

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

DATE: May 10, 2005
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
Kenneth Brown	RF Engineer, Nextel Communications, Inc.
Bob Chernow	Chairman, Regional Telecommunications Commission
Michael Falaschi	President, Wisconsin Internet
Barry Gatz	Network Supervisor, CenturyTel
Michael E. Klasen	Director, Regulatory Affairs, SBC Wisconsin
J. Michael Long	Attorney-at-Law, Murn and Martin, SC
Jeff Mantes	Commissioner of Public Works, City of Milwaukee
George E. Melcher	Director, Office of Planning and Development, Kenosha County
Paul E. Mueller	Administrator, Washington County Planning and Parks Department
Steven L. Ritt	Attorney at Law, Michael Best & Friedrich
James W. Romlein	Managing Director, MVLabs, LLC
Bennett Schliesman	Director, Kenosha County Emergency Management /Homeland Security
Dale R. Shaver	Director, Waukesha County Department of Parks and Land Use
Gustav W. Wirth, Jr.	SEWRPC Commissioner

Members Absent

William R. Drew Vice Chairman	Vice-Chairman, SEWRPC; Executive Director, Milwaukee County Research Park
Roger Caron	President, Racine Area Manufacturers and Commerce
David L. DeAngelis	Village Manager, Village of Elm Grove
Brahim Gaddour	Director of Network Operations, Time Warner Telecom of Wisconsin
Jody McCann	Network Domain Manager, Wisconsin Department of Administration, BadgerNet
Paul R. Schumacher	Program Manager, Tricounty Business Partnerships
Michael Ulicki	Vice President and Chief Technology Officer, Norlight Telecommunications
Darryl Winston	Director of Data Services, City of Milwaukee Police Department

Staff

Kenneth J. Schlager, PhD
Lynn G. Heis
Philip C. Evenson

Chief Telecommunications Engineer, SEWRPC
Staff Secretary, SEWRPC
Executive Director, 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 APRIL 12, 2005

Chairman Bauer noted that copies of the minutes of the sixth meeting of the Reconstituted Regional Telecommunications Planning Advisory Committee held on April 12, 2005, had been distributed to all members of the Committee for review prior to the meeting; and asked that the Committee consider approval of those minutes. He noted that approval of the minutes would constitute final approval of Chapter 3, "Objectives and Standards;" and Chapter IV, "Inventory Findings – Background Conditions" of SEWRPC Planning Report No. 51, "A Wireless Antenna Siting and Related Infrastructure Plan for Southeastern Wisconsin."

There being no additional questions, comments, or corrections, on a motion by Mr. Wirth, seconded by Mr. Chernow, and carried unanimously, the minutes of the meeting of April 12, 2005, were approved as published.

CONSIDERATION OF PRELIMINARY DRAFT OF SEWRPC REGIONAL TELECOMMUNICATIONS PLANNING PROGRAM, TECHNICAL STUDY DESIGN MEMORANDUM NO. 7, WIRELESS PERFORMANCE MONITORING INVENTORY.

Chairman Bauer noted that a copy of the preliminary draft of SEWRPC Regional Telecommunications Planning Program, Technical Study Design Memorandum No. 7, Wireless Performance Monitoring Inventory had been distributed to all members of the Committee for review prior to the meeting. He then asked Dr. Schlager to undertake a page by page review of the draft Memorandum with the Committee.

With respect to the list of equipment set forth on page 2, Mr. Wirth suggested, and the Committee concurred, that all references to specific vendors should be struck from the list. Mr. Mantes indicated, that while he agreed that the reference to specific vendors on page 2 should be struck from the text, any Commission reports documenting the findings of the performance monitoring inventory should contain references to the vendors of the actual equipment used in the inventory.

In answer to a question by Mr. Long, Dr. Schlager indicated that the memorandum under consideration was concerned with monitoring the quality of the service currently provided within the Region as measured by four primary parameters: availability, throughput, response time, and accuracy. Coverage, he said, will indeed be considered, but under another inventory element, which element will be described in Chapter IV of SEWRPC Planning Report No. 51, the report which is to document the wireless antenna siting and plan for the Region.

Mr. Klasen expressed concern about the proposed procedure, noting that it was not clear from the text or the appendices whether, in the sampling process, the originating and terminating provider will be the same; and -- since the Internet is also to be involved -- in effect up to three providers may be involved.

A lengthy discussion ensued concerning the need to, and means of, maintaining the “purity” of the network involved in any given samples to be collected, given the necessary involvement of the Internet in the process. At the conclusion of the discussion, Mr. Klasen suggested, and the Committee concurred, that an additional appendix would be prepared by the staff which would include call path diagrams for each type of sampling measurement, clearly identifying which elements will be held constant and which elements will be subject to change.

Secretary’s Note: See Appendices IV and V of the revised Study Design Memorandum attached to these minutes.

Mr. Klasen indicated that while the monitoring process as proposed may very well permit statements to be made concerning network performance on a regionwide basis, he did not believe any such statements could be made about the performance of individual carriers, or perhaps even about subareas of the Region. Mr. Chernow also expressed concern about publishing any data concerning the performance of individual carriers. Mr. Evenson indicated that it was not proposed to release any carrier specific data without the specific permission of the carrier concerned; and that in the performance monitoring effort the anonymity of the carriers involved would be carefully protected. Chairman Bauer indicated that the intent of the monitoring effort was to measure the existing level of wireless telecommunications service within the Region in order to be able to -- among other things -- compare that level of service with the level of service provided in other regions with which Southeastern Wisconsin is in economic competition, and not to measure the performance of the individual service providers, per se.

In answer to a question by Mr. Brown, Dr. Schlager indicated that it was proposed to monitor packet switched service and circuit switched voice service, and not to monitor Voice over Internet Protocol (VoIP) service.

Mr. Ritt expressed concern about the wording of the last sentence in the last paragraph on page 3 which called for a “specified standard” indicating that the source and authority of such a standard was unclear.

A lengthy discussion ensued upon the conclusion of which the Committee directed that the last sentence of the last paragraph on page 3 be struck; and that the 5th and 6th sentences of the first paragraph on page 4 be struck. It was further agreed that the phrase “which is the voice quality standard” be struck from the last sentence of the third paragraph on page 4; that the third sentence in the fourth paragraph on page 4 be changed to read as follows: “typical values for saved and unsaved lost data are;” and that the last sentence of the first paragraph on the 5 page be struck. It was noted by Chairman Bauer that the intent of this Committee direction was to eliminate from the memorandum any reference to the Commission proposed standards set forth in Chapter III “Objectives and Standards” of SEWRPC Planning Report No. 51.

Mr. Klasen suggested, and the Committee concurred, that any reference to generally used industry standards be clearly identified and referenced to a published document.

With respect to the technologies listed on page 6, Mr. Brown suggested, and the Committee concurred, that iDEN (2.5G) be added to the list of technologies set forth.

Mr. Chernow noted that there are locations within the Region – the Village of River Hills being one – in which no commercial wireless system could provide service. In response to Mr. Chernow’s subsequent question, Dr. Schlager indicated that clearly performance monitoring could not be carried out in areas where no service is available.

A lengthy discussion then ensued concerning the fact that, as explained earlier in the meeting, the memorandum under consideration was concerned with performance monitoring, a quite different issue than coverage; the latter Dr. Schlager again noted would be addressed in Chapter IV of the SEWRPC Planning Report No. 51.

In answer to a question by Mr. Long, Dr. Schlager indicated that it was proposed that the monitoring effort would include ten three-minute calls per day distributed throughout the day for circuit-switched networks – essentially voice traffic, and that the rest of each day would be occupied in accumulating packet-switched data.

In answer to a question by Mr. Klasen, Dr. Schlager indicated that the Commission had entered into service contracts with six wireless carriers providing for both voice and data services. In answer to a further question by Mr. Klasen, Dr. Schlager indicated that the service contracts were deliberately typical service contracts used by the carriers concerned with no reference to any specifications for special services.

In answer to a question by Mr. Brown, Dr. Schlager indicated that the MOS score as used was indeed based on human perceptions of the quality of service, and there had been numerous international tests and studies made with respect to the calculations of the MOS scores and how well the computed score compared with human perceptions of the quality of service. Mr. Klasen indicated that the previously requested additional appendix should reference to ITU.P.800 specification, and identify formula proposed to be used to calculate the MOS values to indicate how those values are proposed to be used in the monitoring effort.

Messrs. Klasen and Ritt expressed concern over the way in which the performance monitoring results will be related to the objectives and standards set forth in Chapter III of the report and suggested that the promulgation of standards was not the responsibility of the Commission. Mr. Chernow disagreed, indicating that it was indeed the Commission's responsibility to promulgate standards for the level of telecommunications service which the Commission and its constituent counties and municipalities believe to be needed within the Region. Chairman Bauer agreed with Mr. Chernow, indicating that it was indeed the Commission's responsibility to set forth advisory objectives and standards defining the desired level of infrastructure facilities and the level of performance provided by those infrastructure facilities within the Region. He noted that the Commission has done this for the last approximately forty years in other important areas such as transportation, sewerage, and drainage and flood control, among others. Mr. Ritt observed that the areas in which the Commission has to date promulgated objectives and standards are all public sector areas and that the Commission's work did not set objectives and standards for private sector service providers. Mr. Evenson disagreed, indicating that clearly the Commission's land use development objectives and standards related to the private sector.

In answer to a question by Mr. Chernow, Dr. Schlager observed that as of this date, there is no true 4G service provided anywhere in the world – even Korea; and that this was true because the specifications for such service included legacy system interoperability as well as throughput rate.

Mr. Chernow expressed concern that since the proposed monitoring effort will collect a huge amount of data, the results may be meaningless unless segmented in a meaningful manner. Dr. Schlager agreed and indicated that the data will indeed be analyzed for and reported in a segmented fashion in order to support the validity of the test results.

Mr. Ritt expressed concern about a statement made in the last sentence of the second full paragraph on page 7 concerning the ability of the proposed performance monitoring effort to state conclusions with a 95 percent confidence. He noted that this statement really only applies with respect to the data developed

in the manner proposed in the memorandum and that the industry gathers its information on performance levels in a complete different manner than proposed in the memorandum and, therefore, has a different set of results. He stressed that, in his opinion, that the results of the proposed performance monitoring were limited by the manner in which the data are proposed to be collected.

A lengthy discussion ensued. In the discussion, Mr. Ritt noted that his concern was based in part upon the fact that the proposed Commission monitoring effort would collect the sample data at static stations, while industry collects its data based on samples collected in a mobile mode. Messrs. Brown and Klasen concurred that the use of static sampling locations may be expected to provide some of the higher performance levels than samples collected in nomadic or mobile mode. He noted, moreover, that the proposed Commission monitoring effort is intended to be continuous over an identified future time and that it was the intent to over time, to add both nomadic and mobile sampling modes. He noted that the initial use of a static mode was dictated by the time constraint inherent in completing the regional wireless siting and facilities plan in a timely manner in accordance with the program schedules.

In answer to a question by Messrs. Brown and Ritt, Dr. Schlager indicated it was indeed proposed to review the results of the initial monitoring effort with the individual service providers concerned prior to presentation of the data to the Committee.

Upon the conclusion of the discussion, the Committee directed that the staff draft appropriate text describing the limitations inherent in the proposed performance monitoring procedure; specifically noting such issues as the use of static as opposed to nomadic or mobile sampling station locations; the effects of an ephemeral conditions such as weather and time of year; and the need to consider network maintenance requirements in any consideration of availability.

In addressing the issue of limitations, Mr. Klasen cautioned that although the volume of sample data to be collected appears to be massive, it may, nevertheless, be impossible to make valid statements based upon the data at a level below the Regional level; and will almost surely not permit conclusions to be drawn with respect to individual carriers. Dr. Schlager agreed, but indicated that he believed it would be possible to draw conclusions from the data concerning performance levels within subareas of the Region, particularly at the county level; and that in any case, it was not the intent of the monitoring system to draw conclusions with respect to the performance of individual carriers.

Secretary's Note: See text beginning on page 13 of the revised Study Design Memorandum attached hereto under the heading "Potential Limitations of the Proposed Performance Monitoring Procedure".

In answer to a question by Mr. Klasen, Dr. Schlager indicated that as the text indicated, the seventy-eight proposed agent sites would be located at local government offices randomly selected from the 147 such office sites available. Mr. Brown cautioned that the location of the agent sites should not be entirely randomized, but would have to involve judgments as to whether or not certain sites were provided with inherent services, such as police stations, or whether other sites might be located in buildings constructed in a manner that would interfere significantly with wireless transmission. The Committee directed that this caveat be added to the text on the limitations.

Secretary's Note: This issue is addressed under the previous Secretary's note.

Messrs. Brown and Long expressed concern over the potential effects of "roaming" – that is, transmission of a call between different carriers on the proposed monitoring results. Dr. Schlager indicated that such roaming was relatively limited within the Region, but that to the extent that it exists it will be avoided in the selection of test sites.

Mr. Ritt asked the staff to comment on how the information resulting from the proposed performance monitoring program was intended to be used in the planning effort. Chairman Bauer indicated that the planning effort was intended to produce a recommended wireless antenna siting and relating infrastructure plan for the Southeastern Wisconsin Region by the end of this year. The plan, he said, was intended to identify the level of service required to maintain an economic viability of this Region with respect to other regions of the world. The data provided by the proposed performance monitoring program was intended to permit a comparison with the current level of service and the desired level as expressed by the supporting objectives and standards. If that existing level of service is found to be below the desired levels, hopefully the private sector will consider providing the needed improvement in the facilities as those needed improvements are identified in the plan.

In response to a further question by Mr. Ritt, the Chairman indicated that based upon the adopted plan, the Commission may indeed be expected to use what Mr. Ritt termed its “bully pulpit” to make recommendations, not only for needed actions by the private sector, but also with respect to needed actions by the counties and local units of government who may be blocking the provision of the needed facilities and services. Mr. Klasen indicated, and the Committee concurred, that the consensus of the discussion just completed be captured in text to be added to the Introductory section of the memorandum.

Secretary’s Note: See text on page 1 of the revised Study Design Memorandum attached hereto.

Mr. Ritt suggested, and the Committee concurred, that the word “written” be inserted before the word “permission” in the last line of the text on page 14.

Mr. Romlein suggested that consideration be given to conducting a baseline test under known conditions, the results of which could be used as a reference for comparison with subsequent program results. Dr. Schlager indicated that it was indeed intended to do this as a routine part of the monitoring effort.

There being no further questions or comments, on a motion by Mr. Klasen, seconded by Mr. Brown, and carried unanimously, approval of Technical Study Design Memorandum No. 7, “Wireless Performance Monitoring Inventory,” was tabled for further consideration of a revised memorandum at the next meeting of the Committee.

CORRESPONDENCE

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

SPECIAL ITEM OF INFORMATION

Mr. Chernow circulated a copy of an article entitled “On the Road to a Broadband Nation” which appeared in the May 2005 issue of “Business 2.0”. He noted that the article described the efforts of nineteen major urban areas of the United States to provide improved telecommunications services through public sector actions.

Secretary’s Note: Any Committee member desiring a copy of the afore referenced article should contact the Committee secretary by telephone at 262-547-6721 to request a copy.

DATE AND TIME OF NEXT MEETING

Chairman Bauer then asked the Committee to consider the date and time for the next Committee meeting. He noted that Mr. Brown had advised that changes in his work responsibilities now made it difficult for him to attend a meeting beginning at 2:00PM on Tuesdays and that he had requested the Committee to consider changing either the time of day or day of week for future Committee meetings.

After a brief discussion it was agreed that the next meeting of the Committee would be held on Wednesday June 29, 2005, at the Commission offices, beginning at 2:00PM.

ADJOURNMENT

There being no further business to come before the Committee, on a motion by Mr. Chernow, seconded by Mr. Wirth, and carried unanimously, the meeting was adjourned at 4:30P.M.

Respectfully Submitted,

Lynn G. Heis
Staff Secretary

KWB/lgh
5/20/05
#107805 V1 - T/C Minutes - 7th Meeting

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

REGIONAL TELECOMMUNICATIONS PLANNING PROGRAM

**TECHNICAL STUDY DESIGN MEMORANDUM No. 7
WIRELESS PERFORMANCE MONITORING INVENTORY**

April 12, 2005

INTRODUCTION

The Regional Telecommunications Planning Program as set forth in the Commission approved Prospectus¹ for that program includes the conduct of a quality of service inventory. That inventory is envisioned to be conducted through end user performance monitoring utilizing computer and telecommunications hardware and software adopted for this purpose. This memorandum describes the proposed network monitoring system, defines the proposed monitoring parameters, and presents the necessary experimental design that provides the basis for the system. A wireless component of the system will be used to monitor the performance of the cellular/PCS wireless service within the seven county planning region. Wireline components will be used to monitor the performance of the regional wireline telecommunications system. This memorandum describes the proposed wireless system performance monitoring system.

The purpose of the proposed performance monitoring inventory is to provide information on the existing level of wireless service within the planning area. That existing level of service can then be compared to the level of service required to maintain the economic viability of this Region in competition with other regions of the world. The proposed Commission wireless antenna siting and relating infrastructure plan will then describe any needed facilities and service improvements, and identify actions required to be taken by private service providers and by the county and local municipal governments concerned to facilitate the attainment of the desired level of service.

¹ SEWRPC: "Prospectus for a Regional Telecommunications Planning Region" Southeastern Wisconsin Regional Planning Commission, December, 2003.

The NetIQ AppManager network monitoring system is proposed to be used as the software vehicle to collect this performance data for packet-switched networks. The NetIQ Vivinet Assessor will function as the evaluation software for circuit-switched networks. Although the NetIQ AppManager and Vivinet Assessor were originally developed for wireline network monitoring, they can be adapted to wireless application with the addition of transceiver interface cards, laptop computer agents and suitable supporting software as described in Appendices I and II.

WIRELESS NETWORK MONITORING SYSTEM

The equipment components of the network monitoring system include:

1. Network Management System (NMS) Server Computer (~~Dell~~)— located at SEWRPC
2. Supervisory NMS Desktop Computer (~~Hewlett Packard~~)— located at SEWRPC
3. Six Laptop Computer Agents (~~Dell~~)— located at various rotating temporary locations throughout the Region.
4. Six Transceiver Interface Access Cards
 - one for each wireless cellular/PCS service provider
 - each integrated with one of the six laptop computers
5. Six cell phones and supporting cable interconnect
 - one for each cellular/PCS service provider
 - each integrated with one of the six laptop computers

The above listed equipment will be operated using the NetIQ AppManager and the NetIQ Vivinet Assessor software. The AppManager will collect data on the packet-switched network parameters defined below while the Vivinet Assessor measures the readiness of each provider's packet-switched network for Voice over Internet Protocol (VoIP). While none of the Regional wireless providers currently offers VoIP, Vivinet measurements of VoIP readiness do provide a well conceived overall measure of network quality. The Vivinet Assessor will also determine the availability and the voice quality of circuit-switched networks.

Originally, it was intended to monitor only the packet-switched network since that is the type of network for which the monitoring software was designed. Packet-switched networks are also the wave of the future and will eventually replace circuit-switched networks. Current day cellular/PCS networks, however, serve primarily voice communications in the circuit-switched

domain. Since a major purpose of the wireless performance inventory is to present the performance of the existing wireless network system, it was decided to include circuit switched voice communications in the wireless performance inventory. This inclusion can be accomplished at little cost since the same laptop computer agent can be used to monitor both networks. Aside from the cell phone and its associated cabling, the only other addition required will be interface device driver software to interface the laptop computer to a particular cell phone.

NETWORK MONITORING PARAMETERS

The primary objective of the wireless network monitoring effort is to measure the four primary network performance parameters: availability; throughput; response time; and accuracy

Specific monitoring measurements, however, depend on the characteristics of wireless network operations and practices. For example, availability measurements such as blocked calls or dropped calls may have no meaning in a wireless packet-switched network. In a wireless circuit-switched network, there are only a limited number of channels. When all of these channels are in use, subsequent calls will be blocked. In packet-switched wireless networks, available bandwidth is typically rationed so that blocked or dropped calls do not occur. Such a practice, however, is inconsistent with the maintenance of a standard for quality of service (QoS). In any event, such spectral rationing, if it takes place, will be indicated in the throughput and response time measurements of the network monitoring system. Availability, however, is a major concern on circuit-switched voice networks. Blocked and dropped calls are key parameters in the evaluation of voice network quality. Given that service providers practices such as the above spectral rationing may influence the indications of some network measurements, the following network parameters have been specified for monitoring:

AVAILABILITY

During any monitoring session, lack of network availability will be time duration recorded as a lack of service. Lack of service time on packet-switched networks will be recorded as a “zero” on a one-zero availability chart over the monitoring period as shown in Appendix III. Chart data will then be accumulated to determine overall availability expressed as a percentage of user operating time. For circuit-switched networks, blocked and dropped calls will be recorded and time accumulated to determine the network availability percentage. ~~The specified standard for both packet and circuit switched wireless network availability is 99.9 percent.~~

THROUGHPUT

For packet-switched networks, data throughput is recorded in bits per second. In current cellular/PCS networks, data rates will be in the kilobits per second range. For a given network, there are two relevant throughput data rates – burst and sustained. Small files will transmit at burst rates while larger files will slow to reduced sustained rates. ~~The specified standard for future “big broadband” wireless networks will be 20 megabits per second. None of the current 2G, 2.5G or 3G networks meet that standard.~~ The Federal Communications Commission (FCC) defines the minimum “little-broadband” data rate as 200 kilobits per second. Current 3G wireless networks are achieving around 300 kilobits per second. Since circuit-switched monitoring will emphasize voice traffic, throughput is not a meaningful parameter.

RESPONSE TIME

Response time data for packet-switched networks are recorded by network application such as Domain Name Service (DNS) IP address lookup, POP3/SMTP (e-mail) protocol, Hyper Text Transfer Protocol (HTTP) – text or graphic and HTTPS -- the secure version, of HTTP. The response time is recorded in seconds over a monitoring time period again as shown in Appendix III. While there is no specific standard for data traffic response time, these times should be consistent with throughput rate standards.

ACCURACY

Accuracy measurements vary with the type of media. For voice communications (VoIP), voice quality is recorded in terms of the R value which in turn depends on three network characteristics: latency time, jitter and lost packets. On-line measurements of these three factors are converted into R values using a standard formula. R values are then converted into MOS values through a linear conversion. R values range from 0 to 100 while MOS values range from 1 to 5. An R value of 80 is equivalent to an MOS value of 4.0. ~~which is the voice quality standard.~~

Data and video communications are monitored in terms of saved and unsaved lost data expressed in percentage. The unsaved percentage will be converted into an uncorrected bit error rate of bits per million bits transmitted. ~~The standards~~ *Typical values* for saved and unsaved lost data are:

1. Saved
 - maximum packet loss of 10 percent data and 5 percent voice

2. Unsaved
 - uncorrected bit error rate of 15 bits per million bits transmitted (0.0015 percent)

Circuit-switched voice traffic will be evaluated based on this same MOS value as packet-switched VoIP although the impact of the VoIP compression algorithm will be removed. ~~The same standard value of 4.0 will also apply.~~

NETWORK MONITORING CATEGORIES

Wireless network monitoring data will be analyzed and summarized in a number of categories.

1. Regionwide
 - Average (mean) values for all of the regional network performance parameters along with their 95 percent confidence interval limits will be provided.
2. Regional Areas
 - Average values for these same parameters will also be summarized for urban, suburban and rural areas of the Region. The Commission land use inventories categorize U.S. Public Land Survey system quarter sections as either urban, suburban or rural based on population density, measured in terms of average lot size per dwelling unit as follows:
 - a. Urban
 - less than 1.5 acres
 - b. Suburban
 - between 1.5 to 5.0 acres
 - c. Rural
 - greater than 5.0 acres
3. Wireless Technology
 - Network performance can also be analyzed by type of technology
 - a. GSM (2G)
 - Global system for mobile communications
 - the global 2G standard

- b. GPRS (2.5G)
 - General packet radio service
 - a 2.5G addition
- c. Edge (2.5G)
 - Enhanced data for GSM evolution
- d. *iDEN* (2.5G)
- e. 3G (Third generation)

All of the above technologies support wireless data transmission. GSM is the slowest. Transmission rates increase in the order listed with 3G technology being the fastest.

4. Service Provider

Mean values for these same parameters will also be estimated for the following Regional service providers:

- a. AT&T/Cingular
- b. Nextel Communications
- c. Sprint
- d. Verizon Wireless
- e. U.S. Cellular
- f. T-Mobile

Service provider data will be reviewed with each provider prior to internal documentation. These data will not be published without the permission of the service provider concerned.

5. County

Cellular/PCS network performance data will also be summarized by each county in the Region.

6. Cellular versus PCS

Cellular Wireless networks operate in the 800-900 MHz spectral region while PCS networks operate at higher frequencies around 1900 MHz. Performance summaries will be prepared for each of these two spectral technologies.

EXPERIMENTAL DESIGN

All of the network performance parameters measurements involve estimates of a sample mean. The accuracy of these estimates depend on the variance of the sampling distribution and the number of samples collected. The standard deviation of the estimated mean is expressed as:

$$\sigma_{\bar{x}} = \sigma/n^{1/2}$$

Where:

$\sigma_{\bar{x}}$ -standard deviation of the mean

σ -standard deviation of the distribution

n-number of samples

Knowing the standard deviations of the mean, it is possible to calculate the 95 percent confidence interval which will be $\bar{x} \pm 2\sigma_{\bar{x}}$. Knowing the confidence interval will enable the wireless performance inventory to state with 95 percent confidence that the performance parameter is within the stated value interval.

Sample Volume

From the above, it is clear that two factors determine performance parameters estimation accuracy; the number of samples and the sample variance. Since there is no way to control the variance of the sample, sample volume is the only control variable. The objective of the wireless performance monitoring inventory is to generate a significant of samples to provide accurate estimates of the performance parameters for each of the categories described previously.

To generate such sample volume, the wireless network monitoring system will be deployed and operate as follows:

1. Sampling Time Period

The sampling time period at each location will be one week.

2. Sample Frequency - Circuit-switched network

Ten (10) three minute voice calls will be scheduled daily. These calls will occur during both peak and off-peak time periods during the 24 hour day.

3. Sample Frequency-Packet switched networks

Packet-switched monitoring will occur every five minutes continuously throughout the day.

With the above time periods and sample frequencies, the following category based sample volumes are expected in the initial three month data collection period:

Region/Circuit-Switched

Conditions:

Laptop Agents – 6

Sample Period – 1 week

Inventory Period – 13 weeks

Samples/Day – 60

Samples/Week – 420

Samples/Inventory – 5,460

Region/Packet-Switched

Conditions:

Same as above except:

Samples/Day – 1,728

Samples/Week – 12,096

Inventory Period – 13 Weeks

Samples/Inventory – 157,248

Urban/Packet-Switched

Conditions:

Samples/Day – 1,728

Samples/Week – 12,096

Inventory Period – 5 Weeks

Samples/Inventory – 60,480

Urban/Circuit-Switched

Conditions:

Samples/Week – 420
Inventory Period – 5 Weeks
Samples/Inventory – 2,100

Suburban/Packet-Switched

Conditions:

Samples/Week – 12,096
Inventory Period – 5 Weeks
Samples/Inventory – 60,480

Suburban/Circuit-Switched

Conditions:

Samples/Week – 420
Inventory Period – 5 Weeks
Samples/Inventory – 2,100

Rural/Packet-Switched

Samples/Week – 12,096
Inventory Period – 3 Weeks
Samples/Inventory – 36,288

Rural/Circuit-Switched

Samples/Week – 420
Inventory Period – 3 Weeks
Samples/Inventory – 1,260

Note: The rural inventory sample volumes are smaller than the urban/suburban because only three weeks of sampling is conducted in rural areas versus five weeks in both urban and suburban areas.

Technology

Technology performance inventory summaries apply to both packet-switched and circuit-switched network, but the categories are somewhat different.

Circuit-switched

1. TDM
2. GSM - 280
3. iDEN - 70
4. UMTS (3G) - 70

Packet-Switched

1. GPRS – 104,832
2. Edge – 26,208
3. 3G – 26,208

Service Provider

Each service provider would be represented by one-sixth of the samples for the regional urban, suburban and rural categories.

County

The following sample sizes are estimated for each of the seven counties:

Kenosha – 15,725

Milwaukee – 15,725

Ozaukee – 15,725

Racine – 15,725

Walworth – 31,450

Washington – 31,450

Waukesha – 31,450

Cellular versus PCS

The three Regional cellular (800-900 MHz) providers are Nextel, Cingular and U.S. Cellular. The other four providers are PCS: Sprint, AT&T, T-Mobil and Verizon Wireless. At the Regional level, the sample size totals will be:

Cellular – 67,392

PCS – 89,856

SAMPLE LOCATION SELECTIONS

Monitoring data will be collected over 78 agent-period locations (6 agents over 13 weeks). To insure adequate geographic coverage of the seven county planning area, the area will be divided into ten data collection zones – one each for Kenosha, Milwaukee, Ozaukee, and Racine counties, and two each for Walworth, Washington, and Waukesha counties. The latter counties will be assigned two zones because they are approximately twice the area of the smaller counties. Each zone will then be assigned 8 agent-period locations with assignment order randomized. The last two zones in the assignment order will receive only seven agent-periods. Within each zone, agent-period entities will be randomly assigned to a prepared list of available sites within the zone. It is anticipated that the agent sites will be located at local government offices randomly selected from the 147 sites available.

The number of samples collected for each of the above categories will be limited by the agent-period entities available in a 13 week period. After the initial three-month inventory period, represented categories will be improved by subsequent weighted, randomized selections that will serve to achieve proper balance in all of the categories based on established principles of statistical sequential analysis.

ESTIMATE ACCURACIES AND CONFIDENCE INTERNALS – SAMPLE ESTIMATES

Without actually collecting sufficient data to determine sample variances, it is not possible to estimate the accuracies of the parameter means and confidence intervals. It is possible, however, to assume a range of variances in percentage terms and then apply that range to probable parameter values to estimate mean and confidence interval deviations.

REGIONAL-LEVEL ACCURACY ESTIMATES

Availability: Packet-Switched

~~Standard~~ Assumed value - 99.9 percent
Assumed standard deviation – 5.0 percent
Sample size – 157,248
Standard error, mean= 0,01 percent

Availability: Circuit-Switched

~~Standard~~ Assumed value - 99.9 percent
Assumed standard deviation – 5.0 percent
Sample size – 5,460

Standard error, mean – 0.07 percent

Throughput – Packet-switched

~~Standard~~ Assumed value – 20 – 200 Mbps

Assumed means

2.5G – 75 Kbps

3.0G – 300 Kbps

Assumed standard deviation

2.5G – 25 Kbps

3.0G– 100 Kbps

Sample size/2.5G - 104,832

Standard error, mean/2.5G – 0.077 Kbps

Sample size/3G – 26,208

Standard error, mean/3G = 0.62 Kbps

Throughput: Circuit-Switched

Not applicable

Accuracy: Packet-Switched

~~Standard~~ Assumed value – MOS 4.0

Assumed mean – 3.0

Assumed standard deviation 1.0

Sample size – 157,248

Standard error, mean = 0.0025

Accuracy: Circuit – Switched

~~Standard~~ Assumed value – MOS = 4.0

Assumed mean – 3.0

Assumed standard deviation – 1.0

Sample size – 5,460

Standard error, mean = 0.0135

The foregoing analysis indicates that the proposed sample sizes will be sufficient to obtain accurate parameter estimates, even in the smaller category sizes. In this respect it should be noted that accuracy estimates were not calculated for packet-switched networks response times because of the wide variation of these values for each application. These estimates will be calculated when sufficient monitoring data are available. Response time is not a meaningful parameter for circuit-switched networks.

POTENTIAL LIMITATIONS OF THE PROPOSED PERFORMANCE MONITORING PROCEDURE

It is important to understand that the proposed wireless performance monitoring may have certain potential limitations. One of these limitation concerns the use of multiple networks involving the Internet or other wireline-wireless service providers that may show the monitoring results. With respect to circuit-switched networks, this limitation is addressed in Appendix IV where it is shown that a common second half circuit is to be used for all circuit-switched monitoring operations, and that the effect of this circuit can be statistically removed by additional network monitoring at the Internet Service Provider (ISP) site. This limitation for packet-switched networks is addressed in Appendix V.

A second potential limitation relates to the proposed fixed nature of the remote testing location. In this respect it should be noted that most service providers field test their networks using moving vehicles. Fixed versus mobile wireless network testing is herein proposed for the first three-month data collection period in order to simplify initial monitoring operations to meet plan completion schedules. The monitoring is proposed to be continuous and nomadic (walking user) and mobile test sequences will be added in later quarterly periods. Fixed testing was also selected to serve as a performance base for later nomadic and mobile monitoring measurements. All wireless communications systems are first developed and tested in the fixed mode where higher performance is typically experienced. Development and testing then moves on to nomadic and mobile versions of the technology. Regional wireless service providers will usually record their highest performance in fixed location use. Later nomadic and mobile testing will then allow for the determination of the effects of mobility on system performance.

A third potential limitation relates to avoiding special test site location situations that would enhance or degrade service. To overcome this limitation it will be necessary to avoid test site locations where a particular carrier would have network performance enhancements in place for

a designated facility, or where the buildings concerned may inordinately interfere with wireless transmissions. Locations where service is provided through roaming arrangements with other carriers should also be avoided.

Monitoring operations during periods of maintenance down time should not, as such, comprise a limitation. Such downtime is part of the provider's network service availability and should, therefore, be treated impartially as part of the availability parameters for all carriers.

Finally, great care will be taken in the use and publication of performance parameter values with small sample sizes. The initial three-month inventory may only permit reliable parameter estimates at the regional level, with other categories having sample sizes too small for accurate parameter estimates. Needed caution will be exercised and parameter values will be stated with both their mean value accuracy estimate, and their 95 percent confidence interval, both of which are dependent on sample size.

Advisory Committee Review Process

All wireless network monitoring system data will be reviewed with the Advisory Committee prior to publication. All monitoring data specific to a particular service provider will be reviewed with that provider and publicly released only with the *written* permission of each wireless service provider

Documentation

The wireless performance inventory resulting from the three initial months of data collection will be documented in both the antenna siting and related infrastructure planning report and later in an inventory technical report. Both reports will include tabular summaries of network parameters for the various categories discussed in this report. Tabular summaries will also be shown using regional and county-level maps displaying wireless network performance by geographic area. A detailed description of the wireless network monitoring system will also be included in these reports.

Following the initial wireless performance inventory, performance monitoring will continue on a year-around basis with technical reports issued quarterly summarizing network performance during the quarter and comparisons made with previous time periods.

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#106128 V3 - T/C-Tech Study Design Memo No. 7-Performance Monitoring Inventory

Appendix IV

**WIRELESS NETWORK MONITORING SYSTEM
(WNMS)**

CIRCUIT-SWITCHED VERSION

APPENDIX IV

WIRELESS NETWORK MONITORING SYSTEM (WNMS) CIRCUIT-SWITCHED VERSION

This Appendix will explain the voice-data traffic flow in the circuit-switched version of the system proposed to be used to measure the availability and voice quality of wireless cellular-PCS networks in the planning area as shown in Figure 1. Voice messages are originated at the transmitting end point using a laptop computer, cellular PCS telephones and associated software as described in Appendix I. The voice message is transmitted to the base transceiver station (antenna site) of the particular wireless service provider. The voice message then moves through the transmission network of the provider to the mobile switching center (MSC) of the provider where it interconnects with a Plain Old Telephone Service (POTS) provider which relays it to the Internet Service Provider A (ISPA).

The ISP A then sends the voice message over the Internet and back through a second ISP (ISP B) to the receiving endpoint at SEWRPC. The management server at SEWRPC receives the values of the performance parameters after each message transaction.

The first part of the voice message circuit to ISP A is unique to each service provider's network. The second part of the circuit from ISP A to the receiving endpoint is common to all message transactions. Both halves of the circuit will impact the parameter measurements. In order to account for the effects of the second half circuit on wireless service provider performance, an additional network agent will be installed at ISP A in order to determine the average availability and voice quality factors from ISP A to the receiving endpoint over time. Because the second half of the network is entirely wireline, these factors will probably be much better than the first half circuit which is partially wireless. Nonetheless, these second half circuit factors will be used to adjust the total performance parameters values to remove the effect of second half circuit performance. Means and variances of both circuits will be combined in a mathematically appropriate manner.

The mean opinion score (MOS) for voice quality will be calculated from monitoring measurements using the E-model method defined in International Telecommunications Standard ITU G.107.

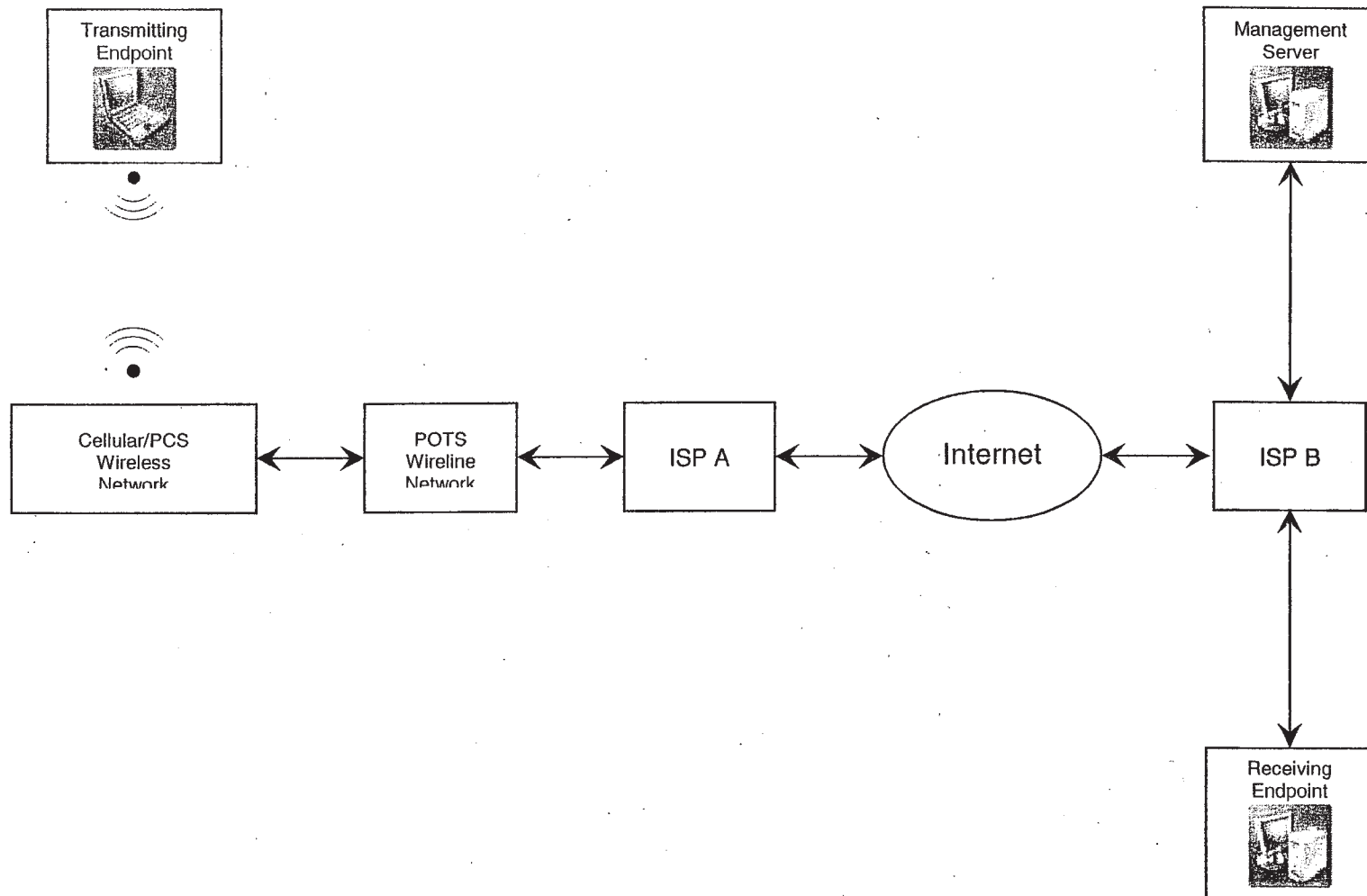


Figure 1: Circuit Switched Monitoring System

Appendix V

**WIRELESS NETWORK MONITORING SYSTEM
(WNMS)**

PACKET-SWITCHED VERSION

APPENDIX V

WIRELESS NETWORK MONITORING SYSTEM (WNMS) PACKET-SWITCHED VERSION

A diagram of the packet-switched version of WNMS is shown in Figure 1. In this application, packet-switched data from the transmitting end-point employs a laptop computer and the transceiver card of each provider to transmit wirelessly as in the circuit-switched application. Data moves through the provider's wireless network and on to the Internet through the provider's Internet Service Provider (ISP). From the Internet, the data message is passed on to the receiving endpoint at SEWRPC as before. Once again, the management server collects performance data on a continuous basis. There is no need to correct for second half circuit effects since they are part of a typical Internet-based packet-switched application.

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05/19/05

#108133 V1 - Appendix V Wireless Network Monitoring System Packet-Switched Version

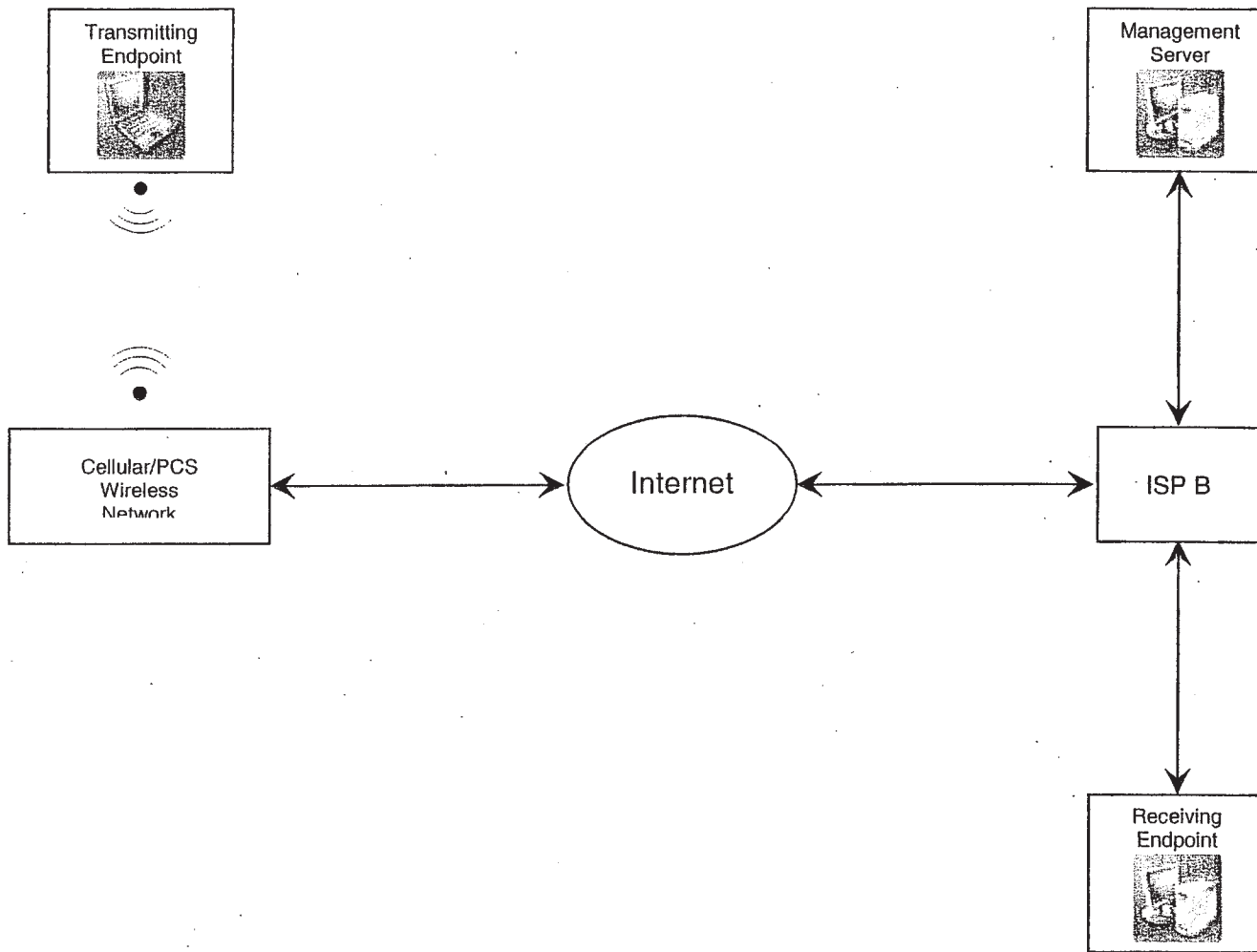


Figure 1: Packet Switched Monitoring System