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ORIGINAL

October 9, 1998

Mrs. Blanca S. Bayó
Director, Division of Records and Reporting
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, FL 32399-0850

Re: Docket No. 980696-TP

Dear Ms. Bayó:

Enclosed are an original and fifteen copies of Brian K. Stahr's Supplemental Rebuttal Testimony, which is being filed jointly by BellSouth Telecommunications and Sprint-Florida, Incorporated. Please file this in the captioned matter. The original exhibits attached to the testimony are in color; the copies of these exhibits, however, are in black and white. Color copies are being reproduced, and they will be provided to the Commission, Staff and all parties on Monday, October 12, 1998.

ACK _____ A copy of this letter is enclosed. Please mark it to indicate that the
APR 1 original was filed and return the copy to me. Copies have been served to the
A. P. _____ parties shown on the attached Certificate of Service.

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King
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L. E. 2
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Enclosures

Sincerely,
J. Phillip Carver
(PA)

J. Phillip Carver

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FILED AT TALLAHASSEE

Supplemental Rebuttal Testimony of
Brian K. Staihr
Docket No. 980696-TP
October 9, 1998

ORIGINAL

1 SUPPLEMENTAL REBUTTAL TESTIMONY
2 OF DR. BRIAN K. STAIHR
3 ON BEHALF OF SPRINT-FLORIDA, INCORPORATED AND
4 BELLSOUTH TELECOMMUNICATIONS, INC.
5 BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION
6 DOCKET NO. 980696-TP
7 OCTOBER 9, 1998

8
9 I. INTRODUCTION

10
11 Q. PLEASE STATE YOUR NAME AND BUSINESS AFFILIATION.

12 A. My name is Brian K. Staihr. I am the Regulatory Economist at Sprint United
13 Management Company.

14
15 Q. ARE YOU THE SAME BRIAN K. STAIHR WHO FILED DIRECT AND
16 REBUTTAL TESTIMONY IN THIS PROCEEDING?

17 A. Yes.

18
19 Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

20 A. The purpose of my testimony is to provide the Florida Public Service Commission
21 (Commission) insight into the flaws in the PNR customer location methodology
22 upon which HAT's modeling of distribution plant is based. My supplemental
23 rebuttal testimony, is filed on behalf of both Sprint-Florida, Incorporated and
24 BellSouth Telecommunications Inc. This testimony is based on an expedited
25 review and analysis of the data at the PNR premises. Although the limitations on

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1 the time frame to review the data precluded an extensive analysis, our findings are
2 indicative of pervasive problems in the methodology employed to construct the
3 PNR polygon clusters and to form the HAI rectangles that correspond to each of
4 the PNR polygon clusters.

5
6 Q. PLEASE SUMMARIZE YOUR PRIMARY FINDINGS AND CONCLUSIONS?

7 A. The evidence provided here validates the criticisms of the HAI model described in
8 my rebuttal testimony and contradicts claims made by the HAI proponents in their
9 rebuttal testimony. The findings described and illustrated in the attached exhibits
10 can be summarized as follows:

- 11 1. Examination of PNR polygon clusters and their corresponding HAI rectangles
12 confirms the disparity between the shape and/or orientation of the underlying
13 PNR polygon clusters and the so-called "equivalent" HAI rectangles.
- 14 2. The PNR clustering algorithm ignores both geographic barriers such as large
15 bodies of water in constructing clusters of customers and modeling the
16 corresponding distribution plant to serve those customers.
- 17 3. Some of the PNR clusters overlap, suggesting the potential to overbuild
18 distribution plant in some areas, despite understating the dispersion of customers
19 in other areas, and underbuilding in other areas. In such clusters, it is unclear
20 which cluster customers have been assigned to in the overlapping area.
- 21 4. Some of the clusters extend beyond the borders of the wire center.
- 22 5. A comparison of the HAI distribution cable and drop lengths to the distribution
23 cable and drop distance required to serve the customers in the locations identified
24 by PNR, taking into account road constraints, indicates that the HAI model
25 grossly underbuilds distribution plant. The extent to which HAI distribution and

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1 drop cable distance falls short in this analysis is much greater than that reflected
2 by the Minimum Spanning Tree (MST) analysis which simply connects customers
3 as the crow flies.

4 6. The limitations of address geocoding are illustrated by depicting the
5 substantial disparity between the address geocoded locations identified by PNR
6 and the actual customer locations obtained via satellite imagery for the
7 Yanketown wire center.

8
9 **II. ANALYSIS OF PNR CUSTOMER LOCATION DATA**

10
11 A. Lack of Correspondence Between the PNR polygon clusters and the HAI
12 rectangles

13 Q. MR. DON J. WOOD AND MR. BRIAN F. PITKIN CLAIM IN THEIR
14 REBUTTAL TESTIMONY THAT THE HAI RECTANGLES "PRESERVE
15 THE BASIC AREA, SHAPE AND LOCATION OF THE PHYSICAL
16 CLUSTER OF CUSTOMERS..." (P. 57.) DO YOU AGREE WITH THIS
17 CHARACTERIZATION OF THE RELATIONSHIP BETWEEN THE PNR
18 POLYGON CLUSTERS AND THE HAI RECTANGLES?

19 A. No, I definitely do not agree with this characterization. Based on our preliminary
20 examination of the PNR polygon clusters and the corresponding HAI rectangles
21 during our visit to PNR, this characterization by Mr. Wood and Mr. Pitkin is quite
22 misleading.

23
24 Q. PLEASE ELABORATE ON WHY THEIR CHARACTERIZATION IS
25 MISLEADING.

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1 A. Certainly. The customer location methodology involves the use of an algorithm
2 to cluster customers. According to the HAI model documentation, this process is
3 subject to three constraints. Once customers are clustered into main and outlier
4 clusters, PNR constructs a convex hull around the set of address geocoded and
5 surrogate points associated with that cluster. It is this convex hull that I refer to
6 herein as the PNR polygon cluster. The PNR polygon cluster is transformed into
7 a rectangle that may have little resemblance to the underlying PNR polygon
8 cluster. According to the HAI model documentation, the HAI rectangle has the
9 same geographic center and area as the PNR polygon cluster. Beyond this,
10 however, the cluster and rectangle do not necessarily resemble one another, in
11 shape and orientation (i.e. North, South, East, West). This phenomenon is
12 illustrated in the attached figures. Exhibit BKS-1 depicts a cluster where none of
13 the actual customer points is contained within the so-called "equivalent" HAI
14 rectangle, and only two lie on the border of the rectangle.

15
16 Since the HAI rectangle is used as the basis for modeling distribution plant,
17 distortions between the shape and orientation of the PNR polygon cluster and the
18 HAI rectangle can result in understating the dispersion of customers in the
19 locations identified by HAI via the PNR polygon clusters. This can in turn result
20 in a substantial underestimate by the HAI model of the distribution plant required
21 to serve the customers as located by PNR. These distortions in the PNR polygon
22 cluster's shape and orientation, relative to the HAI rectangle, are illustrated in
23 Exhibits BKS-2 and BKS-3.

24
25 B. Formation of PNR Polygon Clusters Ignores Geography

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1 Q. MR. JAMES W. WELLS, JR. CONTENDS IN HIS REBUTTAL TESTIMONY
2 THAT "HM 5.0a CLUSTERS CUSTOMERS BASED ON THEIR PROXIMITY
3 TO EACH OTHER AND TRANSMISSION DESIGN RULES, WHICH IS
4 WHAT AN OSP ENGINEER WOULD REALISTICALLY DO IN DESIGNING
5 A LEAST-COST LOCAL LOOP NETWORK." (P. 5) DO YOU AGREE WITH
6 HIS CONTENTION?

7 A. No, I definitely do not agree based on my observations of clusters obtained during
8 the PNR site visit. First, PNR forms polygon clusters that ignore water areas that
9 would never be bridged by a "real" distribution area. This is illustrated in the
10 clusters provided in Exhibits BKS-4, BKS-5, and BKS-6. Exhibits BKS-7 and
11 BKS-8 depict a wire center in the Florida Keys, where the PNR clustering
12 algorithm is oblivious to the fact that it is making one cluster out of parts of two
13 islands, then using another part of that island in a cluster that spans to another
14 island. Clearly this is inconsistent with Mr. Wells' claim that HM 5.0a clusters
15 customers in a manner consistent with a realistic, engineering design of a least
16 cost network.

17
18 Although the Benchmark Cost Proxy Model Release 3.1 (BCPM 3.1) uses a
19 statistical measure that overlays ultimate grids within wire center boundaries that
20 may contain geographic barriers to clustering customers, it is imperative that these
21 issues regarding the formation of HAI clusters are raised here, to dispel the
22 perception created by HAI proponents that HAI's clustering algorithm forms
23 natural clusters of customers consistent with "real" distribution design areas. The
24 evidence provided here refutes their claim that their clustering process is not
25 arbitrary and is superior to BCPM 3.1's clustering process.

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1

2 C. Overlapping Clusters and Clusters Extending Outside the Wire Center's
3 Boundaries

4 Q. ARE THEIR OTHER TROUBLING ASPECTS OF PNR'S CLUSTERING
5 PROCESS?

6 A. Yes, there certainly are. First, many of the PNR polygon clusters that we
7 observed during our on site visit at PNR overlap one another. This is depicted in
8 Exhibits BKS-10, BKS-11, BKS-12, BKS-13, and BKS-14. Given that HAI
9 constructs rectangles upon which distribution plant is modeled that have an area
10 equal to the area of the underlying PNR polygon cluster, there are clearly areas
11 where it appears that distribution plant is overbuilt. Since distribution plant is not
12 fungible, overbuilding in some areas does not compensate in any way for
13 inadequate distribution plant in other areas. Appropriate targeting of universal
14 service funding necessitates properly identifying high cost areas in need of
15 support, designing a network that can serve each high cost area without
16 overbuilding or underbuilding.

17

18 Moreover, since clusters overlap, it is not possible to determine the cluster to
19 which customers identified in the overlapping portion belong.

20

21 Second, PNR's clustering algorithm results in clusters that extend outside of the
22 wire center boundaries that contain the underlying address geocoded and
23 surrogate points. This is illustrated in Exhibit BKS-15. Note that in Exhibit
24 BKS-15, much of the PNR polygon cluster is outside the wire center's
25 boundaries. This phenomenon occurs because the PNR clustering algorithm

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1 forms a convex hull about the original cluster points.

2

3 D. HAI Distribution Cable Distance Falls Vastly Short of the Requisite Distribution
4 Cable Distance Based on Real Road Constraints

5 Q. MR. WOOD AND MR. PITKIN ASSERT IN THEIR REBUTTAL
6 TESTIMONY THAT "ANY MST DISTANCE CALCULATED BY THE
7 BCPM SPONSORS, BASED ON THESE OVERLY-DISPersed
8 SURROGATE LOCATIONS, WILL LIKELY OVERSTATE THE MINIMUM
9 AMOUNT OF CABLE THAT WOULD BE REQUIRED TO SERVE THESE
10 CUSTOMERS WHERE THEY ACTUALLY ARE LOCATED." (P. 72) DO
11 YOU AGREE WITH THEIR ASSERTION?

12 A. No, I do not agree. Mr. Wood's and Mr. Pitkin's contention that the MST
13 presented in my rebuttal testimony is conservative, i.e. is likely to overstate the
14 minimum cable required to serve those customers is refuted by evidence gathered
15 during our on site visit at PNR. Recall that the MST analysis in my rebuttal
16 testimony was based on the minimum distance to connect customers as the crow
17 flies, in locations identified by PNR. As such, that MST distance clearly
18 understates distribution cable distance, which must take into account roads, bodies
19 of water, etc. I present here two analyses of required distribution cable length,
20 based on the road network underlying two HAI clusters whose distribution-plus-
21 drop cable length was already shown to be short of the MST distance for the
22 customer points of the cluster (in one case distribution-plus-drop was only 59% of
23 MST length, in the other case only 65%).

24

25 When we look at the underlying roads, we realize that the required distribution

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1 cable -- taking the minimum route possible along these roads-- is clearly
2 LONGER than the MST distance, and that the HAI Model is EVEN SHORTER
3 in its building of distribution cable than was indicated by a comparison to MST
4 length. MST UNDERSTATES the amount of cable required. Where HAI
5 underbuilds relative to the MST, its shortage in a realistic measurement is even
6 greater than when compared to the MST distance. Exhibit BKS-16 illustrates that
7 in the first case examined, the HAI distribution cable and drop distance for this
8 cluster is only 34% of the requisite distribution cable taking into account the road
9 network. Exhibit BKS-17 illustrates that in the second case examined, the HAI
10 distribution cable and drop distance for this cluster is only 51% of the requisite
11 distribution cable and drop distance taking into account the road network.
12

13 E. Comparison of PNR address Geocoded Locations With Actual Locations Based
14 on Satellite Imagery

15 Q. DID YOUR ANALYSIS OF PNR ADDRESS GEOCODED DATA FOR THE
16 YANKEETOWN WIRE CENTER PROVIDE ADDITIONAL INSIGHT INTO
17 THE SHORTCOMINGS OF ADDRESS GEOCODING?

18 A. Yes, it certainly did. A comparison of the points that PNR address geocoded for
19 the Yankeetown wire center with actual locations based on satellite imagery
20 reveals a gross discrepancy between the address geocoded locations and the actual
21 locations. This is depicted in Exhibits BKS-18 and BKS-19. These observations
22 are a reminder of the limitations of address geocoding and a validation that
23 address geocoding is an estimation process as well.
24

25 III. LIMITATIONS OF THE PROCESS FOR ANALYZING THE PNR DATA

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Brian K. Stahr
Docket No. 980696-TP
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1 AT THE PNR SITE

2
3 Q. COULD YOU PLEASE EXPLAIN WHY THE VARIOUS TOOLS OF
4 ANALYSIS PREVIOUSLY DESCRIBED, WERE NOT APPLIED MORE
5 BROADLY, I.E. INCLUDED A MORE EXTENSIVE ANALYSIS OF
6 CLUSTERS AND WIRE CENTERS IN FLORIDA?

7 A. Certainly. In order to use a wide range of tools of analysis, it was imperative that
8 we limit the application of the tools to a small subset of clusters and wire centers.
9 We only had one and a half days to conduct our on site investigation. The
10 computers were not available to us until Wednesday afternoon, October 7, 1998,
11 despite the fact that the Commission's Order required that their facilities be made
12 available as of October 6, 1998.

13
14 Moreover, limitations on the computers provided impeded the speed and progress
15 of our analysis. We provided our required computer needs to AT&T on October
16 6, 1998. Included in that list was two computers with at least 5 Gigabytes on each
17 computer's hard drive. The computers provided to us by PNR had only 3.1
18 Gigabytes on their hard drives. Consequently, we had to work around this by
19 reading the Florida customer location database from PNR's network. This
20 customer database is quite large, 1.6 Gigabytes (7 million records of data). It
21 required substantial time, i.e. approximately 4 hours, simply to read that data from
22 the network to our desktop machines. This slowed processing time down
23 significantly. Furthermore, one of the computers provided had problems with the
24 hard drive, restricting that hard drive to half of what was presumably available.
25 This precluded our working on that machine. Another machine was provided

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1 during the evening of Wednesday, October 7, 1998. In addition, PNR's network
2 went down while we were half way through the process of reading the FL
3 customer database. That process had to be initiated once again. These
4 challenges, in addition to the restrictive time constraints, limited our ability to
5 analyze more comprehensively the data.
6

7 Q. DID THESE LIMITATIONS ON YOUR ABILITY TO ANALYZE THE DATA
8 MORE FULLY, IMPACT THE INTEGRITY OF THE RESULTS PROVIDED
9 HERE?

10 A. No, they did not. The results provided in my testimony here are indicative of
11 problems inherent in the PNR customer location data, the PNR clustering process,
12 and the corresponding HAI rectangles. These findings validate the criticisms that
13 I raised in my rebuttal testimony. Moreover, they confirm the superiority of
14 BCPM 3.1's superior customer location methodology.
15

16 Q. DOES THAT CONCLUDE YOUR TESTIMONY?

17 A. Yes, it does.

**CERTIFICATE OF SERVICE
DOCKET NO. 980696-TP (HB4785)**

I HEREBY CERTIFY that a true and correct copy of the foregoing was served via Federal Express and *Hand Delivery this 9th day of October, 1998 to the following:

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October 12, 1998

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2540 Shumard Oak Boulevard
Tallahassee, FL 32399-0850

Re: Docket No. 980696-TP

Dear Ms. Bayo:

Enclosed are an original and fifteen copies of Brian K. Staihr's Supplemental Rebuttal Testimony, which is being filed jointly by BellSouth Telecommunications and Sprint-Florida, Incorporated. Copies of Mr. Staihr's Supplemental Rebuttal Testimony were served to the Parties, including staff, on Friday, October 9, 1998 by Fax or Federal Express. Please accept and file Mr. Staihr's Supplemental Rebuttal Testimony in the captioned matter.

A copy of this letter is enclosed. Please mark it to indicate that the original was filed and return the copy to me.

Sincerely,

J. Phillip Carver
J. Phillip Carver

*Filed 10/9/98. Being placed w/ DN 11179-98
per BellSouth/Siranni.
10/12/98*

Enclosures

See

cc: All parties of record
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(+) Protective Agreements