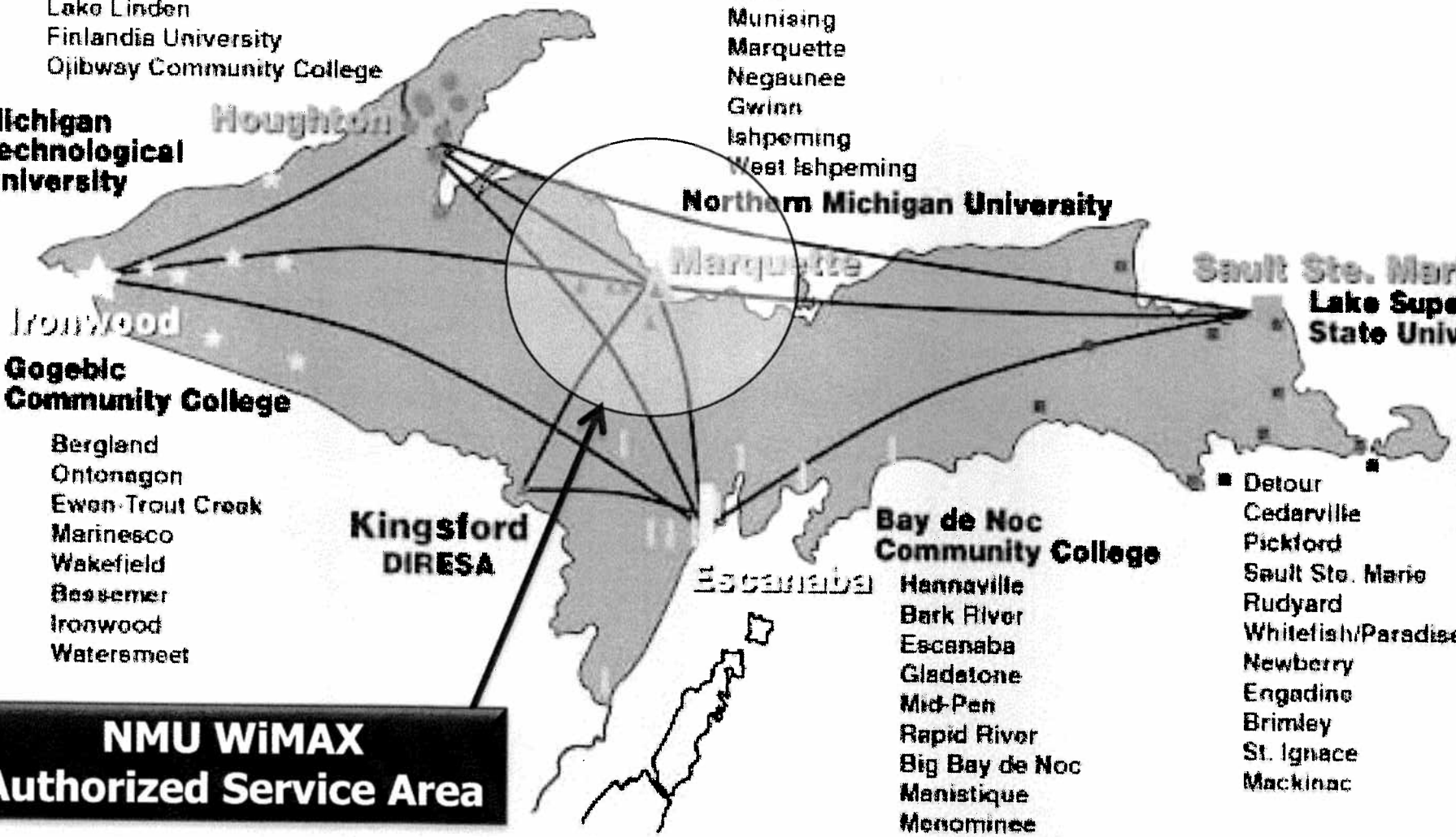

Lake Superior State University

Gogebic Community College

Bergland
Ontonagon
Ewen-Trout Creek
Marinesco
Wakefield
Bessemer
Ironwood
Watersmeet

Kingsford DIRESA

Bay de Noc Community College

Hannaville
Bark River
Escanaba
Gladstone
Mid-Pen
Rapid River
Big Bay de Noc
Manistique
Menominee

Detour
Cedarville
Pickford
Sault Ste. Marie
Rudyard
Whitefish/Paradise
Newberry
Engadine
Brimley
St. Ignace
Mackinac

NMU WiMAX Authorized Service Area

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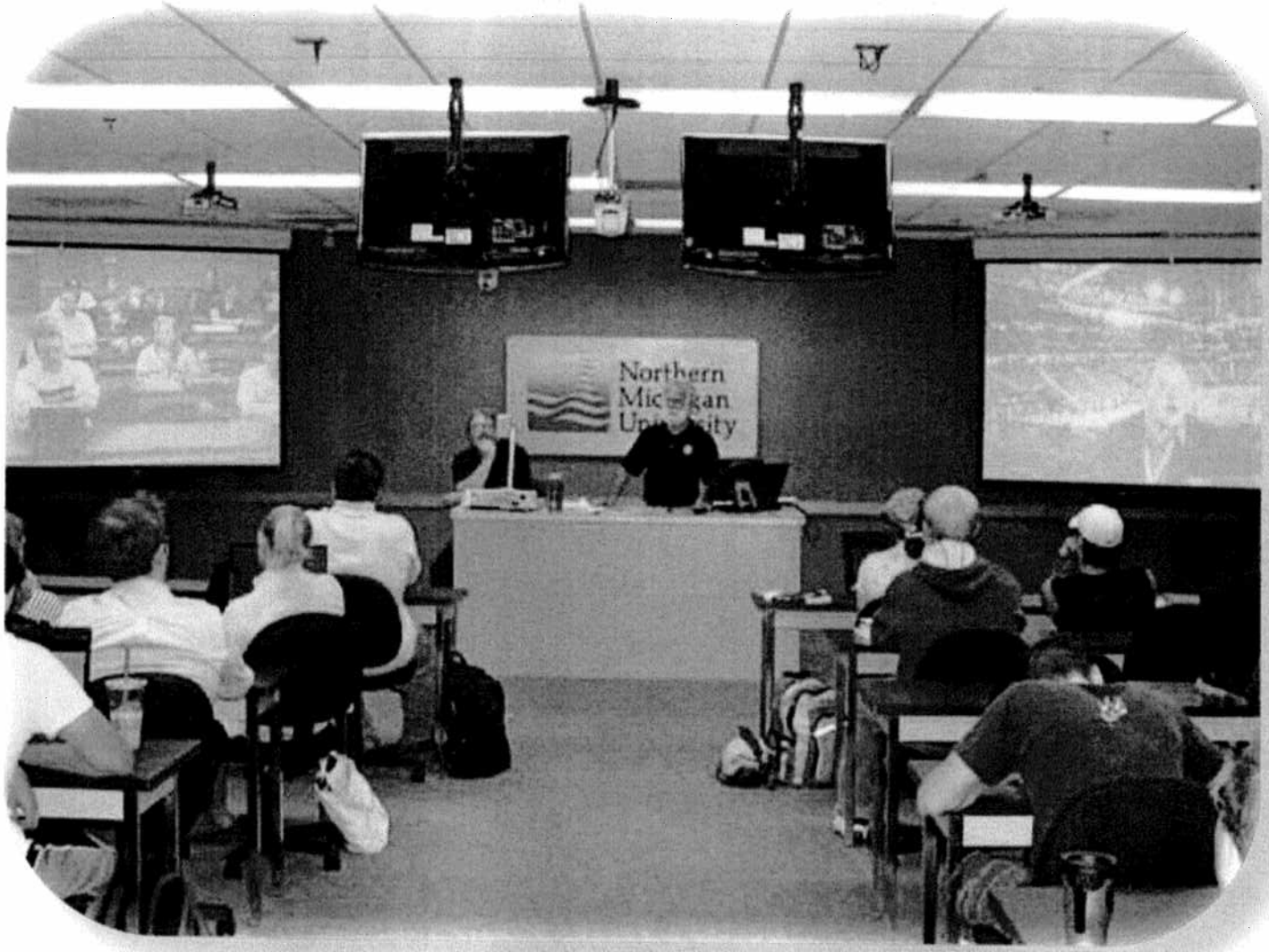
Mobile Computing & Instruction



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Internet vs. Broadcast

Internet

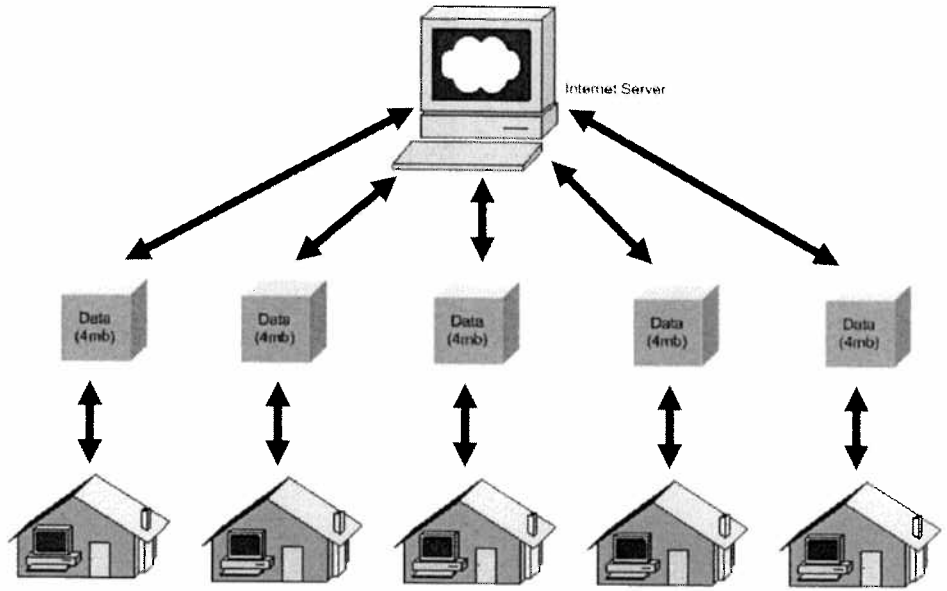
One to one relationship.

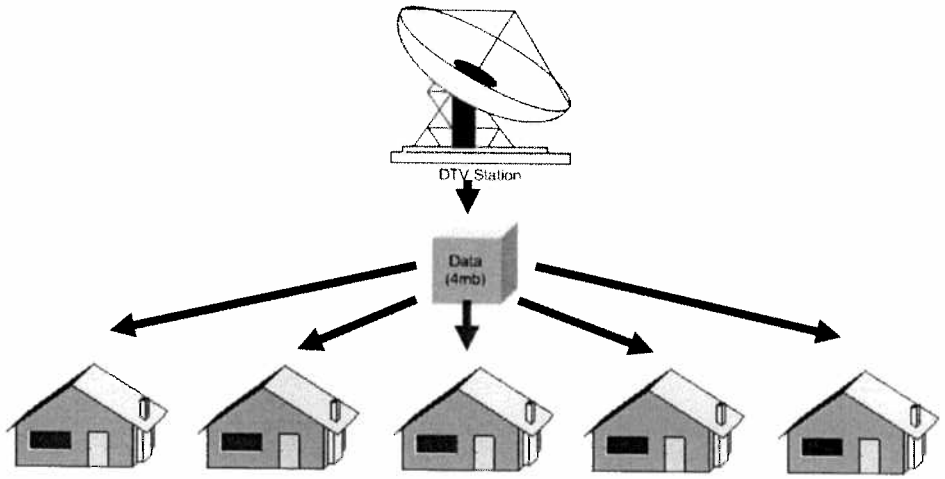
Each file request requires additional bandwidth

Viewers	Number of Files	Bandwidth Required
5	1	20mb
100,000	100,000	400,000mb
5	1	4mb
100,000	1	4mb

Digital Broadcasting

One to many relationship.
Each file request consumes no additional bandwidth





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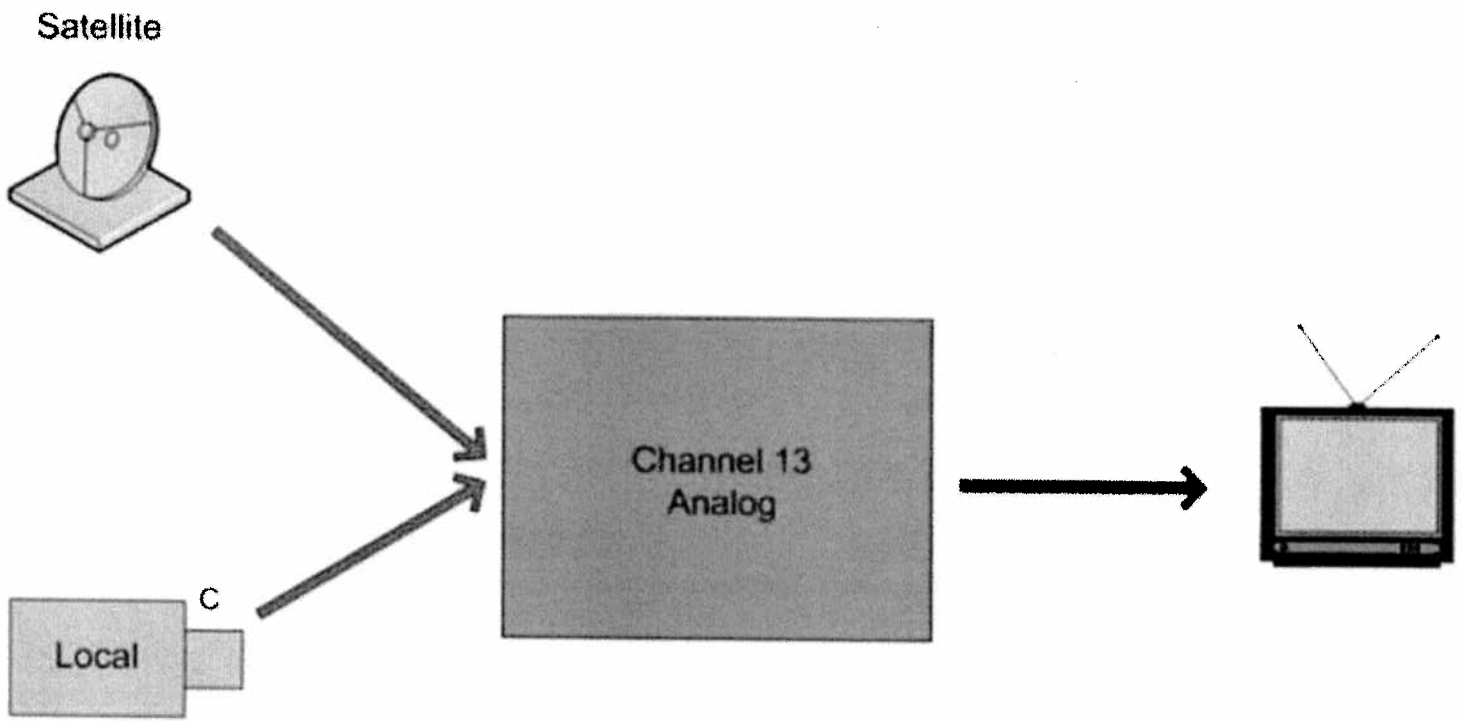
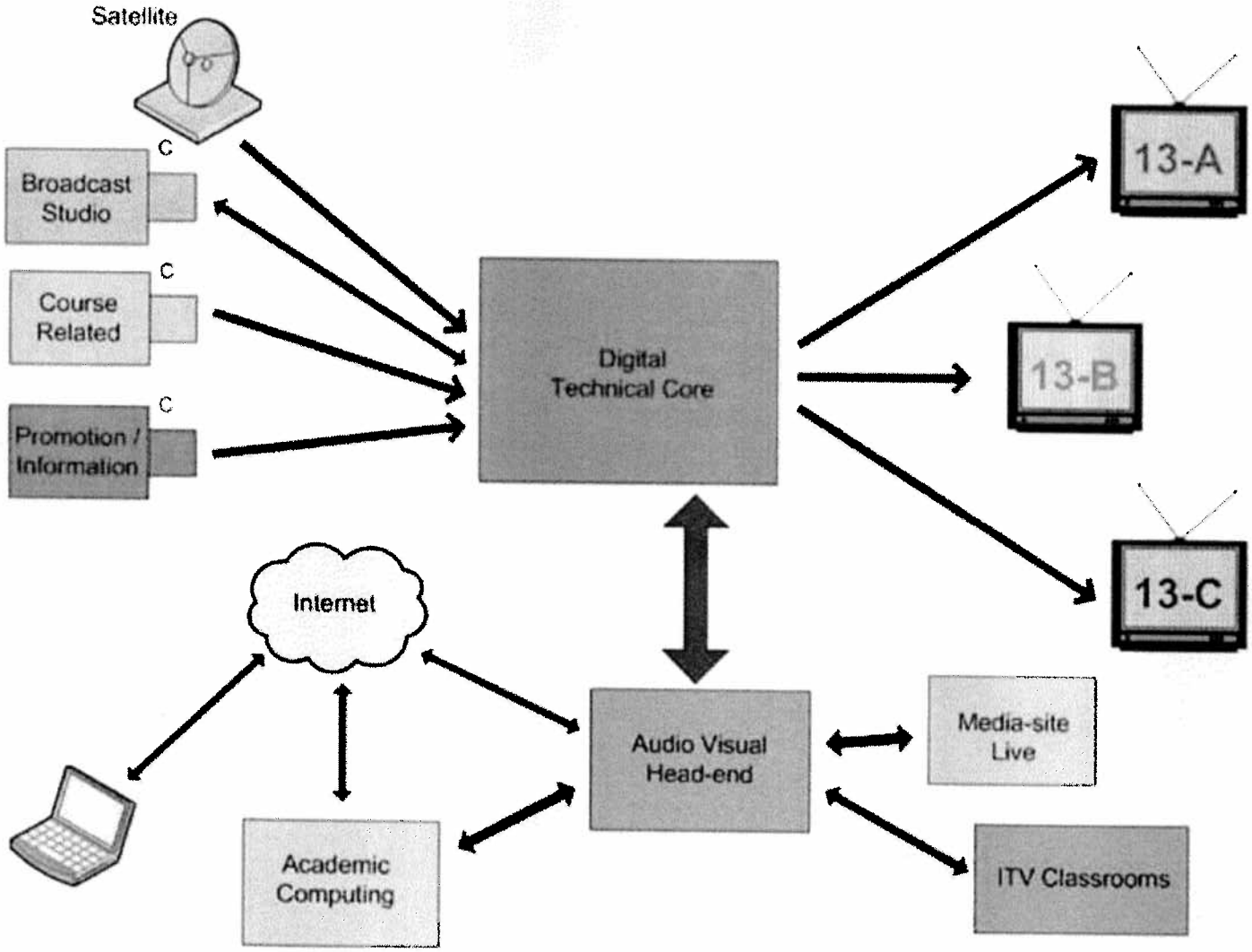
Analog Television



Digital Television



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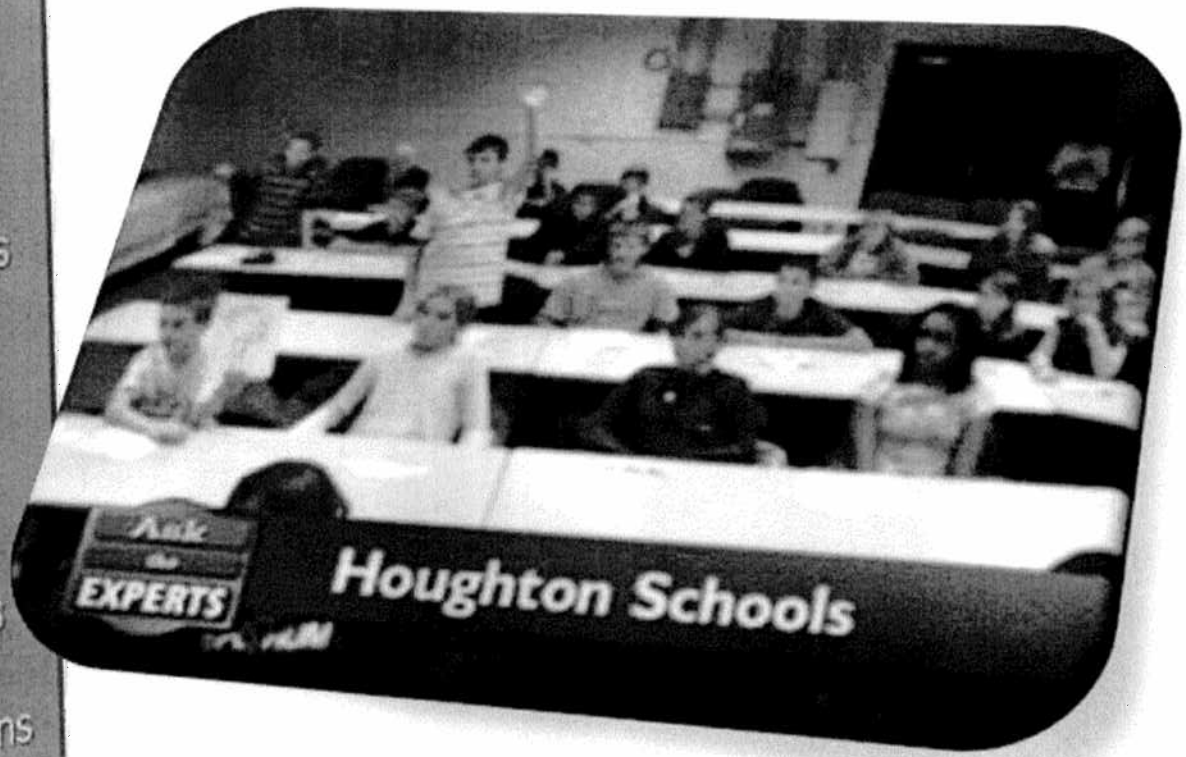
Interactive Television (ITV)

ITV programs:

- 26 Career pathway presentations
- 60 – 80 Virtual field trips each year
- Teacher training
- Inter-district administrative meetings
- International connections with other Universities



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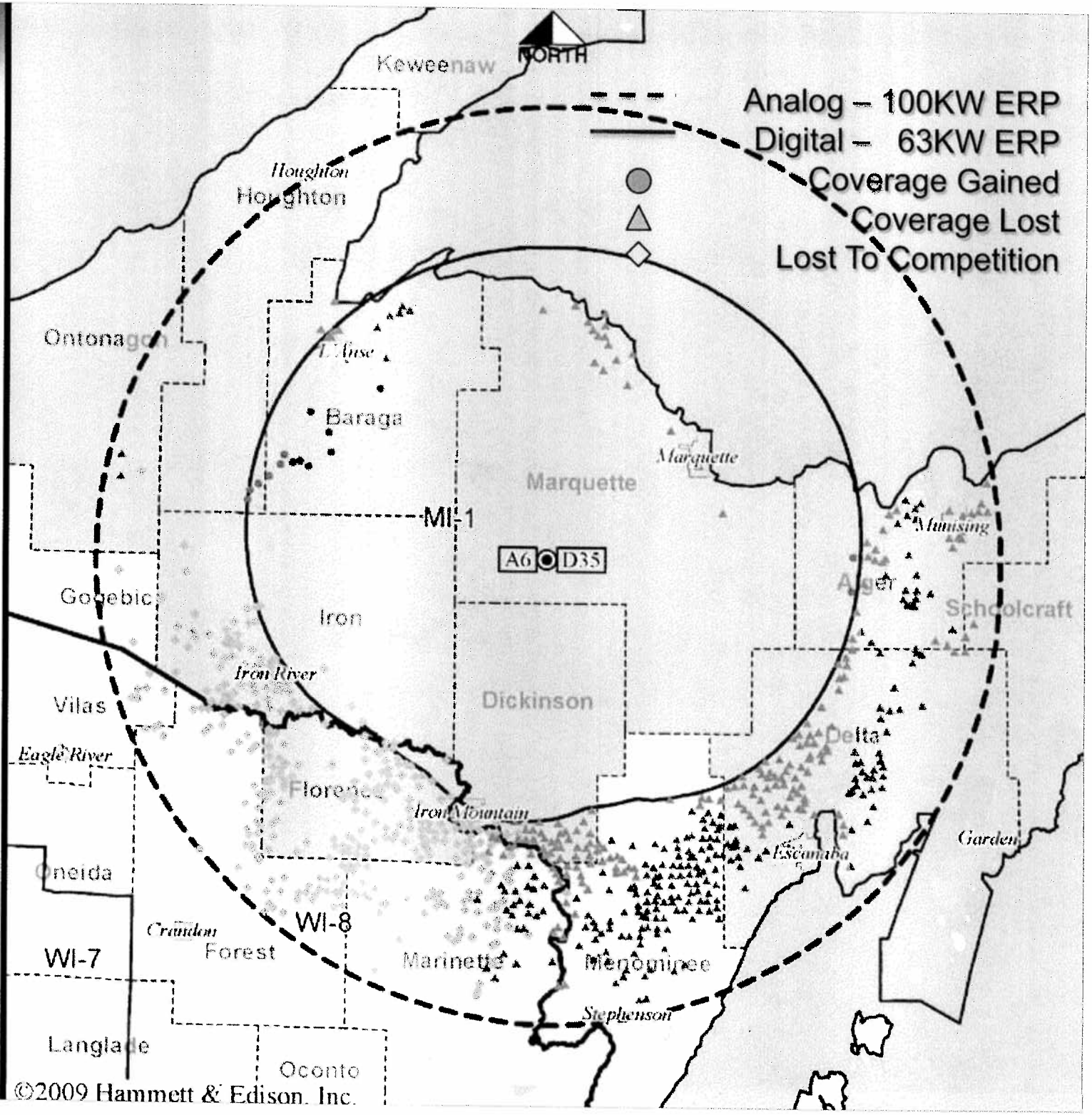
U.P. Broadcast Coverage

WLUC- TV (NBC)



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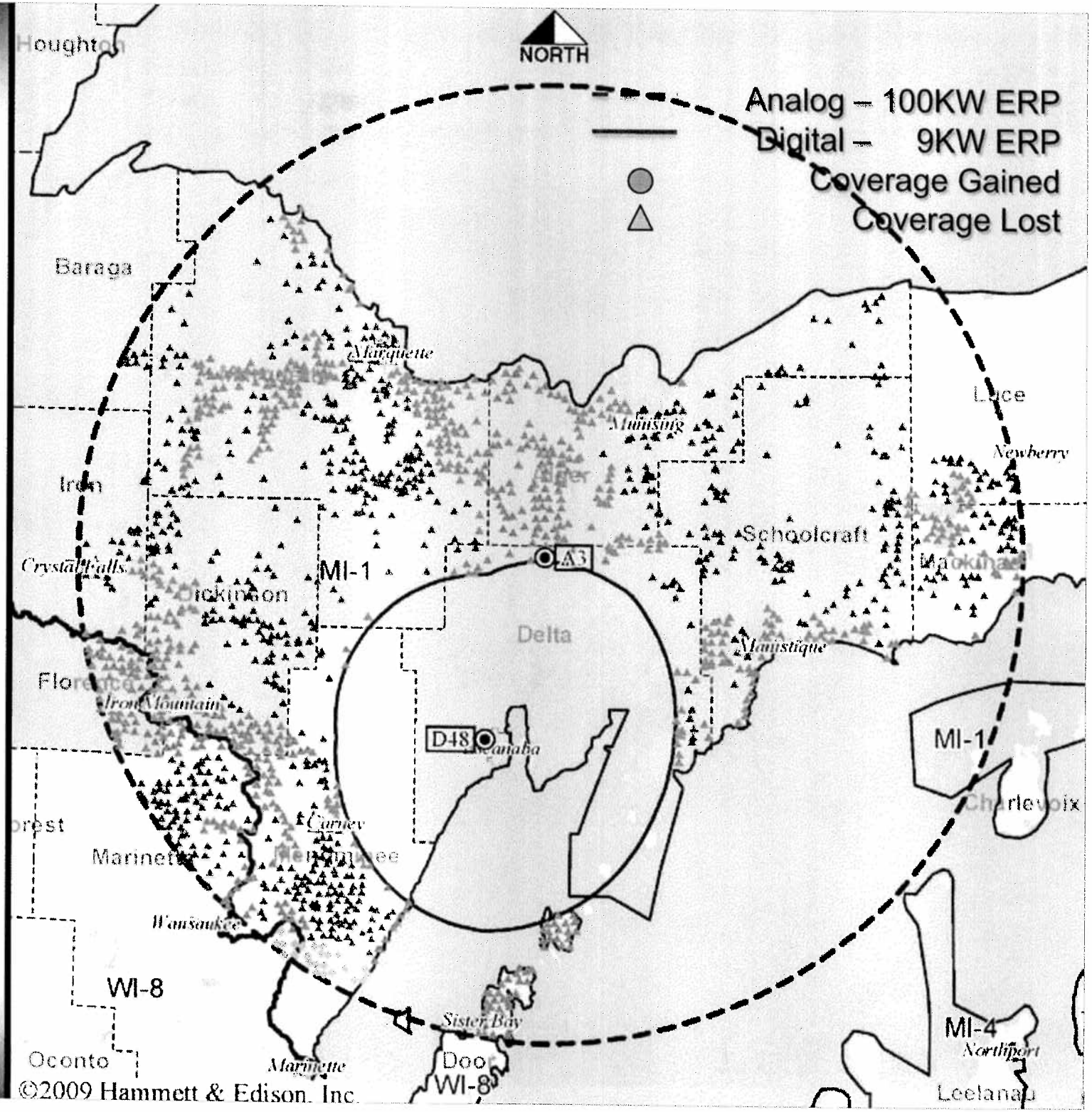
U.P. Broadcast Coverage

WJMN - TV
(CBS)



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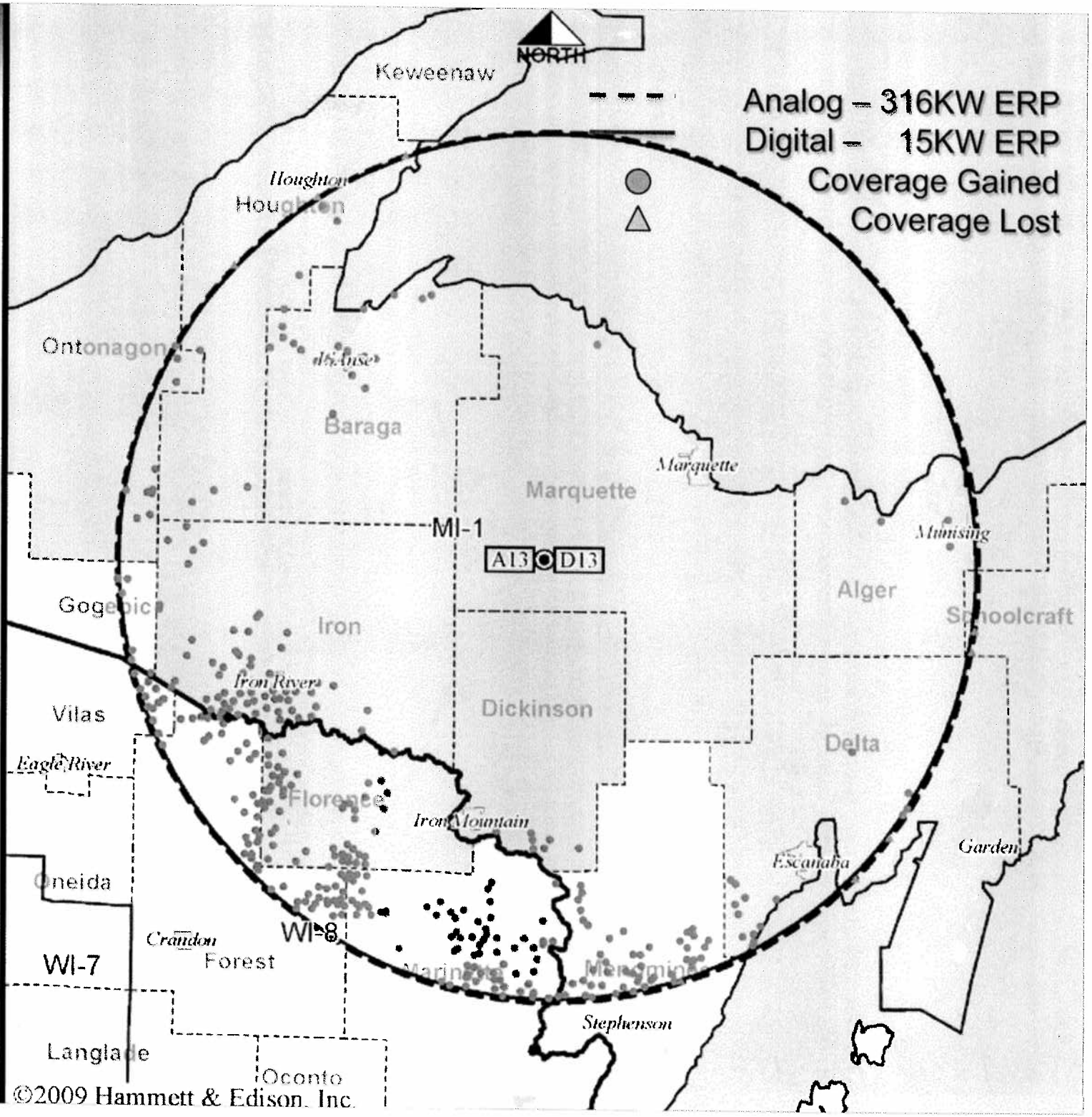
U.P. Broadcast Coverage

WNMU - TV (PBS)



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Michigan's PBS Coverage

(post transition)

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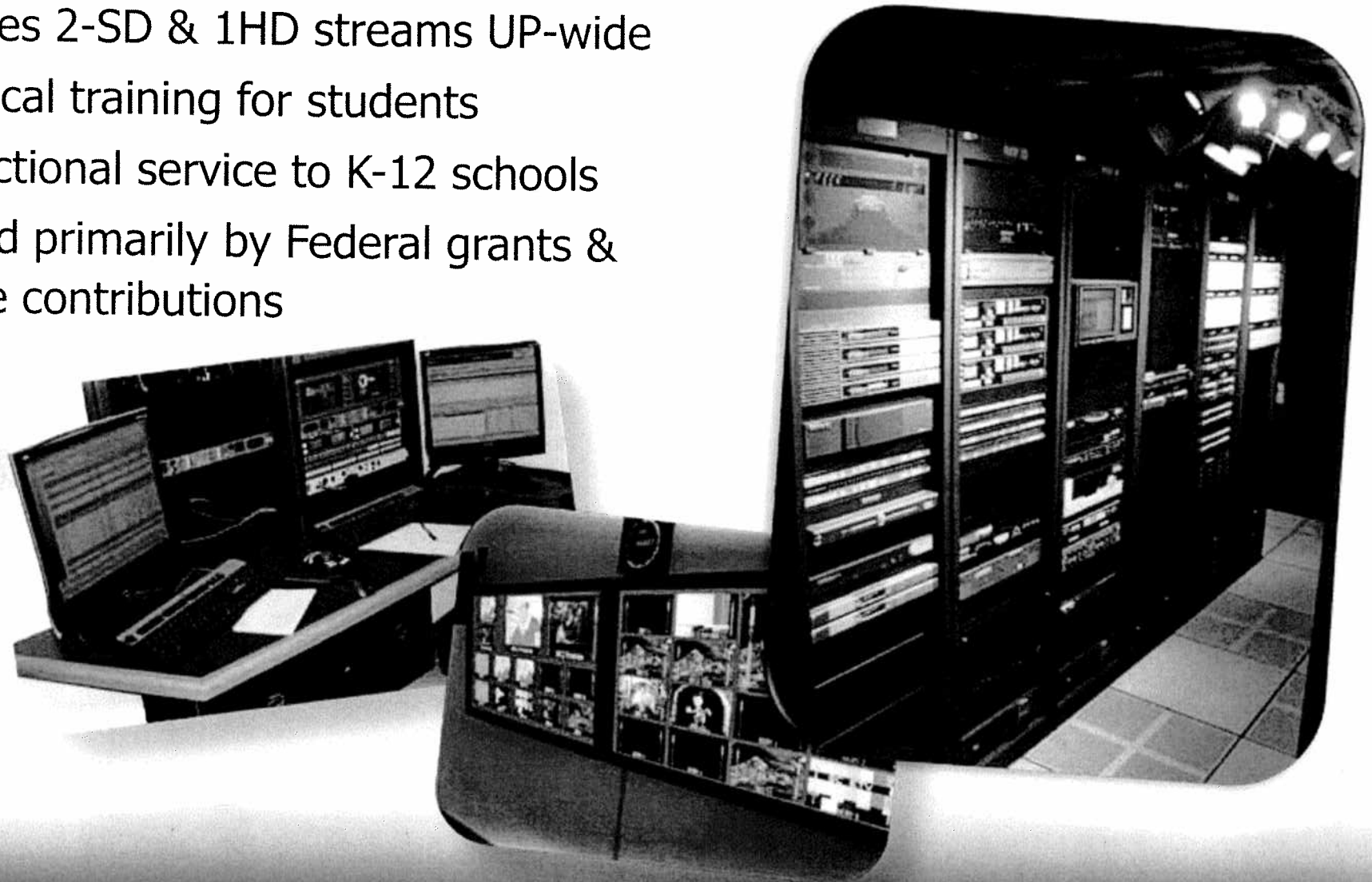
WNMU-TV Technical Core

Facility Summary

- Provides 2-SD & 1HD streams UP-wide
- Technical training for students
- Instructional service to K-12 schools
- Funded primarily by Federal grants & private contributions



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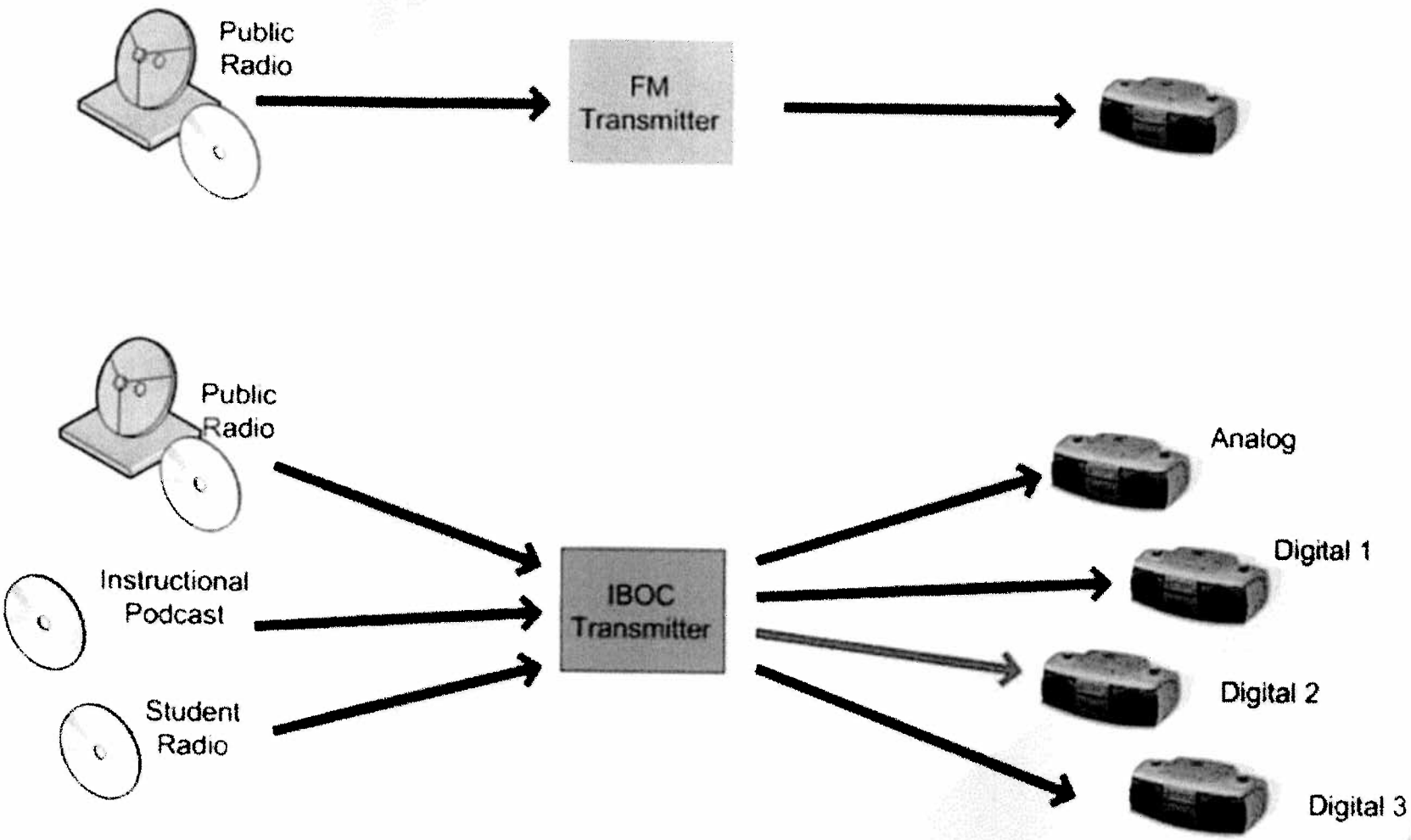
NMU Public Radio



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Future Plans

- FCC approval for additional bandwidth
- Additional collaborative projects with K-12 schools
- Professional development opportunities for teachers
- Local / State "users group" to define collaborative WiMAX projects and potential savings
- University/Corporate test site projects to aid in the development of wireless technology
- New college level curriculum in advanced network engineering

Lessons Learned

- Spectrum is extremely valuable. Michigan's public institutions possess a valuable resource and can use it to the State's advantage.
- Cooperation gets it done… at an affordable price.
- WiMAX technology has the potential expand student access to teaching and learning… especially in rural Michigan.
- Layering wireless and broadcast technologies as appropriate facilitates instructional performance and outcomes.