MINUTES OF THE TWENTY-FIRST MEETING

REGIONAL TELECOMMUNICATIONS PLANNING ADVISORY COMMITTEE (Reconstituted)

DATE: October 2, 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
William R. Drew Vice Chairman	Vice-Chairman, SEWRPC; Executive Director, Milwaukee County Research Park
Roger Caron	President, Racine Area Manufacturers and Commerce
Bob Chernow	Chairman, Regional Telecommunications Commission
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
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
Gustav W. Wirth, Jr.	SEWRPC Commissioner

Members Absent

David L. DeAngelis	Village Manager, Village of Elm Grove
Michael Long	Attorney-at-Law, Murn and Martin, SC
Jeff Mantes	Commissioner of Public Works, City of Milwaukee
James W. Romlein	Managing Director, MVLabs, LLC
Dale R. Shaver	Director, Waukesha County Department of Parks and Land Use
Michael Ulicki	Vice President and Chief Technology Officer, Norlight Telecommunications
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 AUGUST 7, 2007

Chairman Bauer noted that copies of the minutes of the twentieth meeting of the Reconstituted Regional Telecommunications Planning Advisory Committee held on August 7, 2007, had been distributed to all members of the Committee for review prior to the meeting, and he asked the Committee to consider approval of the minutes. He noted that under the Committee established procedure, approval of the minutes would also constitute final approval of the revised preliminary draft of Chapter VIII "Alternative Plan Comparison and Evaluation and Selection of a Recommended Plan" of SEWRPC Planning Report No. 53, *A Regional Broadband Telecommunications Plan for Southeastern Wisconsin* attached to those minutes. He noted that the chapter incorporated all of the changes, which the Committee had at its meeting held on August 7, 2007, directed to be made based upon the Committee review of the preliminary draft of the Chapter. He noted further that the Committee had at that meeting requested that a revised draft of Chapter VIII be presented to the Committee for review and consideration at its next meeting. Finally he noted, that it was intended that consideration of the minutes, to which was attached the requested revised draft of Chapter VIII, would constitute the desired Committee review and approval of the revised Chapter.

Mr. Klasen called attention to the first full paragraph on page 8 of the revised Chapter VIII. He asked why the text did not envision the potential for sharing of the public safety and private commercial infrastructure costs under implementation of the alternative community-based wireless plan as it did under implementation of the alternative regional wireless plan. Mr. Schlager indicated that such cost sharing was considered to be unlikely at the community level since the public safety networks are generally developed at the county, group of counties, or regional levels.

Mr. Klasen observed that it would appear at this point in the rank based expected value analysis, an additional factor was being brought into the decision making process, and that this insertion is misplaced at this point in the process. He suggested that the second full paragraph on page 7 be struck together with the following rank ordering of the four alternative plans being considered; and that the analysis be revised to reflect the rank ordering given at the top of page 8 based upon the actual estimated capital costs.

Mr. Klasen noted that this reordering of the rank of the four alternative plans would result in a final rank of the regional wireless plan approximately equal to that of the fiber-to-the-node plan. It was at that point in the escalation process, he said, that the argument could logically be made that in choosing between the fiber-to-the-node and the regional wireless plan consideration of the potential for cost sharing between the public safety and private commercial systems would favor the adoption of the regional wireless plan.

Chairman Bauer indicated that he believed Mr. Klasen's suggestion to be sound, and that the changes he suggested would result in a more logical application of the alternative plan evaluation method. By consensus, the Committee agreed to Mr. Klasen's suggestion. Chairman Bauer indicated that the Chapter would be amended to reflect Mr. Klasen's suggestion and that the Committee would see the revised Chapter as an attachment to the minutes of this meeting.

There being no further questions or comments, on a motion by Mr. Chernow, seconded by Mr. Drew, and carried unanimously, the minutes of the meeting of August 7, 2007, were approved as amended, the amendments relating to Chapter VIII "Alternative Plan Comparison and Evaluation and Selection of a Recommended Plan" as attached to those minutes.

[Secretary's Note: Chapter VIII has been revised to reflect Mr. Klasen's suggestion as relative to the application of the rank based expected value method of evaluation to the four alternative plans considered as that evaluation relates to capital cost. The revised Chapter is attached to these minutes with the changes made being indicated in accordance with the usual practice of strikeouts and insertions in italic text.]

CONSIDERATION OF PRELIMINARY DRAFT OF CHAPTER IX "PLAN IMPLEMENTATION" 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 Chapter IX "Plan Implementation" 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 observed that in the introduction to Chapter VII of SEWRPC Planning Report No. 51, the text had indicated that the adoption of the regional plan was not intended to result in any entity being prohibited from placing infrastructure that provides broadband telecommunication services in communities of the Region even if that infrastructure is not in conformance with the adopted plan. He suggested that similar wording be added to the introduction of this chapter. The Committee concurred with Mr. Klasen's suggestion.

[Secretary's Note: The following paragraph has been added to the text of Chapter IX following the first partial paragraph set forth on page 2 of the Chapter.

"The currently prevailing telecommunication systems development process within the United States, as established by Federal law, places the responsibility for system development generally within the private sector, that process being, however, regulated by Federal and State laws and regulations. Public Telecommunications service planning efforts such as that conducted by the Southeastern Wisconsin Regional Planning Commission are intended not to replace, but rather to supplement this competitive, market training process in the public interest. The adopted regional plan and its recommended implementation efforts are not intended in any way to impede the implementation of alternative plans prepared and put forth by private providers, or by communities or municipalities within the Region, that would move the existing level of service toward the attainment agreed upon objectives and standards. It is, however, hoped that the adopted plan would serve as a point of departure for further telecommunication planning by private providers and public agencies."]

Mr. Chernow requested, and the Committee concurred, that under the heading "County and Municipal Plan Endorsement" on page 3, the Regional Telecommunications Commission, a plan adoption agency which he chairs, be specifically noted.

[Secretary's Note: In accordance with Mr. Chernow's request the second full paragraph on page 3 of Chapter IX has been revised to read as follows:

"The plan endorsement actions should extend to special purpose agencies such as the Regional Telecommunications Commission, a cooperative agency serving a number of local municipalities within the greater Milwaukee area."]

Mr. Ritt asked how the county or municipal government elected officials concerned can be expected to make informed decisions concerning the desired plan endorsement, since the full cost of plan implementation would not be known by those officials. Chairman Bauer indicated that the full capital cost of the required facilities was included in the report which would be available to everyone concerned. He noted that those infrastructure costs might have to be borne in whole or in part by public agencies in order to achieve plan implementation, depending upon the extent to which cost sharing may be achieved between the public safety and the commercial facilities required. It was true, he said, that the full cost of providing the service envisioned through use of the facilities were not included in the report although a major portion of these costs – namely the Internet connection costs – were included. In any case, these costs were envisioned to be borne by private service providers and the role of the public officials concerned in this respect would be to select a service provider based upon solicited proposals.

A lengthy discussion ensued concerning plan implementation as a process which had already begun in the Town of Wayne, Waukesha County; the Village of Thiensville, Ozaukee County; and in Kenosha County.

In the discussion Mr. Chernow noted that the county and municipal governments within the Southeastern Wisconsin Region had a long history of working with the Commission in regional plan adoption and implementation and were familiar with that process as it was applied to other major regional plan elements. Mr. Melcher agreed indicating that if in considering the adoption of a regional plan element county or municipal officials had questions or concerns, it was the responsibility of the county or local staffs concerned to respond to those questions or concerns either by arranging meetings with Commission staff, by creating review committees of knowledgeable county or local officials, or in some cases retaining the assistance of State or Federal agencies or private consultants. He noted that in his experience of almost forty years in working with the Regional Planning Commission, he had never been misled, and that public officials are in a much better position to make development decisions of the kind concerned by having a Commission like this one available to them. Mr. Chernow reiterated that the

Commission was widely viewed as a highly objective, technically competent organization and its guidelines have been widely adopted and followed.

Mr. Evenson observed that all of the Commission's plans were entirely advisory to the implementing agencies concerned and were intended to serve as points of departure for decision making by Federal, State, county and municipal and special purpose units and agencies of government.

Mr. Klasen called attention to the last paragraph on page 4, carrying over to page 5, and to the sentence in that paragraph which states that public safety communications could also be compatible with a community-based wireless network operating in different frequency bands and noted that this statement was now consistent with the presentations in Chapter IX as that Chapter was to be revised based upon the Committee review at this meeting. Without those changes in Chapter IX he noted, there would have been an inconsistency between Chapters IX and X.

Mr. Richardson called attention to the first sentence of the fourth paragraph on page 6 and suggested that the problem was not technical competency, but the difficulties encountered in achieving a financially feasible operation. The Committee concurred.

[Secretary's Note: The first full sentence of the first paragraph on page 6 has been revised to read as follows:

"A major problem encountered by many communities interested in deploying broadband wireless networks has been finding a financially viable and stable means for operation and maintenance of the desired wireless networks."]

Mr. Falaschi called attention to the fourth sentence of the fourth paragraph on page 6 concerning the potential establishment of an economic development corporation to finance, deploy and maintain the desired wireless network. He expressed the opinion that this approach would be problematic under the existing legal structure if public tax monies were concerned. Mr. Falaschi suggested, and the Committee concurred, that the text be expanded to clarify actions in this respect that would be legal or illegal under the existing local and regulatory structure in Wisconsin. Mr. Chernow objected to Mr. Falaschi's suggestion indicating that the text clearly indicated that resort to government actions would be taken only if no acceptable private infrastructure contractors could be found to implement county or municipal

desired plans, and in such instances public ownership would clearly be legal. Chairman Bauer agreed with Mr. Chernow indicating that if private entities were unwilling to provide the level of service desired, then county and municipal governments should and are clearly able to proceed with plan implementation by a public agency whether that agency is supported by direct taxation or other means.

Mr. Klasen called attention to the costs provided in the last paragraph on page 7, carrying over onto page 8. He asked, and the Committee concurred, that the staff add an appropriate footnote to that page siting the source of the costs concerned.

[Secretary's Note: The following footnote was added to page 7 and 8.

[1] Daggett, B. V. "Dollars and Sense on Muni Wireless," *Government Finance Review*, February, 2007.
[2] *Broadband Wireless Field Test Report, Town of Wayne, Washington County, Wisconsin Southeastern Wisconsin Regional Planning Commission,* October 16, 2006.
[3] *Broadband WiFi, Wireless Telecommunications Planning Proposal*, City of Waukesha, Wisconsin, SEWRPC, October, 2006.

Mr. Chernow called attention to the second sentence of the fifth paragraph on page 10 noting that AT&T was apparently deploying its Project Lightspeed in at least some communities without obtaining the necessary agreements with the municipalities concerned and were utilizing the public rights-of-way without such agreements and municipal oversight. He indicated that the sentence concerned may, therefore, be misleading, it carrying an implicit assumption that entering an agreement would make AT&T plan deployments known. Upon brief discussion the Committee agreed that the second sentence in the first paragraph on page 10 should be struck.

There being no further questions or comments on a motion by Mr. Chernow, seconded by Mr. Mueller, and carried the preliminary draft of Chapter IX "Plan Implementation" of SEWRPC Planning Report No. 53, *A Regional Broadband Telecommunications Plan For Southeastern Wisconsin* was approved as amended with Messrs. Falaschi, Gatz, Klasen and Ritt voting no, the four dissenting members indicating that the reason for their vote was that the companies which they represented objected to the Commission preparing a telecommunications plan.

CONSIDERATION OF PRELIMINARY DRAFT OF CHAPTER X "SUMMARY" OF SEWRPC PLANNING REPORT NO. 53, *A REGIONAL BROADBAND TELECOMMUNICATIONS PLAN FOR SOUTHEASTERN WISCONSIN* (COPY ENCLOSED).

Chairman Bauer noted that a copy of the preliminary draft of Chapter X "Summary" 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. He noted that the Chapter was intended to summarize the findings and recommendations set forth in the report and that there should be no new material in the summary. He noted that the draft of Chapter IX "Summary" would be amended to reflect the changes which the Committee had at this meeting directed to be made in Chapter VIII "Alternative Plan Comparison and Evaluation and Selection of a Recommended Plan" and Chapter IX "Plan Implementation."

There being no questions or comments, on a motion by Mr. Chernow, seconded by Mr. Caron, and carried, the preliminary draft of Chapter X "Summary" of SEWRPC Planning Report No. 53, *A Regional Broadband Telecommunications Plan For Southeastern Wisconsin* was approved as amended with Messrs. Falaschi, Gatz, Klasen and Ritt voting no, the four dissenting members indicating that the reason for their vote was that the companies which they represented objected to the Commission preparing a telecommunications plan.

Secretary's Note: A revised copy of Chapter X is attached to these minutes. That revised Chapter is intended to reflect the changes made by the Committee in Chapters VIII and IX at this meeting.

CORRESPONDENCE

Chairman Bauer indicated that there was no correspondence to be brought to the attention of the Committee.

ADJOURNMENT AND DISSOLUTION OF COMMITTEE

There being no further business to consider, Chairman Bauer noted that the Committee's action on Chapter X concluded its work. The Committee's final report to the Commission would consist of SEWRPC Planning Report No. 53 *A Regional Comprehensive Broadband Telecommunications Plan for*

Southeastern Wisconsin. He noted that the first meeting of the Committee as presently constituted was held on August 24, 2004; and that the Committee had held 21 meetings to complete its work. He expressed his sincere appreciation on behalf of himself, the Commission staff and the Commission to the Committee members for the faithful contribution of their time, knowledge, and experience to the work of the Commission all as a public service; and noted that such service was in the finest tradition of how government was and should be conducted in Wisconsin.

He noted that all of the Committee members would receive a copy of the minutes of this meeting; a copy of SEWRPC Planning Report No. 53; and a self-addressed postcard by which each Committee member will be asked to vote on approval of the minutes of this meeting. He noted that the worst possible outcome of the postcard poll would be a majority of no votes, in which case the Committee would have to be reconvened to collegially consider approval of the minutes.

He noted further that he expected that each Committee member would receive a letter of appreciation from the Commission. He noted that in some cases the Commission does not act to dissolve an Advisory Committee upon completion of its work, but asks the Committee to continue to serve through plan implementation and possible plan revision. Finally he noted, that the Commission in accordance with its long established practice, will hold one or more public meetings and hearings on the recommended plan prior to Commission action to adopt the plan either as presented to it by the Committee or with amendments. All Committee members will be invited to attend such meetings and hearings.

Chairman Bauer then indicated that a motion would be in order to adjourn and to recommend its own dissolution to the Commission. This was done on a motion by Mr. Chernow, seconded by Mr. Caron and carried unanimously. The meeting was adjourned at 3:00PM.

Respectfully Submitted,

Lynn G. Heis
Committee Secretary

KWB/lgh
10/24/07
#131300 V1 - T/C Minutes 21st Meeting

SEWRPC Planning Report No. 53,
A REGIONAL COMPREHENSIVE BROADBAND TELECOMMUNICATIONS PLAN
FOR SOUTHEASTERN WISCONSIN

Chapter VIII

ALTERNATIVE PLAN COMPARISON AND EVALUATION AND SELECTION OF A RECOMMENDED PLAN

INTRODUCTION

The previous chapter of this report described a set of alternative wireless or wireline broadband telecommunications plans that alone, or in combination, were candidates for a recommended comprehensive, regional telecommunications plan for Southeastern Wisconsin. This chapter presents the findings of a comparative evaluation of these alternative plans; and based upon these findings sets forth a recommended plan. The plan selection process looks back to Chapter III of this report which defines the objectives, principles and standards that are intended to serve as the basis for the comparative evaluation of the various alternative and adjunct plans considered, and for selecting one of these alternative plans, or combination of these plans, as the preferred plan for future broadband telecommunications within the Region.

METHOD OF EVALUATION

In the preparation of long range public works facilities plans, the Commission usually uses the benefit-cost analysis method for the comparative evaluation of alternative plans. Although this method may be theoretically applicable to the shorter range alternative telecommunication system plans presented in this report, the method loses much of its effectiveness in such application because of the following limitations:

1. It is impractical to assign a monetary value to the many intangible benefits and costs attendant to telecommunication system development within the Region, and it is extremely difficult to assign monetary values to even the direct benefits and costs associated with such development.

2. Because of the relatively greater uncertainty associated with implementation of a regional telecommunications plan, there can be no assurance that the potential benefits will ever be realized, even though some of the costs associated with the development of a given system may, nevertheless, be incurred.

It was determined that the alternative telecommunication system plans considered would be compared by scaling each plan against each development objective set forth in Chapter III of this report, utilizing the standards supporting each objective and the results evaluated by the Regional Telecommunications Advisory Committee. In addition, the comparative evaluation was supplemented by the application of a method which seeks to assign a value to each alternative plan.

The method chosen, overcomes, to a considerable extent, the difficulties inherent in the application of benefit-cost analysis to telecommunication system planning. The method is an adaptation of the rank-based expected value method used for corporate and military decision making.[1],[2],[3],[4] This method avoids the difficulties associated with the assignment of monetary values to potential benefits and costs associated with the alternative plans by limiting the plan evaluation problem to one of rank ordering each alternative under each of the stated development objectives. It is usually easier to rank order the perceived effectiveness of a given plan in achieving a given development objectives than it is to attempt to assign monetary values to the benefits accruing to the attainment of the objective.

The difficult problems associated with uncertainty of plan implementation are also ranked in the chosen method of plan evaluation through the medium of probability estimation. Some alternative plans, while theoretically highly desirable, may have a low probability of implementation; and, in the application of the method, such plans are assigned a lower value for probability of implementation. Other plans, while theoretically less desirable on the basis of the ability to attain stated objectives, may have higher actual value because of a greater likelihood of implementation.

In plan evaluation, then, the application of the rank-based expected value method involves the following sequence of activities.

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[1] C. H. Igor Ansoff, Corporate Strategy, McGraw-Hill, New York, N.Y., 1965.
[2] K. J. Schlager, "The Community-The Rank-Based Expected Value Method of Plan Evaluation," Highway Research Board, 1968.
[3] Z. Hu, et al., "Fuzzy Expected Value model for Transmission Planning with Hybrid Intelligent Algorithm," Computers and Advanced Technology in Education Conference, October 8-10, 2007, Beijing, China.
[4] Yian-Kui Liu and Baoding Liu, Information Sciences, Volume 155, Issues 1-2, 1 October 2003, Pages 89-102.

1. All specific development objectives, n in number, are ranked in order of importance to the agreed upon development objectives and assigned "weight" of n, n minus 1, n minus 2, and so on to n minus one (n-1) in descending rank order.

2. The alternative plans, m in number, are ranked under each of the specific development objectives and assigned a "score" of m, m minus 1, m minus 2, and so on to m minus one (m-1) in descending rank order.

3. A probability, p, of plan implementation is assigned to each of the plans being ranked.

4. The value, V, of each alternative plan is then determined by summing the products of n times m times p for each of the specific development objectives, or:
   $V = p \Sigma (n_1 m_1 + n_2 m_2 + \ldots + n_n m_n)$

In Chapter III of this report, specific telecommunication system development objectives were expanded into sets of supporting standards which could be used to evaluate the ability of an alternative plan to achieve a given specific development objective. Any ranking of an alternative plan for a given specific development objective must, therefore, be consistent with the ability of the plan to achieve the supporting standards set forth for that objective. To achieve this consistency, it is necessary to compute a value for each of the alternative plans according to the supporting standards set forth for each development objective before arriving at an overall value for each plan in relation to the development objectives. This subsidiary evaluation utilizes a series of matrices in which the development standards replace the development objectives in the matrix table, and in which it is usually not necessary to assign a probability estimate for the standard evaluation.

Ranking the Objectives/Standards

From the eight sets of objectives and standards presented in Chapter III, six were selected to serve as a basis for the comparative evaluation of the alternative plans.

1. Performance
2. Universal geographic coverage
3. Infrastructure cost
4. Redundancy
5. Public safety
6. Most demanding application – video and multimedia

The other two objectives: antenna base site minimization, and antenna aesthetics and safety were not used in the evaluation since these apply only to wireless telecommunications systems, and so can not serve as a basis for comparing wireline and wireless systems.

The above objectives were also ranked in a perceived order of priority -- or importance -- beginning with the highest in priority listed first. Performance was ranked first since it represents the very definition of broadband telecommunications. Performance is also strongly related to the economic development goal of the telecommunications planning program. Universal geographic coverage was ranked second since such coverage is not likely to occur within Southeastern Wisconsin though the operation of market forces alone and without strong governmental incentives and encouragement. Infrastructure cost also rank high since this cost is an important determinant of the economic viability of an alternative plan. Redundancy is an important feature of any telecommunication system because of the need for system reliability in a wide range of public and private applications. Public safety was designated an objective in its own right because maintenance of public safety and effective response to natural and man-made disasters represent two of the most important uses of modern telecommunications. Finally, the ability to meet the most demanding use of the telecommunications bandwidth -- video telecommunications -- was considered important to certain business and governmental functions as well as to the entertainment function of telecommunications systems.

EVALUATION BASED UPON STANDARDS

Prior to the application of the rank-based expected value method (RBEV) to aid in the selection of a regional comprehensive broadband telecommunications plan, each of the four alternative and two adjunct plans were evaluated and ranked on the basis of the ability to meet the supporting standards under each of the six objectives. Such an evaluation and ranking then provided the basis for final plan selection.

Performance Objective

The performance objective, as defined in Chapter III, embraces not only throughput -- transmission rate, but also network reliability and quality of voice communications. Ranking the alternate plans for this objective can be readily accomplished based upon the nature of the four alternate plan technologies. An all fiber network, as represented by the FTTP plan, would clearly be first in rank in this respect. If the active (AON) rather than the passive (PON) optical network had been the selected technology, there would be little or no limit on ultimate network performance. PON technology does have some limitations based on network topology, but even with these restrictions, the FTTP has the highest ultimate

performance potential. While the electronic equipment for wireline network may be expected to continue to evolve and improve, the fiber infrastructure will impose little or no performance limitations for many years to come.

The remaining plan alternatives, FTTN wireline and the two broadband wireless plans all promise to achieve 4G performance levels. The wireless plans, however, while competing favorably on throughput performance short-term and long-term, will probably never achieve the "five nines -- 99.999 percent -- reliability of wireline networks.

Based upon the foregoing considerations, the four alternative plans were ranked for performance as follows:

1. Fiber-to-the Premises (FTTP) Wireline Plan
2. Fiber-to-the Node (FTTN) Wireline Plan
3. Regional Wireless Plan
4. Community-Based Wireless Plan

Universal Geographic Coverage Objective

The universal geographic coverage objective, ranked second in importance among the six plan objectives, is one well suited to plan comparison and evaluation. Only the two wireless alternative plans make such widespread geographic coverage a feasible objective. The Fiber-to-the-Node (FTTN) and Fiber-to-the-Premises (FTTP) wireless alternative plans would serve about 36 percent of the total area of the Region and, therefore, cannot achieve high rank for geographic coverage. Those alternative plans may, however, be expected to serve about 92 percent of the anticipated year 2035 resident population of the Region; about 93 percent of the land anticipated to be devoted to commercial use within the Region; and about 90 percent of the land anticipated to be devoted to industrial use within the Region in that year. The community-based wireless plan has the potential for full geographic coverage of the Region, but such full coverage would depend on the deployment of broadband wireless networks in each of the Region's 147 cities, villages and towns, or in a somewhat smaller number of cooperative municipal service areas. Such a universal adoption and deployment of broadband wireless networks is considered highly unlikely. Even if each municipality were to desire the installation of a community-based wireless network, there is no assurance, especially in low density rural areas, that private, or public, capital funds would be available to support the needed infrastructure deployment. This potential lack of capital funding should not, however, be interpreted as indicating that there would be little demand for high-speed broadband telecommunications services in low density rural areas of the Region: experience has indicated the

opposite to be true. Only the regional wireless plan alternative has both the economic rationale and governmental support structure required for the attainment in a timely fashion of region-wide geographic coverage. The economic rationale is provided by a joint public safety-commercial antenna site infrastructure. The governmental support, however, would have to would come from the counties. While the regional wireless plan is truly region-wide in scope, the required joint public safety-commercial antenna site network could be accomplished on a county-by-county basis.

Based upon the foregoing considerations, the four alternative plans were ranked for geographic coverage as follows:

1. Regional Wireless Plan
2. Community-Based Wireless Plan
3. Fiber-to-the-Node (FTTN) Wireline Plan
4. Fiber-to-the Premises (FTTP) Wireline Plan

Infrastructure Cost Objective

Two methods were used to determine the infrastructure costs of the alternative plans. The first set of infrastructure costs was limited to the actual capital costs of the infrastructure equipment with no provision for operating costs. The second method included the capital costs of the first method plus the present value of that portion of the operating costs representing capital substitution costs, i.e. the incrementally higher Internet access costs resulting from the purchase of Internet access locally at each antenna site rather than regionally based on a optic fiber cable backhaul network allowing for lower Internet access costs.

Based on the first method, the following infrastructure costs were estimated:

1. Community-based Wireless Plan
   - $20.3 million
2. Regional Wireless Plan
   - $6.4 million
3. Fiber-to-the-Node Wireline Plan
   - $77.7 million
4. Fiber-to-the Premises Wireline Plan
   - $246.0 million

Ranking of the alternative plans on the infrastructure cost minimization objective was also accomplished on the basis of the infrastructure costs plus the present value of any higher operating costs resulting from the avoidance of increased fiber infrastructure costs that would result in lower operating rates. The basic direct Internet access rate for the 141 base station sites of the Regional Wireless Plan and the 54 backhaul stations of the Community Wireless Plan is $70 per megabit per second per month. If additional fiber optic infrastructure were installed allowing for high volume Internet connections in the 5 gigabit per second range at only three connections, the Internet access rate would drop to $45 per megabit per second per month. The $25 per month difference in the two rates was then capitalized based on the present value of the payments over a ten year period at 5% interest rate. The modified infrastructure costs using the second method change only for the two wireless plans. The wireline plans are assumed to have no substituted capital costs in their operating costs. Under the second method, the modified infrastructure costs were estimated as follows:

1. Community-based Wireless Plan – $38.6 million
2. Regional Wireless Plan – $39.1 million
3. Fiber-to-the-Node Wireline Plan – $77.7 million
4. Fiber-to-the-Premises Wireline Plan – $246.0 million

~~The above infrastructure costs do not allow for the public safety/private commercial infrastructure cost sharing that is an integral part of the Regional Wireless Plan. This cost sharing will significantly reduce the infrastructure cost of the Regional Wireless Plan, again making it the lowest cost plan alternative. Based on considering both methods of infrastructure costing, the plans were ranked as follows:~~

~~1. Regional Wireless Plan~~
~~2. Community-Based Wireless Plan~~
~~3. Fiber-to-the-Node (FTTN) Wireline Plan~~
~~4. Fiber-to-the-Premises (FTTP) Wireless Plan~~

The above infrastructure cost estimates assume that the full cost of the regional wireless plan will be borne by the private service provider. In the actual implementation, the public safety wireless communications network will utilize the same base station infrastructure and share the deployment costs. The effect of such cost sharing considerations will be considered later in the final plan selection.

All cost estimates here are based on the detailed cost breakdowns developed in Chapter VII which included wireless infrastructure costs in Table 2 and wireless operating costs in Table 3. Wireline cost estimation methodology is covered in the text for each plan alternative.

Redundancy Objective

The inclusion of redundancy as a separate objective was based, at least in part, on the almost universal failure of telecommunication networks, both public and private, in recent national natural and terrorist-inspired post disaster environments. Wireline and wireless networks failed to a large extent to operate after both the September 11, 2001, terrorist attack on the World Trade Center in New York and the Gulf hurricane of 2005 that destroyed much of the New Orleans area. Wireline as well as wireless telecommunications networks are critically dependent on major infrastructure elements such as central offices and antenna base sites. A variety of disaster-induced events such as explosion, grid power loss, or flooding as well as terrorist inspired sabotage, can severely damage telecommunication infrastructure. Emergency-related network traffic congestion can also disable a network even when the infrastructure remains intact. Network redundancy can also play an important role in normal network operation where high network reliability is required to maintain government, commercial and social communications -- especially public health and safety related communications. Wireless networks in particular have experienced reliabilities far below the 99.9 percent standard due to a lack of network redundancy.

As already noted under the performance objective, wireline networks have demonstrated very high reliability in network operations. Such wireline networks, however, do not have known elements of network redundancy. Both the FTTN and FTTP networks are critically dependent on the operation of central offices. A disruption of a single central office operation may disconnect the entire service area of that office. In like manner, loss of a single antenna base station site can disrupt wireless communications over a wide service area. Protection against such communication disruptions requires redundancy in the network. Redundancy was defined in Chapter III as the "average number of alternative transmission paths between users in a network". Accordingly, network redundancy is created by providing alternative transmission paths through the networks. Traditional cellular wireless networks do not typically provide redundancy in the form of alternative transmission paths through the networks. Users communicate through the antenna base stations assigned for a particular time and location. Operational failure of the base station concerned will terminate all communications in the station service area. Established alternative paths are generally not available.

The most redundant communications network topology is the mesh network design. In a mesh network, users with omnidirectional antennas may connect with alternative access points. Once connected, alternative transmission paths through the network provide strong redundancy as long sufficient access points are available for such redundant transmission paths. Power outages and other emergency situations, however, can still drastically reduce the number of such alternative transmission paths. Comprehensive wireless network redundancy requires alternative transmission paths that are independent of the basic infrastructure. Such redundant independence is possible only in ad hoc, peer-to-peer mesh networks that employ the users themselves as backup transmission point nodes. Such an ad hoc mesh network differs from current mesh networks in two primary ways: (1) the ad hoc, peer-to-peer network serves only as an emergency supplement to the basic cellular network; and (2) the mesh network nodes are end users, serving as nodes not separate network elements. Both the community-based and regional wireless plans are envisioned as incorporating this backup ad hoc, peer-to-peer network feature to provide high levels of redundant network operation.

Redundant features of the FTTN and FTTP wireline networks, if any, are unknown at the present time. The basic structure of these networks does not lend itself to redundant transmission paths. Both are critically dependent on central offices for basic operation. Alternate paths to remote nodes from the host, or from another central office, are not known to be provided. Disabling a node in an FTTN network will terminate communications in its square mile service area. Failure of a splitter node in a FTTP network will terminate communications in its service area. In the absence of additional information, redundancy in the FTTN and FTTP wireline networks must be assumed to be low or nonexistent. The redundancy of an FTTP network must be rated better than an FTTN network only because a fiber splitter is a passive component, while a FTTN node operates with active electronic equipment. Based on the forgoing considerations, network redundancy for the alternative plans was ranked as follows:

1. Regional wireless plan
2. Community-based wireless plan
3. Fiber-to-the-premises (FTTP) wireline plan
4. Fiber-to-the-node (FTTN) wireline plan

Public Safety Objective

The public safety objective relates to the response of the telecommunications system in supporting public safety objectives both in normal operations and in public safety emergencies. Because the Regional Wireless Plan would be jointly designed with the public safety communications network, it would directly

support public safety communications in the Region. Community-based wireless networks may also choose to integrate network access points, or antenna base stations, into a shared public-commercial framework in which infrastructure development costs are shared. Such cost sharing directly enhances public safety by leveraging the public safety communications investment for enhanced public safety communications performance.

Wireline Networks, since they do not support mobile, or nomadic users, are less directly involved with public safety communications. Wireline networks, however, are routinely used for public safety communications between fixed locations, and can serve the public safety objective by granting priority to public safety traffic particularly in times of public emergency. The FTTN broadband wireline network would be particularly useful to public safety because of its wider availability throughout the Region. Based on the foregoing considerations, the alternative plans were ranked as follows:

1. Regional wireless plan
2. Community-based wireless plan
3. Fiber-to-the-node (FTTN) wirelines plan
4. Fiber-to-the premises (FTTP) wireline plan

Most Demanding Application Objective

Video, in both its broadcast and videoconferencing forms, is the most demanding broadband communications application. Bandwidth requirements for video can range from 256 kilobits per second to 200 megabits per second depending on application and desired quality. Broadcast television, even in its least demanding form, requires at least five megabits per second. The FTTN and FTTP plans, as presently being deployed by telephone carriers, such as AT&T and Verizon, are primarily aimed at the broadcast television market. As presently constituted, they are asymmetric and so do not support high quality videoconferencing. Videoconferencing, however, has not yet developed as a major application, and so generates minor traffic in comparison to broadcast television. For this reason, the plans were ranked primarily on their downstream throughput performance as follows:

1. Fiber-to-the premises (FTTP) wireline plan
2. Fiber-to-the-node (FTTN) wireline plan
3. Community-based wireless plan
4. Regional wireless plan

Rank-Based Expected Value Plan Evaluation

Plan evaluation using the rank-based expected value method involves the combination of rank value calculations and an estimate of the probability of implementation. Beginning with the community-based wireless plan, each plan was scored based on these rank valuations and implementation probability estimates.

Community-Based Wireless Plan

The community-based wireless plan received the following rankings and related scores:

	Performance	Universal Geographic Coverage	Infrastructure Cost	Redundancy	Public Safety	Most Demanding Application
Rank	4	2	~~2~~ *1*	2	2	3
Score	1	3	~~3~~*4*	3	3	2
Weight	6	5	4	3	2	1
Value	6	15	~~12~~ *16*	9	6	2

Summation of the above value provides a total valuation score of ~~50~~ *54*.

Estimating the probability of implementation of this plan is a difficult task since the implementation depends on deployment in each of the 147 cities, villages and towns within the Region, or on somewhat smaller number of cooperative municipal service areas. Counties are excluded since they are better served by the Regional Wireless Plan. Regional communities have already begun to consider the process of deploying community wireless networks, but the probability of all of the communities in the Region adopting community wireless plans within the plan implementation period is judged to be about 60 percent, for a probability estimate of 0.6. Combining the probability with the rank valuation score of ~~50~~ *54* produces a total plan evaluation value for the Community Based Wireless Plan of ~~30.0~~ *32.4*.

Regional Wireless Plan

Following the same scoring procedure for the Regional Wireless Plan provides the following.

	Performance	Universal Geographic Coverage	Infrastructure Cost	Redundancy	Public Safety	Most Demanding Application
Rank	3	1	2	1	1	4
Score	2	4	3	4	4	1
Weight	6	5	4	3	2	1
Value	12	20	12	12	8	1

Summation of the above values provides a total valuation score of ~~69~~ *65*.

Initially, the probability of implementation of a regional wireless plan was judged to be rather low because there is no regional governmental authority to carry out such a plan. Recent experience with a potential demonstration project in Kenosha County, however, indicates a higher probability of implementation on a county-by-county basis. A successful implementation of the plan in a single county such as Kenosha could ignite sufficient interest for other counties to follow suit for an eventual regionwide deployment. Such a possibility raises the probability of implementation to 60 percent (0.6) for a plan evaluation value of 39.0.

The Kenosha County joint public safety/WiFiA wireless communications demonstration project is currently at the contract closure stage and is scheduled to begin in September, 2007. The project activities will include a detailed 4.9GHz (public safety) and 5.8 GHz (commercial WiFiA) plan followed by a field demonstration of long-range, high-performance at 4.9 GHz communications with law enforcement vehicles. The project will also include a demonstration of peer-to-peer backup communications for public safety that would provide for network continuity when infrastructure is damaged in major public emergencies. If the field demonstration project is successful, Kenosha County intends to implement an early broadband public safety communications safety deployment that is county-wide in coverage.

Fiber-to-the-Node (FTTN) Wireline Plan

The FTTN Wireline plan was scored as follows:

	Performance	Universal Geographic Coverage	Infrastructure Cost	Redundancy	Public Safety	Most Demanding Application
Rank	2	3	3	3	3	2
Score	3	2	2	2	2	3
Weight	6	5	4	3	2	1
Value	18	10	8	6	4	3

Summation of the above values provides a total valuation score of 49.

The probability of FTTN plan implementation is quite high since AT&T is already implementing an FTTN network in the Region. The primary obstacle to assigning a probability implementation of 100 percent is that AT&T is not the ILEC in all of the FTTN – proposed service areas within the Region. AT&T has also clearly stated that it will not provide universal geographic coverage, but coverage only in those areas promising an adequate economic return. These limitations lower the implementation value to 0.8, the highest of any of the plan alternatives. Such a probability produces an FTTN plan evaluation value of 39.2.

Fiber-to-the-Premises (FTTP) Wireline Plan

The FTTP Wireline Plan was scored as tabulated below:

	Performance	Universal Geographic Coverage	Infrastructure Cost	Redundancy	Public Safety	Most Demanding Application
Rank	1	4	4	3	4	1
Score	4	1	1	2	1	4
Weight	6	5	4	3	2	1
Value	24	5	4	6	2	4

Summation of the above values provides a total valuation score of 45.

With the major regional ILEC, AT&T deploying a lower cost alternative wireline technology (FTTN), the probability of implementation of an FTTP network must be considered extremely low. AT&T must recover its return on the FTTN investment, and the FTTN nodal infrastructure still leaves the major costs of an FTTP to be covered in a network expansion. These costs relate to the fiber installation expenses from the nodes to each of the user premises. A probability of implementation of 0.3 seems appropriate. Such a probability produces an FTTP plan evaluation value of 13.5

Rank-Based Expected Valuation (RBEV) Summary

The RBEV summary of the four alternative plans in priority order is listed below:

~~1. Regional Wireless Plan~~
~~V=41.4~~

~~2. FTTN Wireline Plan~~
~~V=39.2~~

1. Regional Wireline Plan
V=39.0

2. FTTN Wireline Plan
V=39.2

3. Community-Based Wireless Plan
V=31.2

4. FTTP Wireline Plan
V=12.6

~~Based on the above valuation, the Regional Wireless Plan is the plan of choice. The RBEV rank of this plan is further enhanced by the public-private consortium nature of the plan which improves governmental functions such as public safety while sharing infrastructure costs with a 5.8 GHZ commercial wireless network.~~

The above RBEV evaluation produces essentially the same values for the FTTN wireline plan and the Regional Wireless Plan. Each contributes a different set of attributes to regional telecommunications capabilities. The Regional Wireless Plan provides universal geographic coverage throughout the Region and significantly enhances the state of public safety communications in the seven county area. The FTTN provides the beginnings of an areawide fiber network in urbanized areas and provides competition in cable television service. A major cost factor not considered in the evaluation is the sharing of the cost of infrastructure deployment between county governments and private providers that would be possible under implementation of the Regional Wireless Plan. Such cost sharing would reverse the above plan rankings and designate the Regional Wireless Plan as the preferred broadband telecommunications plan for the Region. In actual practice, both plans satisfying complementary needs may be expected to proceed toward plan implementation.

None of the above primary plans provide for the mobile (cell phone) users. The fiber link plans, both FTTN and FTTP do not provide for either the nomadic (laptop computer) or the mobile user. The community and regional wireless networks offer broadband communication services to the nomadic user. Since mobile communications will play a dominant role in future broadband communications, each of the above primary plans must be supplemented with an adjunct broadband mobile wireless network.

WiMAX versus WiFi for a Regional Mobile Broadband Wireless Network

The two alternative broadband wireless networks described in Chapter VII utilized either WiMAX or WiFi technologies. Adjunct Plan A was an independent plan based on WiMAX (IEEE Standard 802.16e) and deployed 743 base stations throughout the Region. Adjunct Plan B was a true adjunct plan in that its implementation depended on the pre-existence of one of the two alternative wireless plans – regional or community-based – for its implementation. Following the same approach used for the primary alternative plan evaluation, these two adjunct plans will be rank-evaluated for each of the Chapter III objective standards.

Performance Objective

Early released versions of WiMAX mobile wireless technology do not provide for the throughput data rates of 20 megabits per second as specified in the Chapter III performance standard. Later versions will probably improve in performance but at unknown rate. The WiMAX plan illustrated in Map 8 depicts 20 megabits per second performance in most areas throughout the Region. Such performance was achieved through the deployment of a very large number of antenna base stations (743).

The WiFi and WiFi A based mobile wireless plan, as illustrated in Maps 9 and 10, achieves the specified throughput performance using the community-based wireless network but not with the regional wireless network. Some new features will be added to the regional wireless plan to upgrade throughput performance to standard level, but these features are still untested and so can not be relied upon at this time. Given the uncertainty in this aspect of the regional wireless plan, the WiMAX plan must be ranked higher.

1. WiMAX Mobile Wireless Plan A
2. WiFi Mobile Wireless Plan B

Universal Geographic Coverage Objective

Because it employs licensed radio frequency bands, the WiMAX adjunct mobile wireless plan A must be deployed by a major wireless carrier that owns spectrum in these licensed bands. The high cost of region-wide WiMAX deployment combined with the low economic return expected in lower density rural areas makes it highly unlikely that any private wireless carrier would provide region-wide mobile wireless WiMAX coverage. WiFi Plan B, in contrast, operates off a primary wireless infrastructure, either the regional and the community-based, and so has a reasonably high probability of region-wide implementation. Given this situation, the WiFi mobile wireless plan outranks its alternative adjunct WiMAX plan.

1. WiFi Mobile Wireless Plan B
2. WiMAX Mobile Wireless Plan A

Infrastructure Cost Objective

With an estimated infrastructure cost of $38.0 million, the mobile wireless WIMAX plan far exceeds in cost any added features needed to extend the range or performance of the Regional Wireless Plan for mobile users as called for in Adjunct Mobile Wireless Plan B. With the Community Based Wireless Plan, there is little or no added infrastructure costs to support mobile wireless users. The Regional Wireless

Plan will require some infrastructure augmentation, but at no where near the level of the WiMAX alternative. In either event, the WiFi adjunct plan provides a lower cost alternative than WiMAX based Plan A.

1. WiFi Mobile Wireless Plan B
2. WiMAX Mobile Wireless Plan A

Redundancy Objective

Both the regional and community-based primary wireless plans will be augmented by design features that allow for alternate transmission paths through the network. Based on such design features, WiFi adjunct plan B will have built-in redundancy not known to be featured in WiMAX. For this reason, the WiFi-based mobile wireless plan must be ranked above the WiMAX alternative for network redundancy.

1. WiFi Mobile Wireless Plan B
2. WiMAX Mobile Wireless Plan A

Public Safety Objective

A major feature of the Regional Wireless Plan is its joint public safety-commercial capabilities. As an adjunct to the Regional Wireless Plan, the WiFi Mobile Wireless Plan B would incorporate a capability for communication with hand-held devices including cell phones. WiMAX mobile wireless networks could also operate in the 4.9 GHz public safety frequency band, but this additional capability is not likely to be incorporated in a region-wide WiMAX network by a private wireless service provider. As an adjunct to a community-based WiFi network, Plan B also requires a 4.9 GHz upgrade. On balance, however, the WiFi mobile wireless Plan B better serves this objective.

1. WiFi Mobile Wireless Plan B
2. WiMAX Mobile Wireless plan A

Most Demanding Application Objective

With equivalent bandwidth capability, both the WiFi and the WiMAX can serve the demands of video and multimedia communications. The improved quality of service (QoS) features of WiMAX would appear to favor WiMAX for this objective.

1. WiMAX Mobile Wireless Plan A
2. WiFi Mobile Wireless Plan B

RANK-BASED EXPECTED VALUE ADJUNCT PLAN EVALUATION

Based on the above rankings the following two tables summarize the valuation scores for the WiMAX and WiFI mobile wireless plans.

WiMAX Mobile Wireless Plan A

	Performance	Universal Geographic Coverage	Infrastructure Cost	Redundancy	Public Safety	Most Demanding Application
Rank	1	2	2	2	2	1
Score	2	1	1	1	1	2
Weight	6	5	4	3	2	1
Value	12	5	4	3	2	2

Summation of the above value provides a total valuation score of 28.

The probability of implementation of a broadband mobile wireless plan must be considered rather low because of the cost and the low financial return in rural areas of the Region. There is also some basis for questioning the need for 4G-level throughput in many areas of the Region. These uncertainties result in a implementation probability of only 0.3 which results in a plan evaluation value of only 8.4.

WiFi Mobile Wireless Plan B

	Performance	Universal Geographic Coverage	Infrastructure Cost	Redundancy	Public Safety	Most Demanding Application
Rank	2	1	1	1	1	2
Score	1	2	2	2	2	1
Weight	6	5	4	3	2	1
Value	6	10	8	6	4	1

Summation of the value provides a total evaluation score of 35.

The probability of implementation of this WiFi mobile wireless plan is quite high since it operates off the infrastructure of either the regional or community-based wireless plan. Given the region-wide deployment of either of these fixed user plans, the addition of a mobile wireless capability is judged to be highly likely, so that it should be assigned the same probability of implementation as those two plans which is 60% or 0.6. Such a probability value results in a total plan evaluation value of 21.0.

It is clear from the above that the WiFi mobile wireless plan is the clear winner in the RBEV valuation and probably the only broadband wireless plan able to economically achieve 4G standards in the entire Region.

Regional Comprehensive Broadband Telecommunications Plan Selection

Based on the Rank-Based Expected Value scoring, the leading contender for adoption as the regional telecommunications plan would be the Regional Wireless Plan supplemented by the WiFi Mobile Wireless Adjunct Plan. Together, these two complementary plans would meet the objectives and standards established in Chapter III for a comprehensive, regional broadband telecommunications system to serve the Region in the coming decade. Other considerations, however, require the provision of flexibility in the structure of the plan. This flexibility is required for the following reasons:

1. Existing and Expected Broadband Wireline Network Deployments

   AT&T has already begun the deployment of a Fiber-to-the-Node Broadband Wireline Network in Southeastern Wisconsin. Time Warner and Charter Communications also have the potential of upgrading their cable network in a modified FTTN configuration to satisfy fourth generation broadband requirements. Since these new or modified networks are in least partial compliance with current 4G objectives and standards, flexibility must be provided within the recommended plan to accommodate the continued deployment of these wireline networks.

2. Existing and Expected Community-Based Broadband Wireless Network Deployments

   Strong interest in community-based broadband wireless networks currently is evident within the Region. Initial deployment of some of these networks is already underway. Since those networks would operate in a different frequency band than that which would be used for the regional wireless plan -- 2.4 GHz for the Community-based systems and 5.8 GHz for the regional plan -- they are operationally compatible and could serve together in the Region.

3. Broadband Communications Competition

   In the current regulatory environment, consumer protection and technology innovation are both fostered by competition. It is Federal communications policy as set forth by the Congress and the Federal Communications Commission to encourage such competition. For these reasons, the recommended regional broadband telecommunications plans must provide for a level of diversity that recognizes current trends and the desire for a competitive telecommunications environment.

With the Rank-based Expected Value evaluation results as a foundation, but upon consideration of the foregoing trends and the desire for broadband competition in the Region, the following composite regional comprehensive broadband telecommunications plan is recommended for adoption within Southeastern Wisconsin:

1. Regional Wireless Plan for region-wide broadband coverage to serve fixed and later nomadic users; and
2. WiFi-based Mobile Wireless Plan B - for region-wide broadband coverage of mobile users

The above primary plan components would be supplemented by:

1. Fiber-to-the Node Wireline Plan
   - to provide television and related broadband services within the urbanized areas of the Region
2. Community-Based Wireless Plans
   - for communities selecting local networks to compete with and complement the regional wireless networks.
   - to further support the WiFi-based Mobile Wireless Plan B

Public Sector Broadband Wireless Networks

All of the above alternative broadband communications plans relate to commercial networks generally owned and operated by private service providers. These plans and the final selected composite plan are intended as an advisory plan to the private sector. A separate class of telecommunications networks relate to functions performed by the public sector. These public enterprise telecommunications networks were described in SEWRPC Memorandum Report No. 164, *Potential Public Enterprise Telecommunications Networks for Southeastern Wisconsin*, September, 2005.

One of the particularly important classes of potential public enterprise telecommunications networks described in the aforereferenced report are public safety emergency response networks which support law enforcement, firefighting, pre-hospital emergency medical service (EMS), and public works personnel with their communications needs. This class of network was described in the aforereferenced report with emphasis on high speed data, video, and multimedia applications in the new FCC (2002) frequency spectrum of the 4.9 GHz band. This band is dedicated solely to public safety applications and has sufficient bandwidth -- 50 MHz -- to support high speed fourth generation (4G) communications

performance. Experimental deployment of 4.9 GHz is expected in the next few years. Initial applications will emphasize data and video transfer but extension to voice communication is expected to rapidly follow.

There is a strong synergy between the needs of public safety communications and the recommended regional telecommunications plan. Based upon interoperability needs, there is broad agreement that public safety communications should be regional in nature. The perpetuation of various community-based communications networks is not in the interest of effective operations particularly in times of major, disaster-level emergencies.

The wireless element of the recommended regional telecommunications plan could not only support commercial broadband wireless communications, but also region-wide, interoperable public safety broadband telecommunications. The estimated infrastructure cost of the recommended plan of $6.4 million made no allowance for base station site cost sharing between the public and commercial wireless networks. The close proximity of the public safety band -- 4.9 GHz -- and the commercial WiFiA band -- 5.8 GHz -- makes such base station cost sharing feasible and useful. Such cost sharing would further reduce the regional wireless plan infrastructure cost, and would allow for ready accomplishment of region-wide geographic coverage, an important objective of the regional telecommunications planning effort. Thus the recommended regional telecommunications plan has a unique advantage in being able to support both commercial and public sector broadband telecommunications in the Region.

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PRELIMINARY DRAFT

SEWRPC Planning Report No. 53,
A REGIONAL BROADBAND TELECOMMUNICATIONS PLAN
FOR SOUTHEASTERN WISCONSIN

Chapter IX

PLAN IMPLEMENTATION

The recommended regional telecommunications plan described in Chapter VIII of this report provides a design for the attainment of the specific regional telecommunications objectives set forth in Chapter III of this report. In a practical sense, this recommended plan is not complete until the actions required to implement it, that is to convert the plan into action policies and programs that result in actual network deployments, are specified. This Chapter is, therefore, presented as a guide for use in the implementation of the recommended plan. This Chapter sets forth a recommended procedure for plan implementation, outlining the actions which must be taken by the various public and private agencies concerned if the recommended plan is to be fully carried out. Those public and private agencies which have plan adoption and plan implementation functions applicable to implementation of the recommended plan are identified; the necessary formal plan adoption or endorsement actions are specified; and specific implementation actions are recommended for each of the public and private agencies concerned.

Plan implementation as presented here extends beyond the physical and technical development of the telecommunication networks to the business and operational models required to effectively fund, market and operate the networks concerned. The business model addresses the economics of a telecommunication system in terms of the user charge rates required for economically viable operation, as well as the marketing activities needed to establish and operate the facilities and services envisioned in the plan. The operational model is concerned with network management and an associated network monitoring system necessary to supervise network operation. The plan implementation recommendations are based upon and related to the existing public and private agency programs functioning within the Region. Given the predominance of the

private sector in telecommunication network development, a well-defined procedure for plan implementation becomes an important element of the plan itself.

The currently prevailing telecommunication systems development process within the United States, as established by Federal law, places the responsibility for system development generally within the private sector, that process being, however, regulated by Federal and State laws and regulations. Public Telecommunications service planning efforts such as that conducted by the Southeastern Wisconsin Regional Planning Commission are intended not to replace, but rather to supplement this competitive, market training process in the public interest. The adopted regional plan and its recommended implementation efforts are not intended in any way to impede the implementation of alternative plans prepared and put forth by private providers, or by communities or municipalities within the Region, that would move the existing level of service toward the attainment agreed upon objectives and standards. It is, however, hoped that the adopted plan would serve as a point of departure for further telecommunication planning by private providers and public agencies.

Because of the complex combination of public and private interests involved in the provision of telecommunication facilities and services within the Region, and because of the ever present possibility of unforeseen changes in economic conditions, in State and Federal legislation, in case law decisions, in governmental organization, and in public and private fiscal policies, it is not possible to declare, once and for all time, exactly how a process as complex as regional telecommunication plan implementation should be pursued. In the continuing planning process it will, therefore, be necessary to not only update periodically the recommended plan, and the data and forecasts on which the plan is based, but also the recommendations for implementation.

PLAN ADOPTION OR ENDORSEMENT

Public plan implementation measure must grow out of adopted plans. Because of the completely advisory role of the Commission, implementation of the recommended regional telecommunications plan will be entirely dependent upon action by the county and municipal units of government which constitute the Region, and by the private telecommunication facilities and service providers operating with the Region. If plan implementation is to proceed in an effective, coordinated way, adoption or endorsement the plan by various potential implementing agencies is highly desirable.

Commission Plan Adoption and Certification

The Regional Planning Commission is empowered by State law to prepare and adopt a master plan for the physical development of the Region. It has no statutory plan implementation powers. Its powers are limited to, among others, publicizing plans; issuing reports; and providing -- on request -- planning assistance to county, municipal and special purpose units and government within the Region. For the recommended regional telecommunication plan to have official status, it must be adopted by the Regional Planning Commission itself, and such adoption constitutes the first action to be taken toward plan implementation. In accordance with the Wisconsin Statutes, the Commission -- following such adoption -- transmits certified copies of the resolution adopting the plan and the plan itself to the legislative bodies of the counties, local municipalities and special purpose units and agencies of government concerned. Such transmittal may also be made to concerned Federal and State agencies, including, in this case, the Wisconsin Public Service Commission.

County and Municipal Plan Endorsement

Endorsement, or formal acknowledgement of the transmitted resolution and plan by the county~~,~~ *and* municipal *units and agencies of government, and by* ~~and special purpose legislative bodies, and~~ the State ~~agency~~ *agencies* concerned is desirable, and may in some cases be necessary, to assure a common understanding between the several levels of government concerned and to enable their staffs to program necessary implementation work. *The plan endorsement actions should extend to special purpose agencies such as the Regional Telecommunications Commission, a cooperative agency serving a number of local municipalities within the greater Milwaukee area* It is important in this respect to understand that endorsement of the recommended telecommunications plan by any unit or agencies of government pertains only to the statutory statutes and functions of the adopting agency, and such endorsement itself cannot in any way preempt action by another unit or agency of government within its jurisdiction.

Private Service Provider Endorsement

Private wireless or wireline service providers do not typically have an explicit endorsement process for Commission-developed infrastructure plans. Instead, they may implicitly endorse the plan by their organizational decisions that deploy telecommunications networks consistent with the approved regional plan. Wireline service providers such as AT&T will deploy broadband networks such as their new FTTN network only in as far as they are consistent with independently developed corporate plans.

The role of private service providers in the newly planned wireless networks is significantly different. In the regional wireless plan, the county is the key governmental agency. Endorsement of the plan by a county will set the stage for plan implementation involving private service providers as described in the section

below. Adoption of a community-based wireless plan by a local unit of government will, in a similar manner, open the way for private service providers to participate in plan implementation.

Plan endorsement by private service providers then takes two possible forms:

1. Explicit endorsement and implementation of the plan by a private service provider; or
2. Responding to requests for proposals by local government agencies for services consistent with the plan.

PLAN IMPLEMENTATION

Plan implementation as presented here will take notice of multiple broadband telecommunications networks either being deployed, or expected to be deployed, in the coming years:

1. The Regional Broadband Wireless Network
   - in the 4.9 GHz public safety frequency band
   - in the 5.8 GHz unlicensed commercial frequency band
   - implemented on a county-by-county basis
2. Community-Based Wireless Networks
   - in the 2.4 GHz unlicensed WiFi frequency band
   - implemented on a community-by-community basis
3. Fiber-to-the-Node (FTTN) Wireline Network
   - implemented in the Region by AT&T and perhaps other wireline carriers

The implementation procedures for the above three network plans differ considerably, but the implementation features of each will be described here. While the regional wireless plan is the primary plan for providing universal geographic coverage in the Region, the other two plan initiatives are proceeding forward and must be recognized as key elements in the regional comprehensive broadband telecommunications system.

County Level Public/Private Communications Network Plan Implementation – Regional Wireless Plan

The new 4.9 GHz public safety broadband communications network is an integral part of the regional wireless plan. A major advantage of the regional wireless plan is its public safety network component and the prospect of infrastructure cost sharing with a compatible commercial 5.8 GHz WiFiA broadband

wireless network. Public safety communications can also be compatible with community-based wireless networks operating in a different frequency band. If the public safety and the commercial networks are to be jointly developed, however, a decision must be made early in the planning process to assure coordination of the planning and deployment of the two networks.

Since there is no regional government structure in Southeastern Wisconsin, for telecommunication system plan implementation, such implementation must take place on a county-by-county basis. The seven county governments are, therefore, the key to regional wireless plan implementation. Plan implementation by individual counties, or groups of counties, would consist of the following sequence of steps:

1. Following endorsement of the recommended regional plan, an interested county government, or group of county governments, approve initiation of a 4.9 GHz/5.8 GHz wireless plan implementation project. That initiation approval would include a request to the Regional Planning Commission, or to a consultant, to prepare a more detailed, second level system plan, for the area designated in the request;

2. Review and approval of the preliminary second level system plan by the county or counties concerned. The preliminary system plan should provide for a joint 4.9/5.8 GHz public safety/commercial network that defines the system infrastructure, its estimated performance, and its capital and operating costs;

3. Conduct of field tests to verify or modify the preliminary second level plan as may be found necessary. A randomized test location selection will provide for the necessary plan test at a reasonable cost. For public safety communications, testing with mobile vehicles as well as fixed locations will be required.

4. Review and approval of the revised second level system plan by the county or counties concerned; and approval of a budget for partial or full-scale deployment of the proposed broadband public safety network;

5. Issuance of a request for proposals to deploy the proposed infrastructure required for the 4.9 GHz public safety network in accordance with the approved plan; and selection of an infrastructure development vendor. Network infrastructure deployment must be supported by an equipment operation and maintenance training program for county law enforcement, fire, EMS and public works staff.

6. From this point in the implementation process, the commercial WiFiA network will follow a different path than the public safety network. In the public safety network, the county government is the owner and operator of the network. In a commercial network, the government typically plays a facilitator role. The next step in implementing the commercial element of the network would be the issuance of a request for proposals to deploy the required infrastructure in accordance with the approved plan.

   The deployment of this 5.8 GHz infrastructure would use common base stations with the public safety network, but would be an independent endeavor from the public safety wireless deployment. Substantial gains in efficiency may be expected from coordinating the two deployments.

   A firm commitment for county-wide deployment by the commercial service infrastructure contractor will be an important aspect of the regional wireless plan implementation. Restricting deployment to only areas with higher population densities would defeat a major objective of the plan.

   ~~A major problem encountered by many communities interested in deploying broadband wireless networks has been finding technically competent and financially responsible contractors to install and maintain such a wireless network.~~ *A major problem encountered by many communities interested in deploying broadband wireless networks has been finding a financially viable and stable means for operation and maintenance of the desired wireless networks.* For a county-wide commercial component of a regional wireless network, this problem may be aggravated by the size and deployment cost of the network. For this reason, alternative means of financing and maintaining a commercial county-wide wireless network must be evaluated. One alternative, if no acceptable private infrastructure contractors can be found, involves the establishment of a special non-profit economic development corporation to finance, deploy and maintain the wireless network infrastructure. The details related to the establishment of such a corporation are beyond the scope of this report. Detailed procedures for the launch of such an initiative are available based on similar organizations in other parts of the United States.

7. Issuance of a request for proposals to operate the system and selection of an Internet Service Provider (ISP) to operate the network.

The proposals concerned should typically represent a simple procedure, since there are a significant number of internet service providers operating in the Region. If a separate organizational entity is available to deploy and maintain the commercial wireless network, a number of independent service providers should be well qualified to operate in a broadband wireless environment. A decision will be required by the county or counties concerned relating to whether one or multiple ISPs will be allowed to operate on the county network.

8. System operation

There are at least two separate functions involved in system operation.

a. Network management monitoring and maintenance (M^3); and
b. Internet service provider operation (ISP)

The network M^3 function involves maintaining the integrity of the network by monitoring network traffic and performing actions as required to detect and repair equipment failures and supply sufficient capacity to insure a specified quality of service. ISP operation includes providing web, e-mail and other services along with marketing, sales, help desk and back office functions for customer billing and collections.

Wireless Communications Systems Business Model

The ultimate economic viability of any business depends on the validity of its business model. The wireless communications service business is no exception. The business environment for municipal and rural broadband wireless networks is currently clouded by the difficult startup experiences of municipal WiFi mesh networks. These networks have been plagued by sub-standard performance, unreliability, and subsequent loss of subscriber interest. The performance issue is a critical competitive factor.

Market surveys indicate that wireless network performance must exceed current DSL and cable broadband services in order to attract user interest. Municipal wireless mesh networks now operating in many cities throughout the United States are generally struggling financially with high infrastructure costs and too few users. Unless new wireless services are able to offer superior performance, market interest lags. Municipal wireless mesh networks now are limited to throughput of from one to two megabits per second, with inconsistent network reliability. The sectoral cellular wireless networks that are integral to both the regional wireless and the community-based wireless networks offer significantly lower infrastructure costs and throughout performance in the 15 to 20 megabits per second range. WiFi mesh network deployment costs

range from $100,000 to $250,000 per square mile, with full coverage closer to the latter figure[1]. By contrast, the infrastructure costs for community-based wireless networks employing the sectoral cellular network topology are currently costing about $2,500 per square mile in rural areas such as the Town of Wayne[2] and about $14,000 per square mile in urban areas such as the City of Waukesha[3]. These infrastructure costs cover all of the access point equipment, the network monitoring system, the Internet gateway connection and initial engineering support, but not the server computer equipment of the Internet Service Provider (ISP) which is not part of the network itself. Since there may be multiple ISPs on a given wireless network, these costs are not really part of the network infrastructure. These low infrastructure costs in conjunction with the enhanced throughput performance provide the foundation for a sound business model.

Community Level Network Plan Implementation

Plan implementation by individual municipalities or groups of municipalities would consist of the following sequence of steps:

1. Following adoption or endorsement of the recommended regional plan, the interested municipality, or group of municipalities, would request the Commission, or a consultant, to prepare a second level, more detailed plan for the area designated in the request;

2. Review and approval of the preliminary system plan by the municipalities comprising each service area concerned;

3. Conduct of field tests to verify or modify the preliminary plan as may be found necessary, a randomized test location selection will provide the necessary plan at a reasonable cost;

4. Review and approval of the revised second level system plan by the municipalities concerned, and approval of a budget for partial, or full scale deployment of the proposed system;

5. Issuance of a request for proposals to deploy the proposed infrastructure in accordance with approved plan; and selection of an infrastructure development vendor. Network infrastructure deployment must be supported by an equipment operation and maintenance training program for designated municipal staff;

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[1] Daggett, B. V. "Dollars and Sense on Muni Wireless", *Government Finance Review*, February, 2007.
[2] *Broadband Wireless Field Test Report, Town of Wayne, Washington County, Wisconsin Southeastern Wisconsin Regional Planning Commission,* October 16, 2006.
[3] *Broadband WiFi, Wireless Telecommunications Planning Proposal*, City of Waukesha, Wisconsin, SEWRPC, October, 2006.

6. Issuance of a request for proposals to operate system, and selection of an internet service provider to operate the system; and

7. System operation

Plan preparation using radio propagation modeling and design optimization model tools would take place as previously described in Chapter VII, and would be initiated by the Commission or a consultant upon request of the community. Each community level wireless plan would then be presented to the appropriate local governing body and advisory committees to that body for review and approval. Upon approval, the community would submit a letter requesting the Commission or a consultant to move to step 3 - field study verification of the community wireless plan.

Field study plan verification involves an extensive series of radio frequency signal intensity measurements using temporarily located access point equipment, equivalent to that planned for use in the network infrastructure. A truck-mounted antenna mast is employed for a series of temporary access point locations. For each temporary access point location, a signal-level coverage map is prepared based on a large number of radio frequency signal level measurements collected in a moving vehicle equipped with a WiFi-enabled laptop computer with a professional site survey software package. A variety of network performance measures will be recorded including signal level, noise level, throughput (packet speed), and packet retry and loss rates. In small networks with a few access points as in rural areas, all of the access points can be covered and performance verified. In larger networks, a randomly selected set of access points can be used to statistically verify network coverage and performance. The field survey will identify weak coverage or performance areas which may require additional or relocated access points to achieve network coverage and performance objectives.

Following the completion of the field survey studies, the adjusted plan is resubmitted to the community for final review and approval. Upon approval, the plan implementation process would move to the final five stages which involve various aspects of vendor selection and system startup. The manner in which these final stages are approached depends on the general business model selected. If private service providers are asked and respond to a formal request for proposal, then steps 5 through 8 would be accomplished as a continuous final single stage process. If an alternative government ownership model is chosen, then infrastructure deployment and ISP (Internet Service Provider) selection would be executed as a two-stage process.

Whether the private or public version of a business model is selected, this business model plan must detail the marketing, training, financial and general business aspects of the proposed network operation in order to generate confidence in the economic viability of the new venture in a competitive environment.

Operational management of the new wireless system would be based on a network management system that employs real-time network monitoring to measure network performance in order to provide information for rapid trouble-shooting of network outages, and early identification and correction of network bottlenecks or areas of weak signal coverage.

The end result of the community-based WiFi network plan implementation process would be an operating broadband wireless network system that achieves the agreed upon performance objectives and is able to grow and adapt to an expanding network clientele. A wireless communications network system can be well managed only through constant observation of its dynamic nature as it grows its user base and adapts to changing traffic patterns.

Private Service Provider Plan Implementation

In addition to implementation of the primary regional wireless plan and the supporting community-based wireless plan, other wireline and wireless service providers will be deploying advanced networks designed to enhance the broadband telecommunications capabilities of Southeastern Wisconsin.

In the wireline arena, AT&T is rapidly deploying its U-Verse Network (Project Lightspeed) in selected communities within the Region. ~~The extent and details of this planned deployment were not made known to the Commission.~~ A list of the communities within the Region with AT&T agreements governing the deployment could be obtained by inquiries to communities. Even such a list, however, would not necessarily accurately define the geographic coverage of the FTTN network since AT&T is under no obligation to serve all geographic areas of a given community. U-Verse is a downstream-oriented communications technology. The emphasis is on television service, particularly high definition and interactive video which requires significant downstream bandwidth capacity. Internet upstream data throughput is limited to one megabits per second, while downstream throughput is limited to seven megabits per second. These parameters, originally covered extensively in Chapter VII, are repeated here only to provide a better understanding of the nature of the U-Verse market and its impact on overall regional plan implementation.

Given the performance parameters of U-Verse, there is no inherent conflict envisioned between the parallel deployment of AT&T's U-Verse network and the regional and community-based wireless networks. U-Verse's primary objective is to compete with the cable companies in providing a combination of television, telephone, and Internet data services. The primary objective of the regional wireless network is to provide fourth generation (4G) symmetric broadband Internet data services throughout the entire Southeastern Wisconsin Region. Voice communications services through the Internet (VoIP) will also be available if the demand emerges. A major subsidiary objective of the regional wireless network is a robust telecommunications network for public safety, a network capable of functioning in a major public emergency. Since the commercial element (5.8 GHz) of the regional wireless network will share a common base station layout, these same robust features could also be built into the regional 5.8 GHz network.

The implementation of community-based wireless networks has similar objectives as the regional plan albeit at a more local level. The objectives of these community networks may vary greatly depending on the location and characteristics of the community. Rural townships within the Region such as Wayne in Washington County generally have no broadband services at all. For these communities, a community-based wireless network is practically the only opportunity to cross over the digital divide and achieve 4G-level broadband performance.

Suburban communities within the Region, such as Hartland, Thiensville or the North Shore suburbs, are in a different competitive situation. Broadband communications in the form of cable, telephone DSL or the new AT&T U-Verse networks are, or generally will be, available to all residents and businesses. Except for the new U-Verse network, broadband services from these providers is generally in the 1.5 to 2.5 megabits per second range. Upstream data rates are in the under 500 kilobits per seconds range (0.5 megabits per second). U-Verse, aside from television services, offers upgrades to seven megabits per second downstream, and one megabit per second upstream. The driving force in these communities for advanced broadband communications will be from individuals and organizations whose needs are better satisfied by high speed symmetrical data and video transmission. An example of such an application is video conferencing. High quality video conferencing requires significant data transmission rates not satisfied by current cable, DSL or U-Verse offerings. Business conferencing and medical monitoring in home healthcare, are two examples of potential videoconferencing applications. Such applications along with data intensive small business firms may be expected to comprise the primary justification for the provision of 4G broadband and community based wireless in the coming years.

Cellular Wireless Service Providers

A major class of regional private service providers are the cellular wireless companies: AT&T, Verizon Wireless, Sprint/Nextel, U.S. Cellular and T-Mobile. All five service providers have extensive wireless networks in the Region. Only one of these five, Sprint/Nextel, has committed publicly to a 4G-level technology, WiMAX, for planned deployment in the United States, although not yet in the seven-county region. Some other service providers and communications equipment manufacturers are supporting another evolving technology called Long-Term Evolution-LTE. LTE represents an attempt by the manufacturers and wireless service providers to regain the initiative for proprietary wireless communications technologies. Having lost the performance initiative to IEEE Standard Technologies such as WiFi and WiMAX, LTE tries to find a future broadband role for the current proprietary GSM/UMTS and CDMA technologies. LTE Standards are scheduled to be finalized by the end of 2007. First commercial applications are scheduled to take place in late 2009 or early 2010. Throughput performance exceeding 100 megabits per second is promised. The infrastructure costs of LTE proprietary technologies may be expected to exceed significantly those of IEEE standards. Whether such higher cost technologies can compete with technologies based upon IEEE Standards is still to be demonstrated.

The future of WiMAX as a broadband mobile wireless technology is still uncertain. Originally conceived as an IEEE standards replacement technology for WiFi, WiMAX has currently emphasized use by the private wireless service providers. All of the early releases of WiMAX (802.16e) are in the licensed frequency bands such as 2.5 GHz and 3.5 GHz. These bands are available only to major wireless service providers. At the same time, the early releases of WiMAX seem compromised in throughput performance. Early range targets of 30 to 40 miles have been replaced with 0.5 to 1.0 mile maxima. At these ranges, the WiMAX mobile wireless plan is not competitive and the only alternative for mobile broadband wireless in the Region, at least in the near future, is advanced Mobile WiFi.

SUMMARY

Plan implementation strategies and procedures are outlined in this chapter for both private service providers and public agencies. Public agencies must first approve the plan in a formal plan endorsement process. The regional wireless plan would require endorsement by each of the seven counties prior to implementation in the respective county areas. Community-based wireless plans would require endorsement by the individual local units of government.

Recommended plan implementation strategies and procedures are detailed in this chapter for the regional wireless plan and the Community-based wireless plan. Potential plan implementation strategies and procedures for private service providers in the Region are reviewed and explained.

Regional Wireless Plan implementation at the county level first requires approval of a project that will initiate a planning, field testing and eventual deployment of a broadband public safety network within the county. The initial phases of the project involve network plan preparation and field testing to verify the plan. After the verified plan is approved, the county must provide budget authorization for the deployment of the 4.9 GHz public safety communications portion of the county-based regional wireless plan. Deployment of the public safety network can then move forward in a county-wide application.
Implementing the commercial wireless portion of the Regional Wireless Plan follows a similar path to the public safety network in the early planning and testing phases, but the path of implementation changes in final system deployment. It must be reemphasized here that a central strength of the Regional Wireless Plan is this public-private partnership. This partnership not only supports a major advancement in public safety communications, but it also improves the business model for service to low population density geographic areas throughout the Region that otherwise would go unserved. In light of the recent adverse publicity relating to the viability of WiFi business model, this cost sharing partnership feature is a strong reason for the universal endorsement of the regional wireless plan. Universal geographic coverage has been ranked as second only to performance as a primary objective of this regional telecommunication planning process. A serious effort to accomplish this objective requires implementation of the regional wireless plan.

Implementation of community-based wireless plans face more complex issues. Deployment in rural towns will differ greatly from deployment in urban and suburban areas of the Region. Rural towns currently have little or no broadband telecommunications services and may be expected to be eager to cooperate with any broadband service that can close the digital divide. Urban and suburban areas already have competing cable and telephone line-based broadband communications services. Implementation in such areas will require a more competitive business model with emphasis on service differentiation. Successful community-based wireless networks will require marketing emphasis on performance features that distinguish them from cable or DSL broadband services. Successful community-based wireless will also require the selection of a financially-sound and technically capable service provider. Recent experience indicates a shortage of such organizations, and it may be necessary to divide the responsibility between two organizations – one to finance, deploy and maintain the network infrastructure, and a second, the Internet Service Provider, to operate the system as a business.

Finally, private service providers such as AT&T and the wireless service providers have their own implementation plans. To the extent that these plans improve broadband telecommunications in the Region, they are supportive of regional telecommunications plan objectives. Unfortunately, none of these private plans, wireline or wireless, announced to date, meets all of the objectives set forth in Chapter III of this report. AT&T's U-Verse network complies with downstream throughput objectives, but only for television services not for general Internet usage. Its upstream throughput performance and geographic coverage are far below established 4G standards.

Neither the wireline cable service provider nor the cellular wireless carriers have released any 4G level plans as of this writing.

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PRELIMINARY DRAFT

SEWRPC Planning Report No. 53,
A REGIONAL BROADBAND TELECOMMUNICATIONS PLAN
FOR SOUTHEASTERN WISCONSIN

Chapter X

SUMMARY

This planning report documents the findings and recommendations of the planning process conducted by the Southeastern Wisconsin Regional Planning Commission to develop a comprehensive telecommunications system plan for the seven-county Southeastern Wisconsin Region. The planning process concerned was initiated in August 2004. The wireless telecommunications element of the planning process was completed in May 2006, and the findings and recommendations are set forth in SEWRPC Planning Report No. 51, *A Wireless Antenna Siting and Related Infrastructure Plan for Southeastern Wisconsin.* The plan presented in this report integrates wireless and wireline communications technologies into a comprehensive regional plan for a telecommunications network. The findings and recommendations are presented in the nine chapters which together with this summary comprise the report.

The planning program was directed by a Telecommunications Planning Advisory Committee. This Committee was created by the Commission to assist it in the preparation of a regional telecommunications plan for the seven-county Southeastern Wisconsin Region. The Committee was comprised of 21 members chosen by the Commission on the basis of their knowledge and experience in telecommunications and in comprehensive planning. The membership of the Committee is listed on the inside front cover of this report. The Committee met 21 times during the course of the planning effort, to review, revise as found to be necessary, and approve the draft chapters of this report. Minutes of the Committee deliberations are on file in the Commission offices.

Chapter I presents background information about the Regional Planning Commission, the regional planning concept in Southeastern Wisconsin, and about the seven-county planning Region; including basic information on the size, resident population, employment, real property valuation, and governmental

structure of the Region. The Chapter also contains a brief description of the work programs undertaken by the Commission from its creation in 1960 through 2004. Importantly, the Chapter describes the importance of telecommunications to the continued sound social and economic development of the Region, and the need for regional telecommunications planning. The Chapter notes that the regional telecommunications planning effort was being conducted in accordance with a Prospectus adopted by the Commission in December 2003. This Prospectus envisioned the regional telecommunications plan to be comprised of two principal elements: a broadband wireless communications plan, and a comprehensive telecommunications network plan that considered both wireless and wireline technologies.

Chapter II sets forth the basic principles and concepts underlying the regional telecommunications planning process; describes that process; and, importantly, describes the technologies involved, including wireless and wireline networks.

Chapter III sets forth a set of eight objectives that should be met by the regional telecommunications system, together with their supporting principles and standards. These objectives relate to system performance, as measured by data transmission rate, availability, quality of voice transmission, error rate, and packet loss; universality of service; redundancy; antenna site number optimization; application to be served; cost minimization; antenna site aesthetics and safety; and use in public safety emergencies. The objectives and supporting quantitative standards were intended to be used in plan design and evaluation of alternative plans and the selection of a recommended plan.

Chapter IV presents inventory findings relating to pertinent background conditions within the Region including information on the demographic and economic base, land use pattern, and supporting transportation facilities and services.

Chapter V presents the geographic coverage areas and broadband communications service offerings of wireline and wireless service providers in the Region. The dominant broadband service providers are the incumbent telephone service providers, AT&T, Century Tel and Verizon North, along with the cable companies, Time Warner Cable and Charter Communications. The inventories conducted under the planning program indicate that none of these service providers currently provide the fourth generation (4G) level of performance called for in the objectives and standards specified in Chapter III of this report. None of the existing wireline or wireless services also offer the universal regional geographic coverage recommended in the Commission's fourth generation (4G) standards. AT&T's current deployment of Project Lightspeed will offer download throughput speeds at 4G standards, but upload transmissions of one megabit per second will be below 4G specifications. This new fiber-to-the-node network deployment also will not provide universal geographic coverage within the Region.

Chapter VI documents the current performance of existing broadband wireline and wireless communications technologies based on data collected at the national, state and regional levels. Telephone line-based DSL and hybrid fiber-coax cable broadband services are emphasized since these technologies and companies control about 98 percent of the broadband services communications services market. Throughput performance for both DSL and cable services is in the one to three megabits per second range, below the specified 4G standards. Upload speeds are well below 500 kilobits per second for both DSL and cable as well as for most broadband wireless services. In addition to national and state-level aggregate performance information, performance ratings are also graphically presented for both major and smaller wireline and wireless carriers.

Chapter VII describes the alternative broadband wireless and wireline communications technologies and regional plans for Southeastern Wisconsin. Technology reviews emphasize broadband wireline fiber optic technologies since wireless technologies were extensively covered in SEWRPC Planning Report No. 51. Particular interest was directed to Fiber-to-the-Node (FTTN) and Fiber-to the-Premises (FTTP) technologies. FTTN technology involves the deployment of fiber optic links to remote locations that then connect with subscribes through existing copper wiring. Each node is able to serve users within a radius of 3,000 feet with high speed video and data services. Download throughput, however, is emphasized, with rates up to 25 megabits per second. Upstream transmission in contrast is limited to one megabit per second. Fiber-to-the-Premises technology represents the greatest throughput potential even though the particular passive form now being deployed has serious limitations compared to the active form which is significantly more expensive both initially and in operating costs.

One new wireless technology, mobile WiMAX, which was not considered in SEWRPC Planning Report No. 51, is considered in this report. Mobile WiMAX – as defined by IEEE Standard 802.16e – is the mobile cellular version of WiMAX in which the user employs a WiMAX cellphone. The technology, unlike fixed WiMAX and WiFi, is restricted to large service providers who have purchased licensed spectrum from the Federal FCC. It is a technology with great potential to comply with the plan objectives set forth herein, but in its initially released form it requires an excessively large number of base stations and is not cost effective for universal geographic coverage in the Region.

The majority of the Chapter VII is devoted to descriptions of four alternative primary, and two alternative adjunct, regional broadband communications plans. These alternative primary plans included: 1. A Community-Based Wireless Plan; 2. Regional Wireless Plan; 3. Fiber-to-the-Node Wireline Plan; and 4. Fiber-to-the Premises Wireline Plan.

The two alternative adjunct plans provided for mobile cellphone wireless communications in support of the primary plans that emphasized fixed users. The two adjunct plans included: 1. Mobile WiMAX-Based Wireless Plan, and 2. Mobile WiFi-based Wireless Plan.

All of the primary and adjunct plans were presented in terms of their technical characteristics, geographic coverage, cost and other features to provide the basis for quantitative evaluation and plan selection in Chapter VIII. The only alternative plan which meets the objective of full regional geographic coverage is the regional wireless plan. Geographic coverage of the other plans depends upon the individual decisions of either private service providers or local government officials. The regional wireless plan also provides the lowest infrastructure cost even without considering the cost sharing benefits of common base station sites with public safety communications networks. The regional wireless plan includes explicit provisions for public safety communications in the 4.9 GHz band which may be expected to become the preferred system in broadband wireless public safety communications.

All of the four primary alternative plans, two wireline and two wireless, comply with the basic throughput standard of 20 megabits per second, but the fiber-to-the-premises (FTTP) offers potentially higher performance in future years extending up into the gigabits per second range. The Fiber-to-the Node Plan alternative currently being deployed by AT&T in the Region in Project Lightspeed has more limited throughput performance growth potential based on the bandwidth limitations of the final copper link connection. New developments in wireless communications such as multiple input - multiple output (MIMO) are standardized in the IEEE standard 802.11n which deals with advanced multiple antenna WiFi. Table 4 in Chapter VII provides an abbreviated but comprehensive summary of the four alternative primary and two alternative adjunct alternative plans considered.

The adjunct plans relate to mobile wireless communications. Mobile cellular networks in the United States have developed as semi-independent entities serving mobile users primarily in voice communications. Data services were initiated in second generation (2G) networks and enhanced for faster data transmission recently in 3G networks. The primary focus of this planning effort was a higher throughput networks providing the same performance as fixed user networks. Such improved performance is important since mobile wireless networks have become the primary means of communication for a growing part of the regional population. Many users, particularly younger users, communicate exclusively by mobile and have no fixed service in their place of residence.

The first released versions of WiMAX have limited range as mobile networks and are costlier than their WiFi counterparts which can operate as auxiliary networks to the regional wireless and community-based

wireless networks. The lower costs of WiFi equipment and its ability to operate jointly with fixed wireless networks contributed to its choice for the broadband mobile wireless plan.

Chapter VIII documents the plan evaluation and selection process involved in selecting a final regional comprehensive broadband telecommunications plan. The rank-based expected value method is presented as the basis for plan evaluation and selection. The method involves a priority ranking first of the applicable objectives and standards followed by a ranking of each plan under each standard. These dual rankings are then used to determine the value of each plan. The plan value combined with the probability of plan implementation determine the expected values of the various plans. The plan with the highest expected value is then selected as the preferred plan. The primary alternative plans received rank-based expected values as follows:

1. Regional Wireless Plan
   ~~V = 42.6~~ *V = 39.0*
2. FTTN Wireline Plan
   ~~V = 38.4~~ *V= 39.2*
3. Community-Based Wireless Plan
   V = 31.2
4. FTTP Wireline Plan
   V = 12.6

The rank-based expected value method produces a virtual tie between the Regional Wireless Plan and the FTTN Wireline Plan, but the Regional Wireless Plan was selected as the preferred plan based on public-private cost sharing of the regional wireless plan and its commitment to provide universal geographic coverage in the Region.

The adjunct mobile wireless plans received expected value scores of:

1. WiMAX Mobile Wireless Plan
   V = 8.1
2. WiFi Mobile Wireless Plan
   V = 21.6

Based on the evaluation scores, the regional wireless plan and the WiFi mobile wireless plan were selected as the recommended regional comprehensive broadband telecommunications plan for Southeastern Wisconsin.

Chapter IX sets forth an approach to the implementation of the regional wireless plan and its associated WiFi mobile wireless plan together with provision for other broadband wireline and wireless networks already being deployed in the Region. Telecommunications plans involving public agencies, particularly those including public safety communications networks, require a formal adoption process. Deployment of the regional wireless plan will require regional plan endorsement and subsequent implementation at the County-level of government. Community-based wireless plans are adopted and implemented by municipal units of government.

A central feature of the selected regional wireless plan is the potential for cooperative effort by the public and private sectors in which the infrastructure costs are shared between the public safety and commercial networks. The public safety telecommunications networks are envisioned to be implemented at the county or multi-county level, providing an opportunity for cooperation between the counties and private sector providers.

Community-based wireless networks are implemented on a community-by-community basis with significant differences depending on the location and nature of the community. Low density rural communities such as towns are generally easier to serve than urbanized communities due to their pressing need for broadband communications services. Urbanized communities usually have broadband communications in the form of hybrid fiber-coax cable and telephone-network based DSL. Such communities must be persuaded of the advantages of new higher speed networks in comparison with existing broadband networks.

The only declared 4G-level private service provider initiative in Southeastern Wisconsin is AT&T's Project Lightspeed also called U-Verse. Its primary target however, is the television entertainment market rather than regional economic development as evidenced by the majority of bandwidth being devoted to broadcast television. Neither downstream (seven megabits per second) nor upstream (one megabit per second) data rates comply with the 4G objectives and standards established in Chapter III of this planning document.

Neither the regional two cable service companies nor the five mobile wireless cellular service providers have announced any fourth generation broadband communications initiatives at the time this planning report was completed.

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