

MINUTES OF THE NINETEENTH MEETING
REGIONAL TELECOMMUNICATIONS PLANNING
ADVISORY COMMITTEE (Reconstituted)

DATE: June 5, 2007

TIME: 2:00 P.M.

PLACE: Commissioners' Conference Room
Regional Planning Commission Offices
W239 N1812 Rockwood Drive
Waukesha, Wisconsin

Members Present

Kurt W. Bauer Chairman	Executive Director Emeritus, SEWRPC
Bob Chernow	Chairman, Regional Telecommunications Commission
David L. DeAngelis	Village Manager, Village of Elm Grove
Michael Falaschi	President, Wisconsin Internet
Barry Gatz	Network Supervisor, CenturyTel
Michael E. Klasen	Director, Regulatory Affairs, AT&T
Jeff M. Lowney	Vice President/General Manager, Time Warner Telecom
Jeff Mantes	Commissioner of Public Works, City of Milwaukee
George E. Melcher	Director, Office of Planning and Development, Kenosha County
Paul E. Mueller	Administrator, Washington County Planning and Parks Department
Rob N. Richardson	Director, Racine County Information Systems
Steven L. Ritt	Attorney at Law, Michael Best & Friedrich
Bennett Schliesman	Director, Kenosha County Emergency Management /Homeland Security
Dale R. Shaver	Director, Waukesha County Department of Parks and Land Use
Michael Ulicki	Vice President and Chief Technology Officer, Norlight Telecommunications
Gustav W. Wirth, Jr.	SEWRPC Commissioner

Members Absent

William R. Drew Vice Chairman	Vice-Chairman, SEWRPC; Executive Director, Milwaukee County Research Park
Roger Caron	President, Racine Area Manufacturers and Commerce
Michael Long	Attorney-at-Law, Murn and Martin, SC
James W. Romlein	Managing Director, MVLabs, LLC
Darryl Winston	Director of Data Services, City of Milwaukee Police Department

Staff

Philip C. Evenson	Executive Director, SEWRPC
Kenneth J. Schlager, PhD	Chief Telecommunications Engineer, SEWRPC
Lynn G. Heis	Staff Secretary, SEWRPC

CALL TO ORDER AND ROLL CALL

Chairman Bauer called the meeting to order at 2:00P.M. Roll call was taken by circulating an attendance signature sheet, and a quorum was declared present.

CONSIDERATION OF THE MINUTES OF THE MEETING OF MARCH 27, 2007

Chairman Bauer noted that copies of the minutes of the eighteenth meeting of the Reconstituted Regional Telecommunications Planning Advisory Committee held on March 27, 2007, had been distributed to all members of the Committee for review prior to the meeting. He asked the Committee to consider approval. He noted that these minutes documented the results of the Committee review and conditional approval of pages 1 through 26 -- now 29 -- of Chapter VII of SEWRPC Planning Report No. 53. He noted further that the title of Chapter VII had been changed to "Design of Alternative Regional Broadband Telecommunications Plans", and that the title of the report had been changed to *A Regional Broadband Telecommunications Plan for Southeastern Wisconsin*.

Mr. Falaschi called attention to the third paragraph on page 3 of the minutes in which it was indicated that, under Federal law, AT&T must permit any Alcatel service provider to lease space in an AT&T central office for equipment. He noted that this Federal law was not limited to Alcatel and suggested that the term "facilities-based" be substituted for the term "Alcatel" in the paragraph. The same comment he said, applied to the secretary's note and the text of the Chapter. The Committee agreed that the text concerned should be revised as suggested by Mr. Falaschi.

There being no further corrections or additions, on a motion by Mr. Wirth, seconded by Mr. Chernow and carried unanimously, the minutes of the meeting of March 27, 2007, were approved as corrected.

CONSIDERATION OF PRELIMINARY DRAFT OF PAGES THIRTY THROUGH FORTY-SIX OF CHAPTER VII "DESIGN OF ALTERNATIVE REGIONAL BROADBAND TELECOMMUNICATIONS PLANS" OF SEWRPC PLANNING REPORT NO. 53, *A REGIONAL BROADBAND TELECOMMUNICATIONS PLAN FOR SOUTHEASTERN WISCONSIN*.

Chairman Bauer noted that a copy of the preliminary draft of pages 29 through 49 (formerly pages 30 through 46) of Chapter VII "Design of Alternative Regional Broadband Telecommunications Plans" of SEWRPC Planning Report No. 53, *A Regional Broadband Telecommunications Plan for Southeastern Wisconsin* had been provided to all members of the Committee for review prior to the meeting.

Chairman Bauer then asked Dr. Schlager to undertake a review of the draft with the Committee. The following comments were made, questions were raised, and actions were taken in the course of the review.

Mr. Klasen expressed concern about the statement made in the seventh sentence of the first paragraph on page 30 concerning capital investment recovery periods. He noted that such statements were not included in the text relating to the description of the other three alternative plans being considered, and suggested that any reference to capital investment recovery periods be omitted from the text.

Mr. Chernow indicated that in his opinion the cost structure used was incomplete because it did not include customer service acquisition costs which were substantial, and he suggested that such costs be estimated and included in the cost structures for all of the alternative plans being considered.

A lengthy discussion ensued concerning the conceptual validity of Mr. Chernow's suggestion. Mr. Falaschi observed that in order to maintain the comparability of the alternative plans, customer service

acquisition costs should either be excluded from the cost structure of all of the alternative plans, or included in the cost structure of the plans.

After further discussion, Chairman Bauer observed that apparently there was agreement with respect to Mr. Klasen's suggestion to omit any reference to capital cost recovery periods from the text. However, there appeared to be no agreement with respect to Mr. Chernow's suggestion, the issue there being what costs should logically be considered a part of what might be considered to be the public, or common, infrastructure required to provide the service concerned, as opposed to the private costs entailed in accessing the service. He noted that, for example, in transportation system planning, the full costs of the roadway systems are included in the public capital costs of the public infrastructure, but the capital costs of the vehicles are considered to be private costs and are not so included. Those private capital costs, he said, amortized over a period of 20 years, are then considered as a part of the operating costs of the system. This economically sound and widely accepted approach to public works planning and engineering should, he said, by analogy lead to the conclusion that the customer service acquisition costs of the wireline telecommunications systems be excluded from the estimates of the capital costs of the public, or common, infrastructure of the system under consideration, and instead be included, in amortized form, as part of the customer user charges.

Mr. Mueller observed that as long as the assumptions involved, and the rationale therefore were clearly stated, it was irrelevant to a comparative evaluation of alternative plans whether the user acquisition service costs were included or excluded, and indeed what the estimated amount of those costs were.

Mr. Evenson suggested that the staff be directed to develop and present in the text estimated user service acquisition costs for all four of the alternative primary plans being considered, together with the capital costs entailed, for the delivery of service to 20 percent of the premises concerned. Those capital costs, he said, would not, however, be added to the capital cost of the common infrastructure required for each plan. There was agreement on Mr. Evenson's suggestion.

Mr. Falaschi then raised another concern, namely the estimated capital cost of \$48,000 per node, indicating that this figure appeared to be low. Mr. Ulicki agreed, indicating that he did not believe that this cost included the cost of providing the fiber optic cable connection from a central office to a node. A lengthy discussion ensued.

Mr. Ulicki observed, and Mr. Klasen agreed, that the \$48,000 capital cost per node assumed the availability, at least within the AT&T service area, of the existing fiber optic cable network owned by the company; and that, under this situation, the cost was a reasonable estimate for plan deployment by AT&T. Mr. Ulicki observed, however, that if an independent provider were to attempt such deployment, that provider would have to absorb the capital cost of installing the fiber optic cable connections between the central offices and the nodes.

After some further discussion, Chairman Bauer then attempted to summarize the results of the lengthy discussion concerning the three issues raised as: 1) agreement that any reference to capital costs recovery periods be omitted from the text; 2) agreement that the estimated user service acquisition costs be presented for each of the four alternative plans considered, but that such costs would not be included in the estimated capital cost of the public, or common, infrastructure of the systems concerned; and 3) agreement that the \$48,000 per node capital cost be retained, but that a companion cost including additional capital cost of the installing of the fiber optic cable connections between the central offices and the nodes be included in the text. In order to maintain consistency with the cost structure utilized in the preparation of the two alternative wireless plans, this before capital cost would be used in the cost structure of the Fiber-to-the-Node alternative wireline plan.

[Secretary's Note: The first paragraph on page 29 has been rewritten based upon the guidance provided by the Committee discussion. The revised draft is included in the copy of the Chapter attached to these minutes.

"A threshold household density of 150 households per square mile was selected as the minimum density for service under the FTTN alternative plan since this standard results in an average density in the service area of about 1,343 households per square mile. Such an average household density coupled with a 20 percent "take-rate" assumption would provide for about 200 users per square mile which is the capacity of the smallest ISAM equipment unit. Larger take-rates could be supported by the installation of 400 or 800 line ISAM units, but the plan would provide for efficient utilization of even the smallest 200 nodal infrastructure."]

With respect to the third paragraph on page 31 which continues onto page 32, Chairman Bauer asked Mr. Klasen if AT&T was able, at a user's request, to provide symmetrical data transmission rates as a part of its fiber to the node system service. Mr. Klasen responded that this was not possible, but that AT&T had a range of alternative equipment and services that could, in response to a user's need, provide symmetrical service.

[Secretary's Note: The following sentence was added to the end of the first paragraph on page 32.

Most of ILEC service providers offer a range of other high speed data equipment and services for symmetrical communications such as OC-1 (also called T3 or DS-3) lines, but these services are typically offered at much higher cost rates than the contemplated FTTN network services.]

In answer to a question by Mr. Wirth, Mr. Klasen indicated that the new AT&T fiber to the node service system will offer four simultaneous video channels.

Mr. Evenson asked that the following sentence be added as the penultimate sentence of the first partial paragraph on page 31.

"The latter area, however, may be expected to contain about 92 percent of the anticipated year 2035 resident population of the Region of 2.8 million persons;"

Mr. Mueller recalled that the planning program was undertaken primarily to provide a telecommunications system but would make the Region more competitive with other regions. Therefore, he indicated that it would be helpful to also provide the extent to which the deployment of the alternative plan would serve commercial and industrial establishments within the Region. Mr. Evenson indicated that the staff would explore the means and practicability with which this might be possible to do. The FTTN networks currently being deployed by ILEC service providers are primarily aimed at the residential entertainment (television) market. Bandwidth allocation heavily favor downstream broadcasting. Such networks are not particularly supportive of industrial and commercial communication which require more balanced symmetric communications channels.

[Secretary's Note: The following phrase was also added as the last sentence of the first partial paragraph on page 31. "--; about 93 percent of the 27,600 acres of land anticipated to be devoted to commercial use; and about 90 percent of the land anticipated to be devoted to industrial use in that year."]

In answer to a question and concern raised by Mr. Evenson, Mr. Klasen indicated that the AT&T fiber to the node deployment program does not meet the needs of symmetrical users; however, whenever and wherever additional fiber optic cables are deployed, the potential for higher speed commercial and industrial connectivity is increased, thereby meeting high speed data transmission rate needs. Potential commercial and industrial users, he said, were, therefore, dependent upon a combination of fiber optic cable extension and installation of electronic equipment that the firm offers, however, at increased cost.

Chairman Bauer noted that during the internal staff review of the draft, it had been determined that a section be added to the top of page 34 following the paragraph on cost that would describe the potential for deployment of a fiber to the node system by commercial cable companies operating within the Region. Chairman Bauer indicated that such a section would be included in the revised draft of the Chapter to be provided with the minutes of the meeting for Committee review.

[Secretary's Note: The envisioned paragraph is provided in the copy of the Chapter attached to these minutes.]

Cable Networks and the Fiber-to-the-Node (FTTN) Plan

“Parallels exist between proposed ILEC-based FTTN networks and existing Hybrid Fiber-Coax (HFC) Networks employed by cable service providers. Both networks integrate combinations of fiber optic and copper wire linkages. Since cable networks now offer the same or equivalent services that are the primary target of the new FTTN network, it is reasonable to conclude that such cable networks could also offer fourth generation (4G) communications performance at throughput rates of 20 megabits per second and higher. Such upgrades to current HFC networks with download data rates as high as 100 Mbps have been reported. Charter Communications offers data rates as high as 30 megabits per second over its current HFC network. The structural topology of these HFC networks, however, is also asymmetric and very downstream oriented in bandwidth allocation. Their geographic coverage, like FTTN, is also limited by the high costs of cable deployment.”]

Messrs. Chernow and Lowney questioned the validity of the estimated cost of installing fiber optic cable given as \$21,120 per mile in the second paragraph on page 34. A lengthy discussion ensued upon the conclusion of which it was agreed that the staff would reevaluate this cost.

[Secretary's Note: Following the meeting, Mr. Mantes provided information on costs entailed in City of Milwaukee projects involving the laying of duct work to accommodate the deployment of fiber optic cable, these costs being an order of magnitude higher than the \$21,120 per mile cost cited. As a result, a staff reevaluation of these costs is set forth below and in the revised draft attached to these minutes.

“The cost of laying fiber optic cable will vary widely with the type of area traversed – various urban, suburban, or rural settings – and with the design of the installation. For example, the City of Milwaukee installs its own fiber optic cables in ducts laid to line of grade properly related to the horizontal and vertical location of other utilities and to established street grades. The ducts typically consist of 4 inch diameter plastic tubing and can be laid in groupings of from two to 16 tubes, and encased in a concrete

slurry. Manholes are provided at junctions and at approximately 600 feet spacing between junctions. This represents the best municipal engineering practice, and should be followed for the installation of cable along arterial streets and in areas developed with high density urban uses, and therefore in which the street rights-of-way must accommodate a multiplicity of utility structures. The cable ducts are normally installed using trenching. In lower density urban, suburban and rural areas, the fiber optic cable may be installed without benefit of duct work utilizing cheaper plowing and directional boring techniques. The costs entailed may therefore range from a low of less than \$20,000 per mile, to a high exceeding \$250,000 per mile.

In the base year of the plan – 2000, there were a total of about 8,500 miles of public streets and highways within the planned urban service areas of the Region, of which 2,240 miles consisted of arterial streets and highways, and 6,260 miles consisted of collector and land access streets. As already noted, the collector and land access street network served a total of about 477 square miles of actual urban development within the 975 square miles of planned urban service area. Therefore, an average of 13 miles of collector and land access streets were required to serve one square mile of urban development together with an attendant two miles of peripheral arterial streets. Assuming that, typically, fiber optic cable would be installed only in about 67 percent of the collector and land access street mileage, about 9 miles of cable would be required per square mile of urban development, plus an attendant two miles of cable in peripheral arterial streets. Assuming that duct installation would be required only for the fiber optic cable located in newly reconstructed arterial streets, and that 50 percent of the arterial streets in the urban service area will require reconstruction over the plan design period, duct installation would be required on average for about one mile of arterial street per square mile of development over the plan design period. Thus, for regional systems planning purposes, the cost of providing fiber optic cable service to the individual premises was estimated at \$385,000 per square mile, with a weighted average cost for laying cable of about \$35,000 per mile.”]

With respect to a statement made in the paragraph numbered 3 on page 39, Mr. Ritt asked Dr. Schlager to elaborate on the assumed definitions of existing and proposed new antenna sites. Dr. Schlager indicated that the 380 existing antenna base station sites utilized in the plan were selected from the 1,010 antenna base station sites identified in the Commission inventory, as the findings of that inventory were reported in SEWRPC Planning Report No. 51 *A Wireless Antenna Siting and Related Infrastructure Plan for Southeastern Wisconsin*. In addition, Dr. Schlager said the deployment of the plan would require an additional 363 new antenna base station sites. In answer to a further question by Mr. Ritt, Dr. Schlager indicated that the 743 antenna base station sites required to serve the Region under this alternative would have to include tall masts that would provide for antenna mountings at heights of about 100 feet or more above the base of the mast.

[Secretary’s Note: The text under Item 4 on page 39 was revised to read as follows:

“Antenna Site Layout – the antenna site layout for Alternative Adjunct Plan A shown on Map 8 was based upon radio wave propagation modeling. The modeling assumed that the antennas would be mounted at a height of about 100 feet above the antenna base station masts. Variations in the antenna site

density shown result from both the higher building “clutter” and higher traffic volumes expected for urbanized areas of the Region.”]

In answer to a question by Mr. Ulicki, Dr. Schlager indicated that the geographic distribution of the antenna base station site shown on Map 8 was determined by radio wave propagation modeling and the density required for the proposed service reflected such factors as the presence of clutter in the form of tree canopy, tall buildings, and other impediments to radio wave propagation, as well as the elevation of the sites available for the base stations. In answer to another question by Mr. Ritt, Dr. Schlager indicated that the cost estimates for the base stations needed were carried forward from Table 2 of the Chapter.

There being no further questions or comments, on a motion by Mr. Wirth, seconded by Mr. Chernow, and carried, the preliminary draft of pages 30 through 46 of Chapter VII “Design and Evaluation of Alternative Regional Broadband Telecommunications Plans” of SEWRPC Planning Report No. 53, *A Regional Broadband Telecommunications Plan for Southeastern Wisconsin* was approved as amended with Messrs. Gatz, Klasen and Ritt voting no, the three dissenting members indicating that the reason for their vote was that the companies which they represented objected to the Commission preparing a telecommunications plan.

NEW BUSINESS AND CORRESPONDENCE

Chairman Bauer indicated that there was no new business since nor correspondence to be brought to the attention of the Committee.

DATE AND TIME OF NEXT MEETING

Chairman Bauer then asked the Committee to consider the date and time for the next Committee meeting. After brief discussion, it was agreed that the next meeting of the Committee would be held on Tuesday, August 7, 2007 at the Commission offices beginning at 2:00PM.

ADJOURNMENT

There being no further business to come before the Committee, on a motion by Mr. Wirth, seconded by Mr. Chernow, and carried unanimously, the meeting was adjourned at 3:50 PM.

Respectfully Submitted,

Lynn G. Heis
Committee Secretary

PRELIMINARY DRAFT

Fiber to the Node (FTTN) Alternative Wireline Plan




The Fiber-to-the-Node (FTTN) Alternative Plan is based upon the previously described Alcatel 7330 Intelligent Services Access Manager (ISAM). The early stages of this planned network are being deployed by AT&T in its ILEC territory within the Region as part of its Project Lightspeed. The alternative plan covered would extend the network into other ILEC areas within the Region. The envisioned FTTN network deployment is based upon the location of the ILEC central offices, as documented in Chapter V of this report. Each central office would support a set of remote nodes that in turn would service users within a radius of about 3,000 feet – comprising an approximately one square mile service area. The extent of the envisioned FTTN network deployment would depend upon the household density pattern within the Region. ~~Based upon an estimated cost of \$48,000 per node, and an average user revenue of \$120 per month, the initial capital investment in a node could be recovered in a one-year time period in service areas with a minimum household density of about 150 households per square mile, and a “take-rate” of about 22 percent. Higher take-rates would provide earlier investment recovery. The estimated minimum household density required is based up use of the smallest Alcatel ISAM unit which provides 200 lines per node. Higher density areas may require the use of larger 400 line and 800 line ISAM units. Very high density areas may require multiple combinations of 200, 400 and 800 line ISAM units.~~ *A threshold household density of 150 households per square mile was selected as the minimum density for service under the FTTN alternative plan since this standard results in an average density in the service area of about 1,343 households per square mile. Such an average household density coupled with a 20 percent “take-rate” assumption would provide for about 200 users per square mile which is the capacity of the smallest ISAM equipment unit. Larger take-rates could be supported by the installation of 400 or 800 line ISAM units, but the plan would provide for efficient utilization of even the smallest 200 nodal infrastructure.*

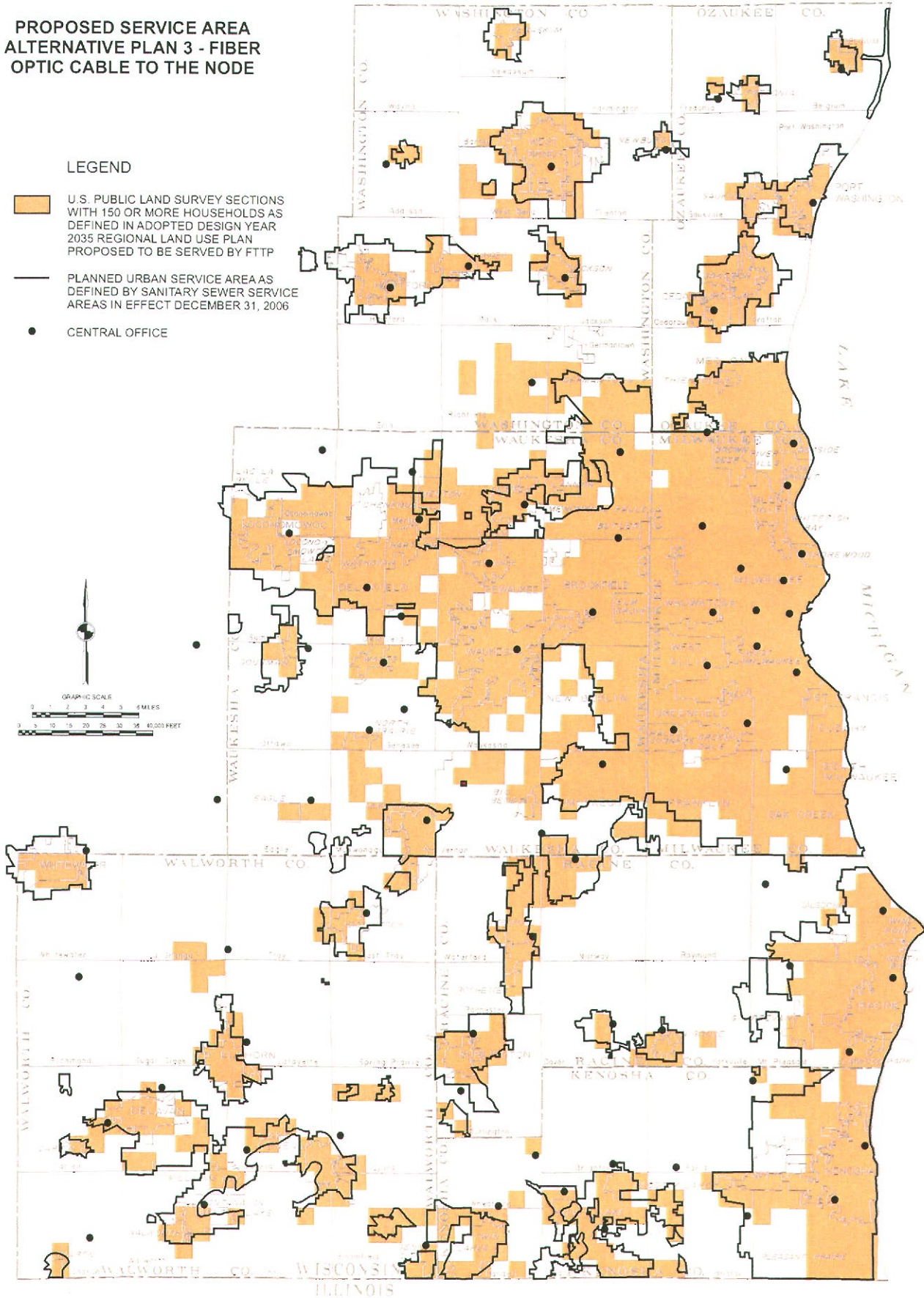
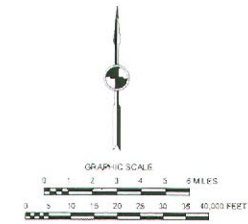
The areas of the Region which may be expected to have a household density of 150 households per square miles or more in the year 2035, the design year of the adopted regional land use plan, are shown on Map 7. These areas, in aggregate, encompass a total of 953 square miles, or about 36.35 percent, of the total area of the seven-county Region. The areas meeting or exceeding the minimum household density standard as shown on Map 7 include areas of such density existing in the inventory base year 2000, as

Map 7

**PROPOSED SERVICE AREA
ALTERNATIVE PLAN 3 - FIBER
OPTIC CABLE TO THE NODE**

LEGEND

-  U.S. PUBLIC LAND SURVEY SECTIONS WITH 150 OR MORE HOUSEHOLDS AS DEFINED IN ADOPTED DESIGN YEAR 2035 REGIONAL LAND USE PLAN PROPOSED TO BE SERVED BY FTTP
-  PLANNED URBAN SERVICE AREA AS DEFINED BY SANITARY SEWER SERVICE AREAS IN EFFECT DECEMBER 31, 2006
-  CENTRAL OFFICE



well as such areas expected to exist in the plan design year 2035. The mapped areas therefore include a number of small scattered and discontinuous areas meeting the minimum density standard. Such small, scattered, and discontinuous areas may be expected to be located beyond the reasonable service area of a FTTN wireline telecommunication system. Map 7 also includes a delineation of the planned urban service areas within the Region, the same areas as those shown on Map 4 of this report. These areas may be expected to accommodate anticipated urban development within the Region to the adopted regional land use plan design year 2035; and represent those areas of the Region which the adopted land use plan envisions being provided with a full range of urban facilities and services, including sanitary sewerage, public water supply, mass transit, and highspeed broadband telecommunications. The urban service areas in aggregate encompass a total of 975 square miles or about 36 percent of the total area of the seven-county Region. *In the base year of the plan -- 2000, about 477 square miles of this planned urban service area were actually devoted to urban development. This area is expected to increase to about 639 square miles by the year 2035. The latter area, however, may be expected to contain about 92 percent of the anticipated year 2035 resident population of the Region of 2.8 million persons; about 93 percent of the 27,600 acres of land anticipated to be devoted to commercial use; and about 90 percent of the land anticipated to be devoted to industrial use in that year.*

The FTTN Alternative Plan is central office oriented, so that the deployment must consider proximity to central office locations as well as housing density. These central offices, previously displayed in Map 4 of the report, are also shown on Map 7 in conjunction with the envisioned service area of the FTTN Alternative Plan. Although AT&T is the only regional wireline carrier that is known to be committed to the deployment of an FTTN network within the Region, the envisioned service area of the FTTN Alternative Plan includes other areas of the Region serviced by ILEC carriers located within the delineated service area of the plan.

The FTTN plan has the following features:

1. Technology

An advanced version of DSL technology known as VDSL -- for very high speed DSL -- is the basis of the proposed FTTN Alternative Plan. Also known as International Telecommunications Union (ITU) Standard G.993, VDSL currently exists in two forms: VDSL -- ITU Standard G.993.1, and VDSL2 ITU Standard G.993.2. VDSL has a maximum downlink transmission rate of 13 to 55 megabits per second, while VDSL2 has a maximum downlink transmission rate of 10 to 100 megabits per second. This asymmetrical nature of all forms of DSL constitutes an important limitation of the technology. Currently, the uplink transmission rates are limited to one megabit

per second. Such a bandwidth allocation, while unimportant to many users, does limit certain applications such as video-conferencing, or the need to transmit large data files, where symmetrical data transmission rates are essential to quality video communications. *Most of ILEC service providers offer a range of other high speed data equipment and services for symmetrical communications such as OC-1 (also called T3 or DS-3) lines, but these services are typically offered at much higher cost rates than the contemplated FTTN network services.*

The FTTN networks currently being deployed by ILEC service providers are primarily aimed at the residential entertainment (television) market. Bandwidth allocation heavily favors downstream broadcasting and website downloading. Such networks are not particularly supportive of industrial and commercial communication which require more balanced symmetric communications channels.

It is of interest to note that DSL in all of its forms transmits data using discrete multitone (DMT), a wired version of orthogonal frequency division multiplexing (OFDM), that is widely used in wireless standards such as WiFi and WiMAX. The data signal to be transmitted is divided into multiple low speed data paths. These paths are modulated on hundreds or thousands of adjacent carriers over a broad spectrum. The medium from the central office to the node is fiber optic cable. The medium from the node to the user is the twisted wire pair telephone cable made with Number 24 or 26 gauge copper long used for voice telecommunications systems.

2. Range

Although a radius of 3,000 feet is the most frequently quoted range of VDSL, network performance varies with the distance from the local node. Maximum data transmission rates depend upon the signal-to-noise ratio (SNR) which declines with distance from the node. Users located closer to the node with a higher SNR will experience higher transmission rates. The range of VDSL can extend as far as approximately 4,500 feet from the node, and VDSL2 as far as approximately 5,000 feet.

3. Cost Structure

The deployment costs of the FTTN Alternative Plan include the central office, node, *fiber optic cable link* and user premise installation costs. Infrastructure costs are primarily nodal *and fiber applicable link* costs -- the cost of the ISAM equipment ~~and its installation~~ *and the fiber link to that node*. Allowing for a proportionate share of central office augmentation costs allocated to

each node, the estimated cost per node approximates ~~\$48,000~~ \$83,000 of which \$48,000 is for nodal equipment and \$35,000 for the fiber optic cable link. This assumes an average fiber optic link of one mile from the central office to each node, and a weighted average cable installation cost of \$35,000 per mile. The basis for the calculation of this weighted average cost is set forth below under the description of the cost structure for the Fiber-to-the-Premises alternative plan.

User acquisition costs for the FTTN Alternative Plan include the equipment and installation labor costs associated with the startup of service to a new user. Based upon an estimated four to eight hour installation time, and a typical user equipment cost of \$150, the total new user equipment and installation cost may be estimated at about \$600. Initially, service providers may absorb this cost to expedite the early growth of the network, but essentially this cost will have to be paid by each new user, either as an installation cost, or as a user cost to be absorbed as part of the monthly charges for the service. For these reasons, user equipment and installation costs were not considered in the comparative evaluation of alternative regional broadband communications plans.

4. Performance

The Alcatel 7330 FTTN technology may be configured to provide a minimum target throughput of 25 megabits per second at each user location. The allocation of this bandwidth lies with the wireline service provider. Since television is the primary driving force behind the current FTTN network deployments, a sizable bandwidth allocation to video may be expected. A typical allocation might be 19 mbps for video, and 6 megabits per second for Internet data communications. As previously noted, a very small portion of the bandwidth is allocated to upload throughput.

Cost

As already noted, the FTTN Alternative Plan is envisioned to be deployed within an aggregate service area of 975 square miles -- the planned design year 2035 urban service area within the region -- or about 36 percent of the total area of the seven-county Region. ~~Given a coverage area for each node of about one square mile, the infrastructure cost attendant to implementation of the FTTN alternative plan may be estimated at \$46.8 million.~~ This regional area is currently supported by 77 central offices each covering an approximate 12 square mile service area requiring 12 nodes per central office. At the previously estimated cost of \$83,000 for each FTTN node, the cost attendant to the implementation of the FTTN alternative plans may be estimated at \$77.7 million.

Cable Networks and the Fiber-to-the-Node (FTTN) Plan

Parallels exist between proposed ILEC-based FTTN networks and existing Hybrid Fiber-Coax (HFC) Networks employed by cable service providers. Both networks integrate combinations of fiber optic and copper wire linkages. Since cable networks now offer the same or equivalent services that are the primary target of the new FTTN network, it is reasonable to conclude that such cable networks could also offer fourth generation (4G) communications performance at throughput rates of 20 megabits per second and higher. Such upgrades to current HFC networks with download data rates as high as 100 Mbps have been reported. Charter Communications offers data rates as high as 30 megabits per second over its current HFC network. The structural topology of these HFC networks however, is also asymmetric and very downstream oriented in bandwidth allocation. Their geographic coverage, like FTTN, is also limited by the high costs of cable deployment.

Fiber to the Premises (FTTP) Alternative Wireline Plan

The Fiber-to-the Premises (FTTP) Alternative Plan is based upon the previously described Alcatel 7340 Fiber-to-the-Premises System which uses Passive Optical Network (PON) technology to reach new subscribers. A single fiber originating in a central office is split at a remote site using an optical splitter to connect up to 32 end users into the fiber network. Since there is no active electronic equipment between the central office and the user, the infrastructure deployment costs consist primarily of the cost of laying the fiber cable to the user's premises. The cost per user will depend on the household density in a given area. Since the costs of laying fiber cable per mile in various urban, suburban or rural settings are essentially fixed, the economic viability of FTTP depends on the population density of an area. Based on ~~a~~ an average fiber optic cable deployment cost of ~~\$4 per foot,~~ \$35,000 per mile, and an estimated ~~16~~ 11 miles of ~~public street~~ cable required typically to serve one ~~in a typical~~ square mile of urban development area, the cost of installing the fiber optic cable would approximate ~~\$338,000-~~ \$385,000 per square mile. ~~The minimum number of potential users required to warrant the fiber optic cable deployment is 40 per lineal mile, equivalent to an investment of \$528 per potential user. Given the cost of the installation of the fiber optic cable of \$21,120 per mile, the minimum density of development required to support FTTP approximates 640 households per square mile. With the same assumed 22 percent take rate used in the FTTN plan, and an average user revenue of \$120 per month, the initial capital investment could be recovered in 20 months. Higher take rates would provide earlier capital investment recovery. Lower household density areas would require a higher capital investment per household than service providers may be willing to invest. Although such lower density deployment is technically feasible, it would require some form of governmental subsidy to be economically viable. The FTTP plan was assumed to serve the same area within the Region as the FTTN plan. This assumption~~

was made to ensure comparability between the FTTN and FTTP alternative plans, although return on investment analyses would lead to smaller and different service areas for each plan.

~~The areas of the Region which may be expected to have a household density of 640 households per square mile or more in the year 2035, the design year of the adopted regional land use plan, are shown on Map 8. These areas, in aggregate, encompass a total of 435 square miles, or about 16 percent of the total area of the seven-county Region. The areas meeting or exceeding the minimum household density standard as shown on Map 8 include areas of such density existing in the inventory base year 2000 as well as such areas expected to exist in the plan design year 2035. The mapped areas therefore include a number of small scattered and discontinuous areas meeting the minimum density standard. Such small, scattered and discontinuous areas may be expected to be located beyond the reasonable service area of a FTTP wireline telecommunications system.~~

The FTTP like the FTTN plan is central office oriented, so that deployment must consider the availability of central office locations as well as housing density. The long reach, however, of the Alcatel 7340 System -- up to 12.4 miles -- along with the ready availability of central offices to 400 household per square mile density areas should not seriously restrict the deployment of FTTP networks.

The FTTP plan has the following features:

1. Technology

The Alcatel 7340 FTTP System is a second generation PON (passive optical network) platform that distributes voice, data and video transmissions through a passive (no electronic or electro-optic components) optical fiber network in which each fiber terminated at the CO can be split into 32 fiber lines at a remote Optical Splitter (OSP) for servicing up to 32 optical network terminals in homes or businesses. A PON network is selected in preference to an active optical network (AON) which provides for a direct fiber connection between each user and the CO. The AON has much greater potential capacity than a PON, but it also has a higher initial investment cost and higher operating and maintenance costs.

2. Range

The Alcatel 7340 FTTP supports a range of up to 12.4 miles from the central office to the end user. At some intermediate distance, each co-originated fiber is split into 32 fibers, each one serving an individual.

3. Cost Structure

The infrastructure costs of the FTTP Alternative Plan include the central office, fiber optic deployment and user premises installation costs. Infrastructure costs embrace only the first two of the cost elements since user premises installation costs occur only when a resident or business elects the service. User premises installation costs include the equipment and installation labor costs associated with the structure of service to a new user. These costs are absorbed by the user either in terms of an initial fee or as part of fees over the life of the service.

The cost of laying fiber optic cable will vary widely with the type of area traversed -- various urban, suburban, or rural settings -- and with the design of the installation. For example, the City of Milwaukee installs its own fiber optic cables in ducts laid to line of grade properly related to the horizontal and vertical location of other utilities and to established street grades. The ducts typically consist of 4 inch diameter plastic tubing laid in groupings of one by two to four and four, and encased in a concrete slurry. Manholes are provided at junctions and at approximately 600 feet spacing between junctions. This represents the best municipal engineering practice, and should be followed for the installation of cable along arterial streets and in areas developed with high density urban uses, and therefore in which the street rights-of-way must accommodate a multiplicity of utility structures. The cable ducts are normally installed using trenching. In lower density urban, suburban and rural areas, the fiber optic cable are usually be installed without benefit of duct work, utilizing cheaper plowing and directional boring techniques. The costs entailed may therefore range from a low of less than \$20,000 per mile, to a high exceeding \$250,000 per mile.

In the base year of the plan -- 2000, there were a total of about 8,500 miles of public streets and highways within the planned urban service areas of the Region, of which 2,240 miles consisted of arterial streets and highways, and 6,260 miles consisted of collector and land access streets. As already noted, the collector and land access street network served a total of about 477 square miles of actual urban development within the 975 square miles of planned urban service area. Therefore, an average of 13 miles of collector and land access streets were required to serve one square mile of urban development together with an attendant two miles of peripheral arterial streets. Assuming that, typically, fiber optic cable would be installed only in about 67 percent of the collector and land access street mileage, about 9 miles of cable would be required per square mile of urban development, plus an attendant two miles of cable in peripheral arterial streets. Assuming that duct installation would be required only for the fiber optic cable located in newly

reconstructed arterial streets, and that 50 percent of the arterial streets in the urban service area will require reconstruction over the plan design period, duct installation would be required on average for about one mile of arterial street per square mile of development over the plan design period. Thus, for regional systems planning purposes, the cost of providing fiber optic cable service to the individual premises was estimated at \$385,000 per square mile, with a weighted average cost for laying cable of about \$35,000 per mile.

4. Performance

The Alcatel 7340 offers high speed Internet access service up to 100 megabits per second. This data rate is far below the ultimate optical fiber capacity, but is constrained by the topology of the inactive PON network which has some of the same upload traffic limitations as hybrid fiber coaxial cable networks.

It is important to understand that a PON FTTP System is a shorter term solution that may in the future limit the full potential of fiber optics telecommunications in the coming years. An active optical network (AON) would have higher initial costs for both optical fiber and electro-optical equipment. It would also have higher operating costs in the form of equipment maintenance. It would, however, have essentially unlimited bandwidth and the ability to expand in service capability with future advances in electro-optical technology. This future potential would warrant consideration in the final chore of an FTTP broadband wireline telecommunications plan.

Cost

The FTTP Alternative Plan is envisioned to be deployed within ~~an~~ *the same* aggregate service area of 402 975 square miles or ~~about 15~~ 36 percent of the seven-county Region *as the FTTN plan, of which, as already noted, about 639 square miles would be devoted to actual urban development. the yellow colored area on Map 8. The proposed service area excludes 33 square miles of isolated development meeting the density requirement for service. The excluded areas are also shown on Map 8.* Given the areal cost value of about ~~\$338,000~~ *\$385,000* per square mile, the infrastructure cost attendant to the implementation of the FTTP plan may be estimated at *about \$246.0 million* ~~\$135.9 million~~.

ALTERNATIVE ADJUNCT PLANS

The primary alternative system plans herein presented serve only fixed and nomadic users. A complete telecommunications system for the Region would, therefore, require an adjunct network to serve mobile users. Although competing networks designed to serve mobile users currently exist within the Region, none is currently able to meet the objectives and standards set forth in Chapter III of this report. Therefore, each of the primary telecommunications system plans herein presented must be accompanied by an adjunct plan to provide mobile users with service meeting the objectives and standards set forth in Chapter III of this report.

Two technologies could be used to provide such adjunct service: WiMAX technology based on IEEE Standard 802.16e, or WiFi technology based on IEEE Standard 802.11a or g. The former technology employs licensed frequency bands primarily owned by existing wireless mobile service providers. The latter technology employs unlicensed frequency bands, and may be deployed as an extension of the primary community-based and the regional wireless system alternative plans. Deployment of the former technology is envisioned in Alternative Adjunct Plan A as herein presented, while deployment of the latter technology is envisioned in Alternative Adjunct Plan B as herein presented. Alternative Adjunct Plan A is a potential supplement to all of the primary wireless or wireline plan alternatives; while Alternative Adjunct Plan B is a potential supplement only to the two primary fixed wireless plans – the community-based and the regional wireless system plans.

The technical limitations of mobile and nomadic user service rest primarily with the user's communications device. Both the laptop computer and the cell phone currently suffer from low performance radio receivers and low transmitter powers. Although transmitter power, particularly for unlicensed radio bands, is limited by the Federal Communications Commission, receiver technology is limited only by technical innovation. Such innovation may be expected to improve the wireless telecommunications performance of both cell phones and laptop computers. Each of the alternative adjunct broadband wireless telecommunications plans herein considered depend upon the continued advance of the state of the art of wireless telecommunications technology.

Alternative Adjunct Plan A

Recognizing the dynamic evolving state of mobile wireless telecommunications technology, the formulation of Alternative Adjunct Plan A was based upon the assumption that the range of mobile wireless WiMAX antenna base stations will be extended from the current ~~introductory~~ range of about 0.5

mile to at least 1.0 mile. It was further assumed that these assumptions will be met through the use of a combination of increased transmitter power and improved cellphone receiver sensitivity by equipment manufacturers.

Since it involves the use of licensed frequency bands, Alternative Adjunct Plan A must be deployed and operated by a wireless carrier with ownership of licensed frequency bands. Since Sprint-Nextel Communications is the only known national wireless service provider currently operating in Southeastern Wisconsin that has selected WiMAX technology for its next generation deployment, the antenna sites of this service provider within the Region as shown on Maps 12, 13, 19, 20, 26, 27, 33, 34, 40, 41, 46, 47, 53, and 54 of Chapter V of SEWRPC Planning Report Number 51 "A Wireless Antenna Siting and Related Infrastructure Plan for Southeastern Wisconsin," September 2006, were used in the design of this adjunct plan. Extensive and accurate base station site data are available for Sprint and Nextel sites in Southeastern Wisconsin. The use of such base station sites in the plan design is not intended to imply that this alternative plan represents a recommended network layout for Sprint-Nextel Communications. Rather, use of the base station sites concerned allows for the preparation by the Commission of a meaningful and practical alternative plan that can be considered as a part of a final recommended comprehensive regional broadband telecommunications plan.

Alternative Adjunct Plan A was designed to offer the following features:

1. Frequency Band

Alternative Adjunct Plan A would operate in the licensed 2.5 GHz frequency band with sub-bands selected based on Sprint Nextel band assignments.

2. Technology

System operation would be based on IEEE Standard 802.16e WiMAX technology.

3. Antenna Base Station Sites

The network infrastructure would be based on 380 existing antenna base station sites, and 363 new antenna sites necessary to provide universal service coverage within the Region.

4. Antenna Site Layout

~~The antenna site layout for Alternative Adjunct Plan A is shown on Map 9. Variations in the antenna site density shown result from both the higher building "clutter" and the higher traffic~~

~~volumes expected in urbanized areas of the Region.~~ *The antenna site layout for Alternative Adjunct Plan A shown on Map 8 was based upon radio wave propagation modeling. The modeling assumed that the antennas would be mounted at a height of about 100 feet above the base of the antenna base station masts. Variations in the antenna site density shown result from both the higher building "clutter" and higher traffic volumes expected for urbanized areas of the Region.*

5. Internet Gateway Connections

Consistent with the regional wireless system plans for fixed and nomadic users, the plan was based upon the provision of fiber optic gateway interconnections at each antenna base station site. Some of the current base stations have interconnections with a wireline network, but such interconnections may consist of either coaxial copper cable or fiber optic cable. The broadband nature of the proposed WiMAX based wireless network will require fiber optic cable interconnections.

6. Cost Structure

The cost structure of the plan will be similar to that of the regional wireless plan for fixed and nomadic users except that costs will be increased to reflect the higher price WiMAX infrastructure equipment. The number of antenna base stations required for the plan reflects the conflicting effects of higher base station transmitter power versus low receiver sensitivity. Accordingly, the plan proposes the use of 743 antenna base stations to serve the Region.

7. Performance

The network layout in ~~Map 9~~ *Map 8* is designed to provide a minimum service level of six megabits per second throughput to mobile users within the Region.

Cost

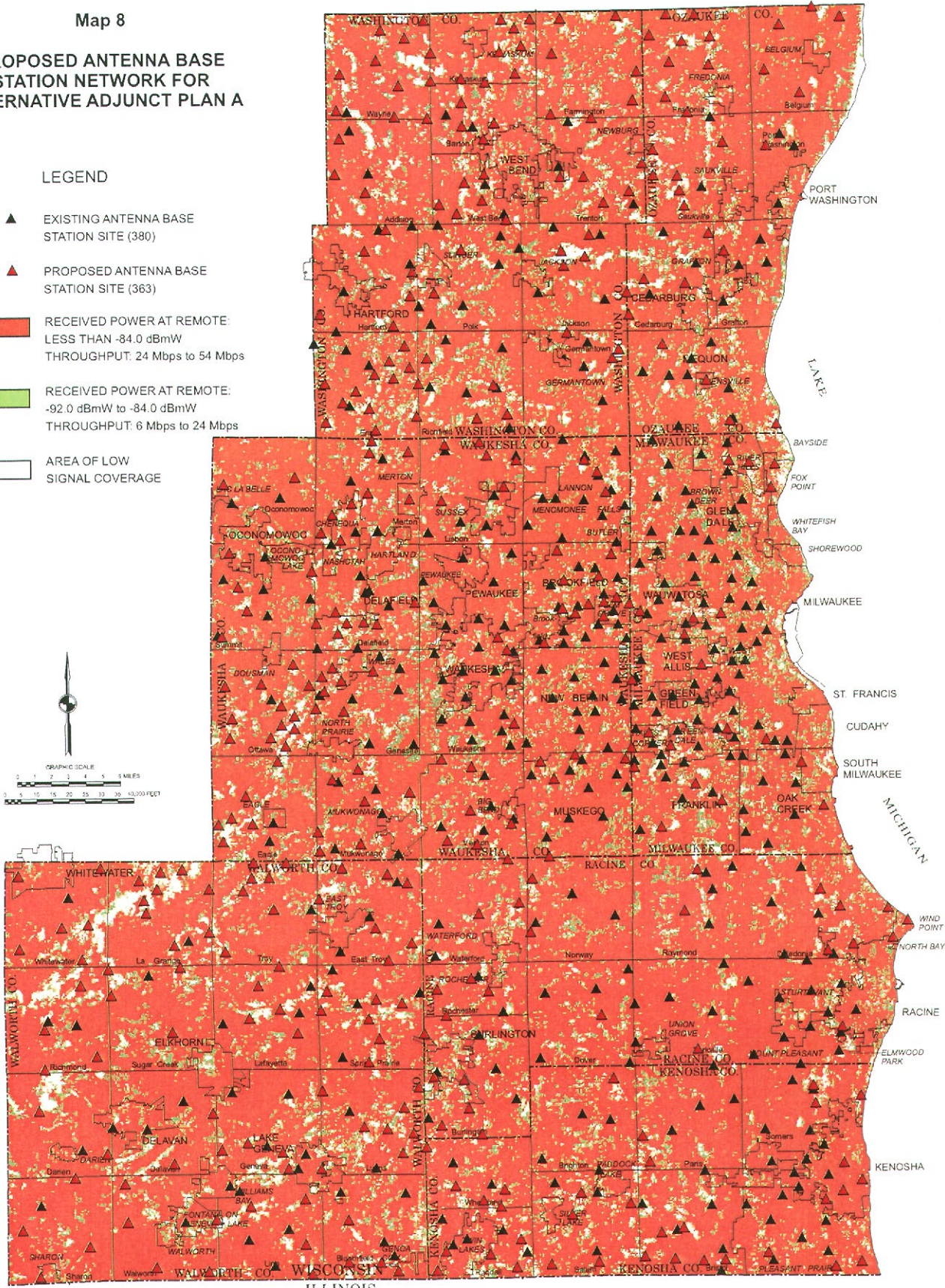
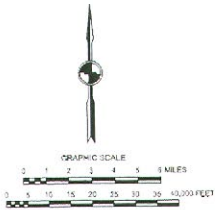
WiMAX-based antenna base station costs may be expected to be similar to those shown in Table 2 for co-located backhaul base stations, except that WiMAX transceiver equipment would fully replace all WiFi equipment. Three WiMAX 802.16e transceiver modules would replace the WiFi-WiMAX combination given in Table 2 at an estimated cost of \$15,000 per base station. This cost replaces the \$5,800 of transceiver equipment cost listed in Table 2. Adding the needed fiber optic interconnections

Map 8

PROPOSED ANTENNA BASE STATION NETWORK FOR ALTERNATIVE ADJUNCT PLAN A

LEGEND

- ▲ EXISTING ANTENNA BASE STATION SITE (380)
- ▲ PROPOSED ANTENNA BASE STATION SITE (363)
- RECEIVED POWER AT REMOTE: LESS THAN -84.0 dBmW THROUGHPUT: 24 Mbps to 54 Mbps
- RECEIVED POWER AT REMOTE: -92.0 dBmW to -84.0 dBmW THROUGHPUT: 6 Mbps to 24 Mbps
- AREA OF LOW SIGNAL COVERAGE



ILLINOIS

Source: SEWRPC.

would entail an estimated cost of \$2,500. Accordingly, the cost of a co-located WiMAX antenna base station site may be expected to total \$25,000 and a new base station \$37,500. With 743 base stations required, of which 363 would be new stations and 380 would be co-located stations, the estimated capital cost of the required base stations would total \$23.1 million. The cost of the needed fiber optic cable connections would add an estimated \$20,000 per site. Thus, the total capital cost of Alternative Adjunct Plan A is estimated to be \$38.0 million. Operating costs are estimated at \$5.6 million per month, based on a rate of \$7,000 per month for a capacity of 100 megabits per second at each site and \$500 for other expenses.

Alternative Adjunct Plan B – Advanced WiFi and WiFiA

Alternative Adjunct Plan B can serve as an adjunct to either of the two proposed primary wireless service plans – the Community-Based Wireless Plan and the Regional Wireless Plan. As an adjunct to the Community-Based Wireless Plan, Plan B would provide mobile telecommunication service using IEEE Standard 802.11g technology. As a subsidiary to the Regional Wireless Plan, Plan B would provide service using IEEE Standard 802.11a technology. Alternative Adjunct Plan B would utilize the unlicensed spectrum, thus allowing WiFi network users an alternative compatible with their fixed and nomadic communications needs.

As already noted, wireless communications systems performance is limited in part by the sensitivity of the remote cellphone device. A typical cell phone antenna gain is only -2.0 dB. Such a low overall gain means that the cellphone antenna and any supporting amplifier actually attenuates rather than amplifies incoming voice or data signals. A gain of -2.0 dB means that the cellphone captures only 63 percent of an incoming signal. Such a low gain -- coupled with the high signal-to-noise ratios required for data transmission severely limits the range of the broadband mobile communications antenna base stations concerned. Early high data rate WiMAX mobile telecommunications networks have antenna base station ranges of only about 800 meters -- or approximately one-half mile. Such a system would require over 3,400 antenna sites to cover the seven-county Region. An expanded range of 1 mile may be expected to be provided by a later version of mobile WiMAX, and this would reduce the number of base station sites required to 856 – a feasible maximum since there are currently 1,010 cellular/PCS wireless antenna sites within the Region. Increasing the range, and thereby decreasing the antenna base station density, depends primarily on the provision of either increased transmitter power or improved cellphone sensitivity or gain. In licensed frequency bands, transmitter power can be increased almost at the discretion of the service provider; given, however, technical limits on increased transmitter power due to potential interference in other cellular sectors of the network concerned. For the unlicensed frequency bands proposed to be used

in Alternative Adjunct Plan B, transmitter power would be limited to about 4.0 watts. Such a limitation leaves improved receiver sensitivity as the only means for range improvement.

Another technology available for use with both WiFi and WiMAX to increase the range of base stations, is known as Multiple Input Multiple Output, or MIMO, technology. MIMO technology involves the use of multiple -- from two to four -- base station antennas and complex digital signal processing. Pre-certified WiFi versions of MIMO in the form of IEEE Standard 802.11n are now available in retail outlets. Early versions of mobile WiMAX will also incorporate MIMO. Experience to date, however, indicates range extensions have been modest, particularly if high data transmission rates are also required. Given the evolving nature of broadband 4G mobile wireless communications technology, Adjunct Plan B is based on the following assumptions in that the FCC limitations on transmitter power for the unlicensed 2.4 GHz and 5.8 GHz frequency bands will remain in force and that WiFi, and WiFi mobile cellphone sensitivity enhancement -- gain -- may be expected to improve the current gain level of -2.0 dB to 10 dB. WiFi and WiFi mobile cellphone transmitter power may be expected to remain at the current level of 23 dB.

Based on the above assumptions, Alternative Adjunct Plan B has been specified to offer the following features:

1. Frequency Band

Alternative Adjunct Plan B would utilize the 2.4 GHz frequency band in conjunction with the community-based primary wireless network plan; and the 5.8 GHz frequency band in conjunction with the regional based primary wireless network plan.

2. Technology

The plan operation would be based on IEEE Standard 802.11g wireless technology in conjunction with the community-based primary wireless networks plan; and IEEE Standard 802.11a technology in conjunction with the regionally-based primary wireless network plan.

3. Antenna Access Points

The adjuncts to the community-based wireless systems would use the same access points as the primary fixed and nomadic user service community wireless networks.

4. Example Community-Based Mobile WiFi Wireless Network

As an example, a WiFi mobile wireless network plan was developed using the Cedarburg-Grafton fixed wireless infrastructure. This network employs the same access point locations as the fixed

and nomadic user service network. It differs, however, in the sensitivity of the user device, a cellphone in this application. The network differs in the throughput performance levels which are indicated on Map 9 for a receiver sensitivity enhancement of 10 dB.

5. Regional Mobile WiFi Wireless Network

The Alternative Adjunct Plan B network would employ an infrastructure configuration taken from the primary service Regional Wireless Plan. It would differ in the areal performance levels possible as a function of receiver sensitivity. Based upon radio wave propagation modeling, Map 10 illustrates the mobile data rates possible for a cellphone antenna gain of 10 dB. Although data communications performance is emphasized as the primary criterion in all of the broadband mobile wireless plans, all of these networks would be able to provide for voice communication which has only modest bandwidth requirements.

6. Internet Gateway Connections

The mobile wireless networks would be based on the same Internet gateway connections as the host fixed user networks. The community-based networks would generally have wireless backhaul to central gateway locations. The regional wireless network would have a fiber optic cable connection Internet gateway at each antenna base station site.

7. Cost Structure

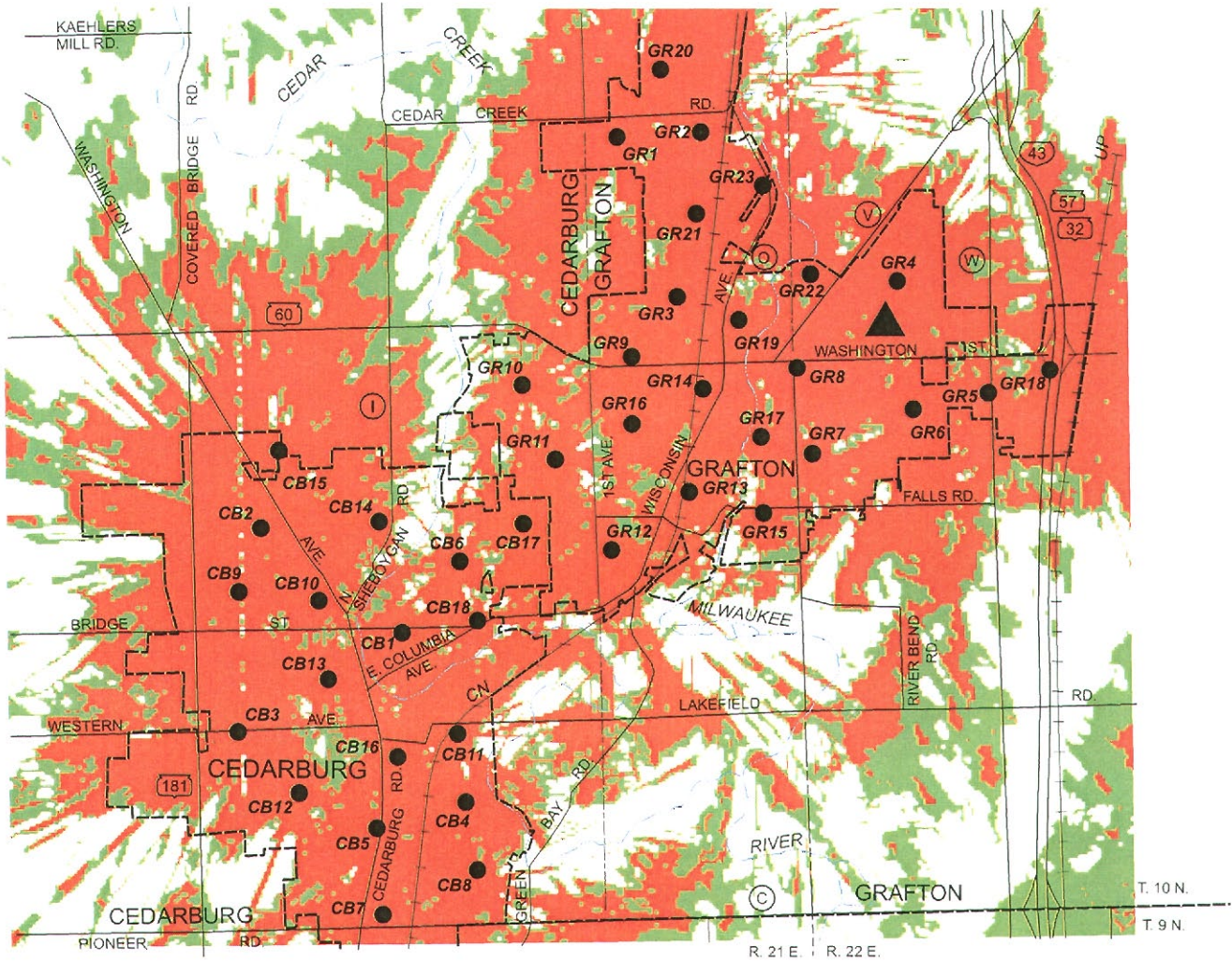
The cost structures of the community-based and regional network mobile wireless plans are identical to their host fixed wireless networks since they employ the same access points and base stations.

8. Performance






As already noted, the performance levels of the two versions of Adjunct Plan B are shown in ~~Maps 10 and 11~~ *Maps 9 and 10*. The prevailing data rate throughput is estimated to be in the 6 megabits per second range or better. It should be emphasized that laptop computer and WiFi phone active antenna gains were increased to the 10 dBi level from the current 5 dBi for laptop, and -- 2 dBi for WiFi phone equipment to achieve the indicated performance level. These remote devices constitute the "bottleneck" in extended range nomadic/mobile broadband communications. Remote device receiver sensitivity technology levels will need to be improved to achieve 4G performance objectives.

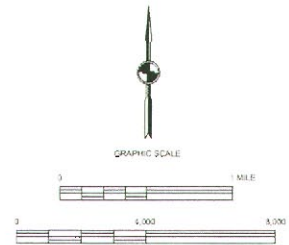
Map 9

SERVICE COVERAGE PROVIDED BY ALTERNATIVE
ADJUNCT PLAN B COMMUNITY WiFi NETWORK



LEGEND

-  EXISTING BASE STATION TO BE USED FOR WIMAX APPLICATION
-  RECOMMENDED LOCATION OF WiFi ACCESS POINT
- GR3** IDENTIFICATION NUMBER (SEE TABLE 1)
-  RECEIVED POWER AT REMOTE: -84dBmW TO -92dBmW, THROUGHPUT: 24 Mbps to 54Mbps
-  RECEIVED POWER AT REMOTE: GREATER THAN -92dBmW THROUGHPUT: 6 Mbps to 24 Mbps
-  AREA NOT WITHIN ACCEPTABLE COVERAGE



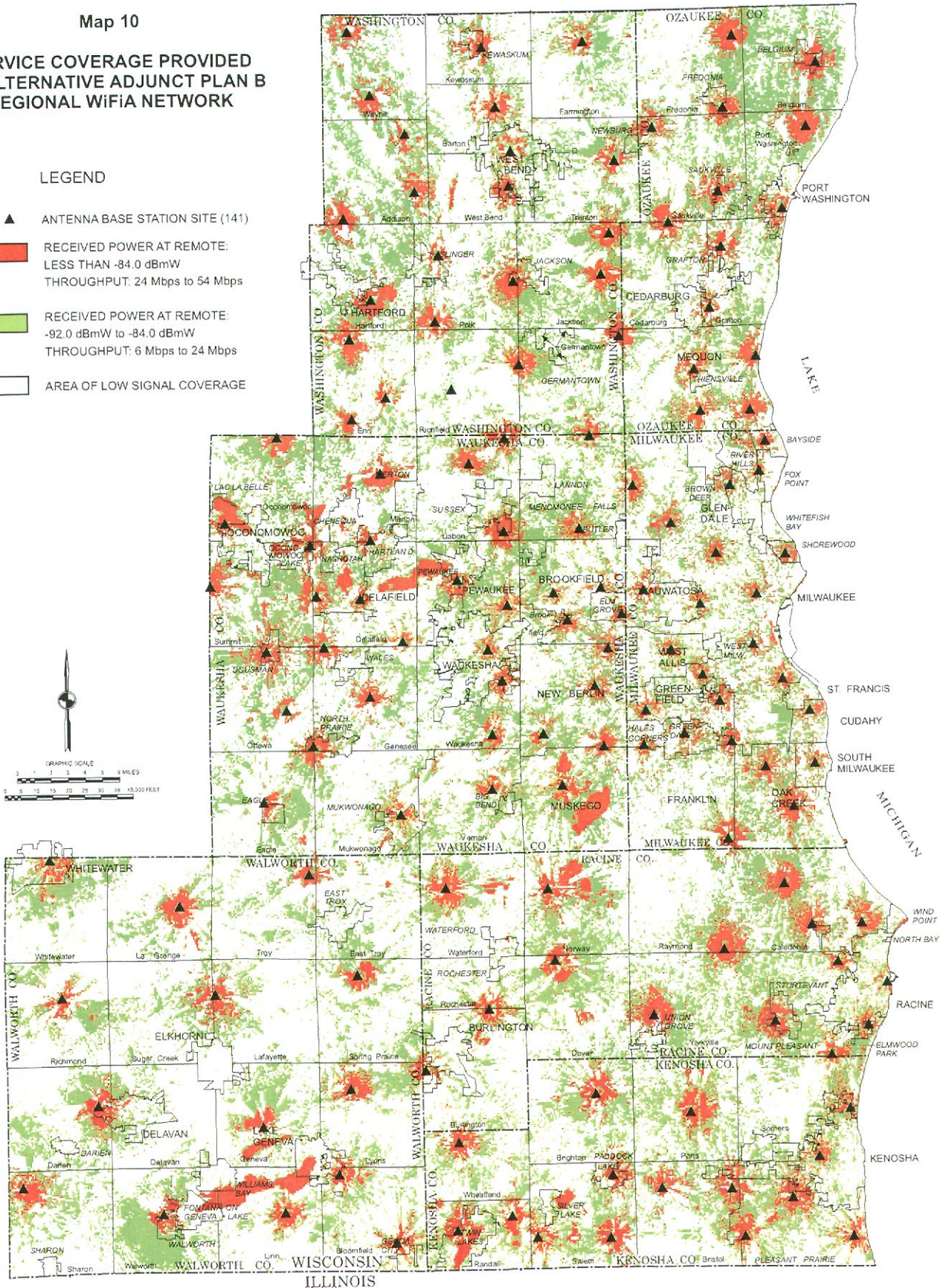
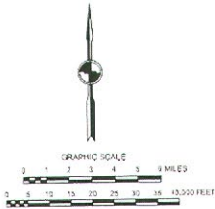
Source: SEWRPC.

Map 10

SERVICE COVERAGE PROVIDED BY ALTERNATIVE ADJUNCT PLAN B REGIONAL WIFIA NETWORK

LEGEND

- ▲ ANTENNA BASE STATION SITE (141)
- RECEIVED POWER AT REMOTE: LESS THAN -84.0 dBmW THROUGHPUT: 24 Mbps to 54 Mbps
- RECEIVED POWER AT REMOTE: -92.0 dBmW to -84.0 dBmW THROUGHPUT: 6 Mbps to 24 Mbps
- AREA OF LOW SIGNAL COVERAGE



Source: SEWRPC.

Alternative Adjunct Plan B Costs

As previously stated, there are no new infrastructure costs for either the community-based or the regionally-based mobile wireless networks. Both versions utilize fixed wireless host networks. Thus the capital cost of Alternative Adjunct Plan B when used in conjunction with a community-based fixed and nomadic user host network for the example Cedarburg-Grafton service area would approximate \$353,000. The operating costs would approximate \$4,600 per month.

The capital cost of Alternative Adjunct Plan B when used in conjunction with the regional wireless system host network would approximate \$6.4 million. The operating costs would approximate \$987,000 per month.

SUMMARY

The preparation of alternate regional broadband communications plans involved a seven step process:

- 1. Selecting a set of communications technologies for use in formulation of the plans;*
- 2. Identifying infrastructure and user equipment requirements;*
- 3. Developing performance data on the various technologies;*
- 4. Developing cost data on the various technologies;*
- 5. Preparing geographic network layouts of alternate plans;*
- 6. Specifying the expected performance and costs of alternate plans; and*
- 7. Evaluating each alternate plan in terms of the previously established objectives and standards*

The WiFi (IEEE 802.11g and 802.11a) and WiMAX (IEEE 802.16) standards were selected as the technologies for use in formulating the alternate wireless plans because they were the only technologies correctly specified to achieve the fourth generation performance targets. As IEEE standards technologies, they were also significantly lower in cost than competitive technologies. The Alcatel Fiber-to-the-Node (FTTN) and Fiber-to-the-Premises (FTTP) wireline technologies were selected for use in formulating the alternative wireline plans as typical of fiber communications technology today – Alcatel Lucent is the leading world provider of fiber communications systems. The current versions of these technologies Alcatel 7330 and Alcatel 7340 may be expected to be electronically upgraded over the coming years, but the necessary basic fiber or fiber/copper infrastructures will remain essentially unchanged. The deployment costs -- particularly of the FTTP technology -- all more dependent on the construction costs of laying fiber than on the specific electronic equipment employed.

Having selected the basic technologies to be used in formulating the alternative plans, it was then necessary to specify equipment configurations for both the network infrastructure and the service users. The wireless equipment required special high gain antennas at both infrastructure access points and end users in order to achieve the performance standards previously established. Wireless plans were also based on a sectoral cellular topology to take advantage of the high gain active directional antennas. A conventional mesh network topology requires the employment of lower gain omnidirectional antennas which do not have the gain performance necessary to achieve the 4G throughput standards. Performance estimates for wireless network were based on manufacturers specifications, radio propagation modeling and extensive field testing with the specified equipment. Wireless cost data were collected from manufacturer price schedules. The estimated geographic coverage of wireless network plans was based primarily on radio propagation modeling verified by field testing.

Fiber-to-the-node (FTTN) and fiber-to-the-premises (FTTP) equipment requirements, performance data and cost data were all obtained from Alcatel specifications and pricing schedules as confirmed by cost data publicly available from either corporate financial reporting or the FCC.

A summary of the characteristics of the alternative broadband wireless and wireline communications plans in terms of plan objectives and standards are set forth in Table 4. The plan characteristics shown in the table will be used to evaluate alternate plans and select a final plan in the next chapter.

Table 4
Summary of Salient Characteristics of Alternative Regional Telecommunications Plans

<i>Plan</i>	<i>Universal Geographic Coverage</i>	<i>Performance</i>	<i>Infrastructure Cost</i>	<i>Redundancy</i>	<i>Public Safety</i>	<i>Most Demanding Application</i>
Community-Based Wireless Plan	Geographic coverage depends on a community-by-community plan implementation	Meets the throughput standard but may have less speed improvement potential than fiber-based systems	Plan is much lower in cost than fiber-based systems \$20.3 million	Built-in redundancy is possible using peer-to-peer communications feature to be field tested as part of the regional wireless plan	Joint 4.9 GHz frequency operation for public safety communications is possible as an added feature in a community network	Plan is not designed for broadcast video services but is well suited to video conferencing
Regional Wireless Plan	Plan specifies coverage for the entire Region, but implementation depends on a county-by-county deployment	Meets the throughput standard but may have less speed improvement potential than fiber-based systems	Plan is the lowest in infrastructure cost by a wide margin \$6.4 million	Plan will have inherent redundancy for both alternative transmission paths and for failure of infrastructure base stations	Plan has specific separate network for public safety	Plan is not designed for broadcast video services but is well suited to videoconferencing

<i>Plan (continued)</i>	<i>Universal Geographic Coverage</i>	<i>Performance</i>	<i>Infrastructure Cost</i>	<i>Redundancy</i>	<i>Public Safety</i>	<i>Most Demanding Application</i>
<i>Fiber-to-the Node (FTTN) Wireline Plan</i>	<i>Plan will cover only 35 percent of the geographic areas of the Region</i>	<i>Plan will meet throughput standards in the downstream but not the upstream direction</i>	<i>For a third of the geographic coverage, plan is more than 10 times the cost of the Regional Wireless Plan \$77.7 million</i>	<i>Plan has no explicit redundant transmission paths</i>	<i>Plan does not specifically provide for public safety communica- tions except for priorities in times of public emergency</i>	<i>Plan emphasizes the video broadcast application. Slow upstream throughput is not compatible with video conferencing</i>
<i>Fiber-to-the- Premises (FTTP) Wireline Plan</i>	<i>Plan, like the FTTN plan, cover only 35 percent of the Region</i>	<i>Plan will have the greatest throughput potential of any plan</i>	<i>It is the most costly of all of the plans \$246.0 million</i>	<i>Plan has no explicit redundant transmission paths</i>	<i>Plan does not specifically provide for public safety communica- tions except for priorities in times of public emergency</i>	<i>Plan is well suited to both broadcast video and video con- ferencing</i>
<i>WiMAX Mobile Wireless Plan A</i>	<i>Economic considerations will limit coverage in low density rural area</i>	<i>Plan provides for 4G throughput performance</i>	<i>The cost far exceeds that of the WiFi mobile wireless plan \$38.0 million</i>	<i>There is no provision for network redundancy</i>	<i>There are no specific public safety features in this plan</i>	<i>Videoconferencing is supported in this plan</i>
<i>WiFi Mobile Wireless Plan B</i>	<i>Operating with both the regional and community- based wireless networks, this plan provides for full regional coverage.</i>	<i>Plan provides for 4G throughput performance</i>	<i>Infrastructure costs are minimal and relate to augmentations of the other two wireless plans \$1.0 million</i>	<i>Plan calls for redundancy using peer-to- peer transmission paths</i>	<i>Plan allows for integration with 4.9 GHz public safety wireless network</i>	<i>Video conferencing is supported in this plan</i>

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