

**Summary of Current Support For Proposed Performance Measurements**

Measurement	AT&T	NPRM	DOJ	LCUG V6.1	SWBT	PB	BST	BA- NYNX	Amer	USW
OS/DA Grade of Service					√	√	√			√
<b>Interconnection Measurements</b>										
Network Performance	√			√						
Percent Blocking on Interconnection (Final) Trunks	√	(¶96)	√		√	√	√	√	√	
Percent Blocking on Common Trunks	√	(¶100)	√		√	√	√	√	√	
Call Attempts Blocked							√		√	
% Common Transport Blocking >2%					√	√				
Trunk Restoral Interval					√	√	√			
Trunk Restoral Interval > "x" Hours			√				√		√	
Average Time to Respond to Collocation Requests	√	(¶103)								√
Average Time to Provide a Collocation Arrangement	√	(¶103)								
% of Due Dates Missed – Collocation Arrangements	√	(¶103)								√
<b>UNE</b>										
Availability of Network Elements	√			√						
Performance of Network Elements	√			√						

Sources:

1. NPRM: In the Matter of Performance Measurements and Reporting Requirements for Operations Support Systems, Interconnection, and Operator Services and Directory Assistance, CC Docket 98-56, RM-9101, Notice of Proposed Rule Making, Adopted April 16, 1998, Released April 17, 1998
2. Department of Justice (DOJ): Letter from Donald J Russell of the U.S. Department of Justice to: Liam S. Coonan of SBC Communications, Inc., Attachment A, dated March 6, 1998.
3. SBC: Investigation of Southwestern Bell Telephone Company's Entry into the interLATA Telecommunications Market, Case No. 16251, Texas Public Utility Commission, Affidavit of William R Dysart, filed April 17, 1998.

### **Summary of Current Support For Proposed Performance Measurements**

4. BST: Performance Measurements for Telecommunications Interconnection, Unbundling and Resale, Docket No. 7892-U, Georgia Public Service Commission, Order, Record submitted December 2, 1997, Date decided December 30, 1997.
5. Bell Atlantic/NYNEX (BA-NYNEX): Proceeding on Motion of the Commission to Review Service Quality Standards for Telephone Companies, Order Approving Interim Guidelines for Carrier-to-Carrier Performance Standards and Reports, Case 97-C-0139, New York Public Service Commission, issued and effective March 16, 1998.
6. Ameritech: Letter from Susan West of Ameritech to Mike Pfau of AT&T, dated April 6, 1998.
7. US West: In the Matter of the Petition of American Communications Services, Inc. and American Communications Services of Pima County, Inc. for Arbitration with US West Communications, Inc. of Interconnection Rates, Terms, and Conditions Pursuant to 47 USC § 252(b) of the Telecommunications Act of 1996, et al., Docket No. U-3021-96-448, Arizona Corporation Commission, Joint filing of the Parties in response to March 26, 1998 Arizona Procedural Order in Docket No. U-3021-96-448 et al., filed via letter on May 22, 1998.
8. Pacific Bell (PB): Rulemaking on the Commission's Own Motion to Govern Open Access to Bottleneck Services and Establish a Framework for Network Architecture Development of Dominant Carrier Networks, et al., Case No. R.93-04-003, California Public Utilities Commission, Rebuttal Affidavit of Gwen Johnson in Support of Pacific Bell's (U 1001 C) Draft Application for Authority to Provide interLATA Services in California, filed May 20, 1998.
9. LCUG: Local Competition Users Group (LCUG) – Service Quality Measurements (SQM) Version 6.1, dated September 26, 1997.

### Summary of Product Disaggregation Commitments

Proposed	SWBT	BST	BA/NYNEX	Ameritech	US West	PacBell	LCUG
Resale POTS Residence Business Centrex ISDN BRI ISDN PRI Analog PBX DID	Resale POTS Residence Business  (note 2, pg. 19)  [See Resale Specials for ISDN]	Resale POTS Residence Business	Resale POTS	Resale POTS Residence Business Centrex  [Disaggregation of Resale POTS provide only for Avg Inst Intvl , Conf. Due Dates Not Met & MTTR]	Resale POTS Residence Business Centrex ISDN BRI ISDN PRI PBX DID Digital Sw Svc	Resale POTS Residence Business  [See Resale Specials for ISDN]	Resale POTS Residence Business Centrex Res. ISDN Bus. ISDN PBX Trunks
Resale Specials: VGPL Digital DS0 DS1 DS3 >DS3	Resale Specials: VGPL Digital DS0 DS1 DS3 ISDN  (note 3, pg. 19)	Resale Specials	Resale Specials: DS0 DS1 DS3	Resale Specials Subrate Hicap	Resale Specials: DS0 Service DS1 Service DS3 Service	Resale Specials: VGPL Digital DS0 DS1 DS3 ISDN	Resale Specials T1.5 (muxed) Other
UNE Loops 8dB Analog 2 wire digital 4 wire digital ADSL HDSL  UNE Switch Port (line side) Analog	UNE Loops 8dB Analog 2 wire digital DS1  UNE Switch Port Analog Analog DID	UNE Loops With ILNP [pre-order, ordering & provisioning only]	UNE Specials DS0 DS1 DS3	UNE Loops	UNE Loops 2-wire analog 2-wire digital 4-wire digital  Unbundled Switch	UNE Loops 8dB Analog 2 wire digital DS1  UNE Switch Port Analog Analog DID	UNE Loops DS0 DS1 Other  Unbundled Switch

**Summary of Product Disaggregation Commitments**

<b>Proposed</b>	<b>SWBT</b>	<b>BST</b>	<b>BA/NYNEX</b>	<b>Ameritech</b>	<b>US West</b>	<b>PacBell</b>	<b>LCUG</b>
BRI DS1	BRI PRI					BRI PRI	
UNE Switch Port (trunk side) PRI DID Msg							
UNE Dedicated Transport: DS0 DS1 DS3	UNE Dedicated Transport:				Unbundled Transport	Unbundled Dedicated Transport	
Combinations: Loop+port+ Transport DS1 loop+mux	UNE loop & port (when combined by SWBT in TX)	UNE-Design [prov & mtce]  UNE-Non- Design [prov & mtce]  UNE [pre-order & ordering]	UNE POTS				Loop+port+ Transport DS1 loop+mux  Other UNE
Collocation Physical Virtual							

### Summary of Product Disaggregation Commitments

Proposed Common	SWBT	BST	BA/NYNEX	Ameritech	US West	PacBell	LCUG
INP	INP				INP		INP
Interconnection Trunks	Interconnection Trunks	Interconnection Trunks	Interconnection Trunks	Interconnection Trunks	Interconnection Trunks (LIS)		

Sources:

1. SBC: Investigation of Southwestern Bell Telephone Company's Entry into the InterLATA Telecommunications Market, Case No. 16251, Texas Public Utility Commission, Affidavit of William R Dysart, filed April 17, 1998.
2. BST: Performance Measurements for Telecommunications Interconnection, Unbundling and Resale, Docket No. 7892-U, Georgia Public Service Commission, Order, Record submitted December 2, 1997, Date decided December 30, 1997.
3. Bell Atlantic/NYNEX (BA-NYNEX): Proceeding on Motion of the Commission to Review Service Quality Standards for Telephone Companies, Order Approving Interim Guidelines for Carrier-to-Carrier Performance Standards and Reports, Case 97-C-0139, New York Public Service Commission, issued and effective March 16, 1998.
4. Ameritech: Application of Ameritech Michigan Pursuant to Section 271 of the Communications Act of 1934, as amended, to Provide In-region, interLATA Services in Michigan, CC Docket No. 97-137, Affidavit of Warren Mickens, filed May 21, 1997; Letter from Susan West of Ameritech to Mike Pfau of AT&T, dated April 6, 1998.
5. US West: In the Matter of the Petition of American Communications Services, Inc. and American Communications Services of Pima County, Inc. for Arbitration with US West Communications, Inc. of Interconnection Rates, Terms, and Conditions Pursuant to 47 USC § 252(b) of the Telecommunications Act of 1996, et al., Docket No. U-3021-96-448, Arizona Corporation Commission, Joint filing of the Parties in response to March 26, 1998 Arizona Procedural Order in Docket No. U-3021-96-448 et al., filed via letter on May 22, 1998.
6. Pacific Bell (PB): Rulemaking on the Commission's Own Motion to Govern Open Access to Bottleneck Services and Establish a Framework for Network Architecture Development of Dominant Carrier Networks, et al., Case No. R.93-04-003, California Public Utilities Commission, Rebuttal Affidavit of Gwen Johnson in Support of Pacific Bell's (U 1001 C) Draft Application for Authority to Provide interLATA Services in California, filed May 20, 1998.
7. LCUG: Local Competition Users Group (LCUG) – Service Quality Measurements (SQM) Version 6.1, dated September 26, 1997.

### Summary of Activity Disaggregation Commitments

Proposed	SWBT	BST	BA/NYNEX	Ameritech	US West	PacBell	LCUG
Provisioning: Outside Dispatch Central Office Work Software Only No Access Administrative Disconnect	Field Work No Field Work	Dispatch No Dispatch	Dispatch No Dispatch	None	New Service Installation Svc Migration w/o Changes Svc Migrations With Changes Move/Changes Feature Changes Svc Disconnects	Field Work No Field Work	New Service Installation Svc Migration w/o Changes Svc Migrations With Changes Number Porting Move/Changes Feature Changes Svc Disconnects
Maintenance: Outside Dispatch Out-of-Service Service Affecting Central Office Work Out-of-Service Service Affecting No Access/No Trouble Found Administrative	Field Work OOS SA No Field Work OOS SA	Dispatch OOS SA No Dispatch OOS SA	Loop (POTS)  Central Office (POTS)	None	None	Field Work OOS SA No Field Work OOS SA	Out of Service Dispatch Nondispatch No Trbl Found Hold Open CPE Loop/Access Ln No Access Office Eqpt Interoffice Fac Other

### Summary of Activity Disaggregation Commitments

Proposed	SWBT	BST	BA/NYNEX	Ameritech	US West	PacBell	LCUG
Pre-ordering Query: Address Verif TN Request CSR Request Svc/Prod Avail  Appt Sched.  Rejects/Errors	Address Verif TN Request CSR Request Svc/Prod Avail  Appt Sched.	None	Address Valid TN Request CSR Request Svc/Prod Avail  Appt Sched.  Other Pre-order	None	Address Valid. TN Reservation CSR F/F Availability Fac. Availability Svc Availability Appt Sched Due Date Avail	Address Verif TN Request CSR Request Svc Availability  Appt Sched	Address Valid. TN Reservation CSR F/F Availability Fac. Availability Svc Availability Due Date Resv. Appt Sched Reject/Failures
Ordering Status and Quality  If Standalone:  Directory Listing (DL) Directory Assistance (DA) DA + DL  All other orders:  New Install Change Disconnection Inside Move Outside Move LSP Conversion – “as is” LSP Conversion – with changes Records Other Activity	None	None	None	None	None	Varies by measurement	New Service Installation Svc Migration w/o Changes Svc Migrations With Changes Number Porting Move/Changes Feature Changes Svc Disconnects

### Summary of Activity Disaggregation Commitments

Billing: Usage: End User Access Alternate Bill Invoices: TSR UNE Interconnection	None	None	None	None	None	None	Usage: End User Access Alternate Bill Invoices: TSR UNE
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Sources:

1. SBC: Investigation of Southwestern Bell Telephone Company's Entry into the InterLATA Telecommunications Market, Case No. 16251, Texas Public Utility Commission, Affidavit of William R Dysart, filed April 17, 1998.
2. BST: Performance Measurements for Telecommunications Interconnection, Unbundling and Resale, Docket No. 7892-U, Georgia Public Service Commission, Order, Record submitted December 2, 1997, Date decided December 30, 1997.
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4. Ameritech: Application of Ameritech Michigan Pursuant to Section 271 of the Communications Act of 1934, as amended, to Provide In-region, interLATA Services in Michigan, CC Docket No. 97-137, Affidavit of Warren Mickens, filed May 21, 1997; Letter from Susan West of Ameritech to Mike Pfau of AT&T, dated April 6, 1998.
5. US West: In the Matter of the Petition of American Communications Services, Inc. and American Communications Services of Pima County, Inc. for Arbitration with US West Communications, Inc. of Interconnection Rates, Terms, and Conditions Pursuant to 47 USC § 252(b) of the Telecommunications Act of 1996, et al., Docket No. U-3021-96-448, Arizona Corporation Commission, Joint filing of the Parties in response to March 26, 1998 Arizona Procedural Order in Docket No. U-3021-96-448 et al., filed via letter on May 22, 1998.
6. Pacific Bell (PB): Rulemaking on the Commission's Own Motion to Govern Open Access to Bottleneck Services and Establish a Framework for Network Architecture Development of Dominant Carrier Networks, et al., Case No. R.93-04-003, California Public Utilities Commission, Rebuttal Affidavit of Gwen Johnson in Support of Pacific Bell's (U 1001 C) Draft Application for Authority to Provide interLATA Services in California, filed May 20, 1998.
7. LCUG: Local Competition Users Group (LCUG) – Service Quality Measurements (SQM) Version 6.1, dated September 26, 1997.

## Summary of Disaggregation Appropriate to Proposed Measurements

Measurement	CLEC	Svc	Act	Vol	Geo.	Other
<b>Pre-ordering</b>						
Average [Query] Response Time (§43)	Yes	No	Yes	No	No	By interface offered
<b>Provisioning</b>						
Average Completion Interval (§53)	Yes	Yes	Yes	Yes	Yes	
Percentage Due Dates Missed (§54)	Yes	Yes	Yes	Yes	Yes	
<b>Coordinated Customer Conversions</b>						
Average Coordinated Customer Conversion Interval (§57)	Yes	Yes	Yes	Yes	Yes	
<b>Order Status Measurements</b>						
Average Reject Notice Interval (§60)	Yes	Yes	Yes	No	No	By interface offered
Average FOC Notice Interval (§61)	Yes	Yes	Yes	No	No	By interface offered
Average Jeopardy Interval (§62)	Yes	Yes	Yes	No	No	By interface offered
Percentage Orders Given Jeopardy Notices (§63)	Yes	Yes	Yes	No	No	By interface offered
Average Completion Notice Interval (§64)	Yes	Yes	Yes	No	No	By interface offered
<b>Held Order Interval</b>						
Average Interval for Held Orders (§66)	Yes	Yes	No	No	Yes	By Hold Reason
<b>Installation Troubles</b>						
Percentage of Troubles in 30 Days for New Orders (§68)	Yes	Yes	No	No	Yes	
<b>Ordering Quality Measurements</b>						
Percent of Order Flow Through (§72)	Yes	Yes	Yes	Yes	No	By interface offered
Orders Rejected (§75)	Yes	Yes	Yes	Yes	No	By interface offered
Average Submissions per Order (§76)	Yes	Yes	Yes	Yes	No	By interface offered
<b>911 Database Updates and Accuracy</b>						
Percentage of Accurate Database Updates (§78)	Yes	No	No	No	No	
Percentage of Missed Due Dates (or Average Interval to Update) (§79)	Yes	No	No	No	No	
<b>Repair &amp; Maintenance</b>						
Average Time to Restore (§82)	Yes	Yes	Yes	No	Yes	
Frequency of Troubles in a 30-Day Period (§84)	Yes	Yes	Yes	No	Yes	
Frequency of repeat Troubles in 30-Day Period (§84)	Yes	Yes	Yes	No	Yes	
% of Customer Troubles Resolved Within Estimate (§85)	Yes	Yes	Yes	No	Yes	
<b>Billing</b>						
Average Time to Provide Usage Records (§89)	Yes	No	Yes	No	No	Resale/UNE/Interconnect
Average Time to Deliver Invoices (§90)	Yes	No	Yes	No	No	Resale/UNE/Interconnect
<b>General Measurements</b>						
Systems Availability	No	No	No	No	No	By Interface Offered
Center Responsiveness	No	No	No	No	No	By Center
OS/DA Average Time to Answer (§93)	No	No	No	No	No	By OS and DA
<b>Interconnection Measurements</b>						
Percent Blocking on Interconnection (Final) Trunks (§96)	Yes	No	No	No	Yes	
Percent Blocking on Common Trunks (§100)	Yes	No	No	No	Yes	
Average Time to Respond to Collocation Requests (§103)	Yes	No	No	No	Yes	By Physical/Virtual
Average Time to Provide a Collocation Arrangement (§103)	Yes	No	No	No	Yes	By Physical/Virtual
% of Due Dates Missed – Collocation Arrangements (§103)	Yes	No	No	No	Yes	By Physical/Virtual

### Summary of Disaggregation Appropriate to Proposed Measurements

<b>Other Measurements Not in NPRM</b>						
Percent Order Accuracy	Yes	Yes	Yes	No	Yes	
Percent Jeopardies Returned	Yes	Yes	Yes	No	Yes	
Call Abandonment	Yes	No	No	No	No	
Usage Accuracy	Yes	No	Yes	No	No	
Invoice Accuracy	Yes	No	Yes	No	No	
Network Performance	Yes	No	No	No	No	
Availability of Network Elements	Yes	Yes	Yes	No	Yes	
Performance of Network Elements	Yes	Yes	Yes	No	Yes	

**ILEC Retail Analogs for Selected UNE Elements and Combinations**

Measurement Area	UNE Loop (when associated with CLEC switch)		UNE Transport	UNE Platform
	Analog UNE Loop	Digital UNE Loop		
	<p><b>Provisioning</b></p> <p>Average Completion Interval                      Percentage Due Dates Missed                      Average Coord Cust Conversion Interval                      Average Interval for Held Orders                      Percentage of Troubles in 30 Days for New Orders                      Percent of Order Flow Through Orders Rejected                      Average Submissions per Order</p>	<p><b>Hot loop cutover analog</b>                      Retail residential or Business POTS outside move activity. An outside move occurs when a customer, with existing service, moves from one premises to another within the same Central Office area without disconnecting and reconnecting service. [Although an outside move involves disconnecting an existing loop from an operating port and reconnecting a different loop (within the same office) to that same port, the work involved is very similar (i.e., coordinated re-termination). For hot loop cuts, the same loop is moved from an existing port moved to what is effectively a different port (the CLEC collocation point).]</p> <p><b>New loop analog:</b>                      Installation of a new line for residential or business POTS where an outside dispatch must be made by the ILEC.</p>	<p><b>Hot loop cutover analog</b>                      An outside move activity of a digital PBX trunk or a ISDN BRI service.</p> <p><b>New loop analog</b>                      Installation of a new line for ISDN BRI or a new digital PBX trunk where an outside dispatch must be made by the ILEC.</p>	<p>DS0, DS1 and DS3 UNE dedicated transport provisioning activities each have a retail analog in the ILEC private line interoffice channel services or in dedicated exchange access (special access).</p>

Measurement Area	ILEC Retail Analogs for Selected UNE Elements and Combinations			
	UNE Loop (when associated with CLEC switch)		UNE Transport	UNE Platform
	Analog UNE Loop	Digital UNE Loop		
<b>Maintenance:</b>  Average Time to Restore Frequency of Troubles in a 30-Day Period Frequency of Repeat Troubles in a 30-Day Period % of Cust Trbls Resolved within Estimate	Residential or Business POTS troubles that are isolated to the local loop (disposition codes of 3 or 4)	Business POTS troubles that are isolated to a PBX trunk (disposition codes of 3 or 4)	Retail PL troubles isolated to the interoffice facilities (by DS0, DS1, or DS3) of Dedicated (Special) Access troubles isolated to the interoffice facilities.	Residential or Business POTS troubles

**Attachment G**

Before the  
 FEDERAL COMMUNICATIONS COMMISSION  
 Washington, D.C. 20554

In the Matter of )  
 )  
 Performance Measurements and )  
 Reporting Requirements ) CC Docket No. 98-56  
 for Operations Support Systems, ) RM 9101  
 Interconnection, and Operator )  
 Services and Directory )  
 Assistance )

**Affidavit of Dr. Colin L. Mallows**

Colin L. Mallows, being duly sworn, deposes and says:

1. I am a Technology Consultant at AT&T Laboratories. I make this affidavit in support of AT&T's comments regarding the use of statistical methods to determine whether incumbent local exchange carriers ("ILECs") are providing nondiscriminatory, i.e., parity, service to competing carriers ("CLECs"). I understand this is a requirement of law under Section 251 of the Telecommunications Act of 1996 ("Act").

**Qualifications**

2. I have been a professional statistician for nearly 45 years. I obtained a B.Sc. in Mathematics in 1951 and a Ph.D. in Statistics in 1953, both from University College, London. After two years in the British Army I became a lecturer at University College in the area of statistics. Since 1960, I have been employed at AT&T (formerly Bell)

Laboratories, becoming Head of the Statistical Models and Methods Research Department in 1969. I relinquished that title in 1986. From 1960 through 1964, I was also an adjunct associate professor at Columbia University, teaching courses in statistical analysis.

3. I am a Fellow of the American Statistical Association ("ASA"), and I served as an associate editor of Journal of the American Statistical Association from 1966 to 1971, and again from 1986-1989. I am also a Fellow of the Institute of Mathematical Statistics ("IMS"), and an elected member of the International Statistical Institute. I was twice elected to the Council of IMS, and have served on various committees of the IMS and ASA. In 1997 I was honored by being named Fisher Lecturer at the Joint Statistical Meetings held by the ASA, IMS, the International Biometric Society and the Statistical Society of Canada.

4. I have published over 100 papers, with a large number of co-authors, in a variety of journals. My name is attached to several well-known statistical techniques, including the Cp-plot for selecting regression variables, the phi-model for analysis of ranking data, and a weighting scheme for robust linear regression. My professional interests include foundations, data analysis, statistical graphics, time series, robustness, software reliability,

moment-problems and Chebychev inequalities, combinatorics and coding theory.

### Introduction

5. I have reviewed the Commission's Notice of Proposed Rulemaking ("Notice") in this proceeding, focusing on its discussion of the use of statistical analysis as a means of determining whether ILECs are providing parity service to new competitors. The Notice (§ 34) is clearly correct that "reporting averages of performance measurements alone, without further analysis, may not reveal whether there are underlying differences in the way incumbent LECs treat their own retail operations in relation to the way they treat competing carriers." Thus, it properly proposes to require the use of statistical tests to determine whether measured differences in average ILEC performance for themselves and competitors "represent true differences in behavior rather than random chance."

6. As the Commission is aware, AT&T has supported the use of statistical tests to determine whether an ILEC has met its statutory obligations. Earlier this year, AT&T provided the Commission with a concept for applying statistical analysis to ILEC performance measurements.<sup>1</sup> The AT&T Statistical Ex Parte provided a methodology, given the

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<sup>1</sup> Ex parte letter from Frank S. Simone, AT&T to Magalie Roman Salas, FCC, CC Docket No. 96-98, RM9101, dated February 3, 1998 ("AT&T Statistical Ex Parte").

presence of random error, to determine if an ILEC has complied with its statutory obligations when it reports results of numerous individual parity measurements, some of which show "worse" results for CLECs than for the ILEC.<sup>2</sup>

7. AT&T's Statistical Ex Parte correctly recognized that each of the individual tests of ILEC performance contained statistical Type I error. Thus, it is appropriate to use a Type I error concept when reviewing the ILEC's parity tests in the aggregate to determine whether the ILEC has met its nondiscrimination obligations. AT&T's Statistical Ex Parte thus described the use of a three-part analysis to determine whether ILEC measurements and reported results, when viewed in the aggregate, represent nondiscriminatory performance.<sup>3</sup>

8. Since that time, I have been asked to review and comment upon AT&T's Statistical Ex Parte and provide additional insight on the use of statistical tests in this

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<sup>2</sup> Since most of the measurements for these purposes are measurements of time, a "worse" result for a CLEC is usually a larger value, e.g., a 5-day installation interval for a CLEC is worse than a 3-day interval for the ILEC.

<sup>3</sup> AT&T's proposal recommended establishment of separate thresholds for: (1) the maximum number of "failures" on a monthly report that could reasonably represent mere randomness resulting from the measurement process rather than disparity of performance; (2) repeated failures on specific performance measurements in consecutive months; and (3) measurements showing extreme differences in average performance for the ILEC and CLECs. Id., p. 3.

context. As described in Section I below, the more detailed statistical methodology that is proposed here requires only a two-part analysis and provides the ILECs with more leeway than the original AT&T proposal. Nevertheless, I believe that it provides a valid statistical comparison of the ILECs' actual performance for itself and CLECs.

#### Summary of Testimony

9. Specifically, my testimony below shows that AT&T's proposed methodology satisfies the Commission's desire to assure that reported differences in ILEC performance are statistically meaningful. With respect to individual tests of ILEC performance, there are three key components in developing an appropriate statistical methodology. First, the modified z-statistic proposed by LCUG provides an appropriate test statistic to determine whether there are significant differences in the mean and the variance of an ILEC's performance for itself and for CLECs. Second, a one-tailed test with Type I error held at the 5% level strikes a fair balance between the need to account for both Type I and Type II errors. Third, the t-distribution provides a useful basis for calculating the critical value for individual tests of ILEC performance, which is used to determine whether CLECs have been given equal treatment by the ILEC. Moreover, in those cases where the sizes of the ILEC and

CLEC samples are small, a permutation distribution can be developed that will provide valid test results.

10. My testimony also demonstrates that it is appropriate to aggregate the results of individual tests to determine whether the ILEC is in compliance with its duty to provide nondiscriminatory treatment to CLECs. This should be done through the use of a two-part analysis that sets limits on the number of individual tests that fail to demonstrate parity in any given month and the number of individual tests that fail in three consecutive months. These limits can be determined so that the overall Type I error is held at 5%.

11. I have also been asked to review the BellSouth statistical proposal referenced in the Notice, which is based on the use of Statistical Process Control principles. As shown in Section II below, such principles were not developed for the purpose of determining parity of performance for two different populations. Thus, BellSouth's proposal is unsuited to the present purposes and should be rejected.

**I. AT&T's Proposed Statistical Methodology**

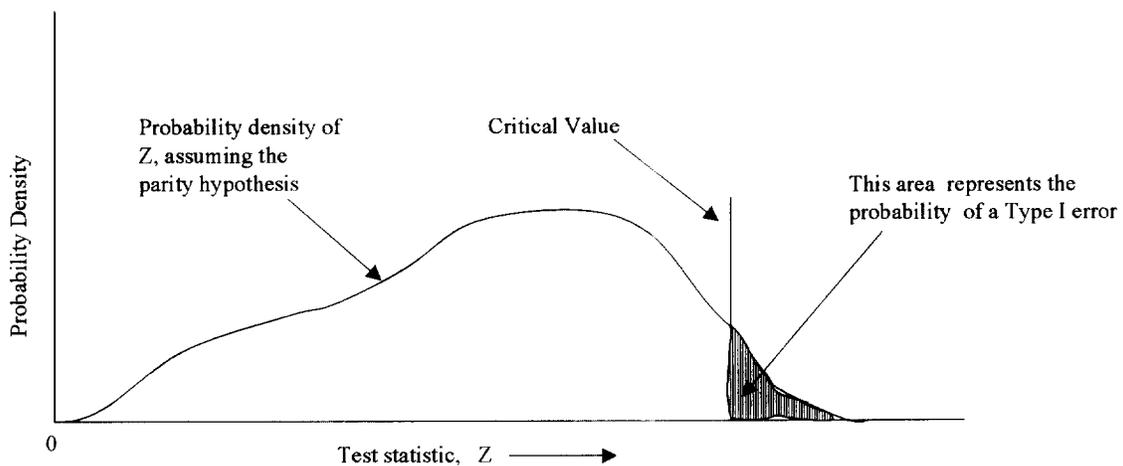
12. The statistical tests described below are designed to test the "null hypothesis," i.e., the assumption that the ILEC's performance is the same for itself and for CLECs. This hypothesis refers to the populations of ILEC and CLEC

measurements, from which the observed measurements are assumed to be drawn. We cannot observe these populations, and must base our test procedures on the observed samples. If the null hypothesis is accepted through the use of the chosen tests, then any differences in the ILEC's performance results for itself and the CLEC are deemed "statistically insignificant," and parity can be assumed.

13. All such statistical tests have three components. First, the test designer must select a test statistic, which is a formula that produces a single number summarizing the observed ILEC and CLEC data. Next, an acceptable Type I error probability must be adopted. The error probability represents the test designer's tolerance for falsely rejecting parity when it exists (Type I error is discussed in Section I.B below). Finally, the test designer must derive, from probability theory or known data, the probability distribution of the test statistic, describing the variability of performance under the null hypothesis.

14. Once these components are established, the test designer can determine (usually from a statistical table) a "critical value" against which to compare the computed value of the test statistic that is based on the actual results. If the test statistic is less than the critical value, it can be inferred that the ILEC's performance has "passed" the test of parity. If, however, the computed test statistic is

greater than the critical value, the ILEC's performance is judged to be not at parity, and the ILEC has "failed" the parity test for that measurement. The relationship between the performance distribution under the null hypothesis and the critical value is demonstrated graphically below.



**A. Test Statistic: The Commission Should Use The Modified Z-Statistic Recommended By LCUG.**

15. The modified z-statistic recommended by the Local Competition Users Group ("LCUG") is an excellent choice of test statistic in these circumstances. The "z-statistic" is a standard test statistic.<sup>4</sup> It is used to determine if the

<sup>4</sup> The formula for the z-statistic (also called the t-statistic), for the case where the observations are of measurements rather than proportions or rates, is

$$z = \frac{(\bar{Y} - \bar{X})}{\sqrt{\left(\frac{1}{m} + \frac{1}{n}\right)S^2}}$$

average results (or means) drawn from two separate performance samples (here the monthly ILEC performance data for itself and CLECs) have population means that are equal.<sup>5</sup> Thus, the standard z-statistic formula can determine whether, based on the reported results, the ILEC's average performance for itself and for CLECs is the same.

16. However, it is not enough to test for a difference in means alone. In order to obtain parity, CLECs are entitled to service from the ILEC that produces both the same mean performance and also the same variance in performance.<sup>6</sup> The z-statistic, in its standard form, is not

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where  $\bar{X}$  (resp.  $\bar{Y}$ ) is the average of the ILEC (resp. CLEC) measurements,  $m$  (resp.  $n$ ) is the number of these measurements, and  $S$  is a measure of the scale of variation of these measurements. The usual situation is that the statistical test is designed to detect a difference in the population means of the ILEC and CLEC measurements, assuming the population variances to be equal. In this case the standard choice for  $S^2$  is

$$S^2 = S^2_{pooled} = \frac{(m-1)S^2_{ILEC} + (n-1)S^2_{CLEC}}{m+n-2}$$

<sup>5</sup> Similar statistics can also be used to detect differences in proportions and rates.

<sup>6</sup> The Commission also recognizes that it would be discriminatory if the ILEC has the same mean performance time for itself and CLECs but the variability of its performance for CLECs is greater (see Notice, Appx. B, ¶ 4 ("variability of response times . . . may affect the competitiveness of a competing carrier but may not be reflected in a comparison of average response times")). For example, CLECs would be at a commercial disadvantage if ILEC retail customers could always rely on an installation period of 4 days while installation dates for CLECs ranged from 2-6 days or more.

designed to detect differences in variance between CLEC and ILEC performance.

17. In order to create a single test that can account for both of these factors, LCUG proposes a modification that will make the statistical test have the power to detect whether the ILEC's variance in its performance for CLECs is greater than the variance in its performance for itself. Specifically, LCUG proposes to use the ILEC variance, rather than the "pooled" variance, in calculating the z-statistic.<sup>7</sup> This proposal is based on well-supported statistical testing principles and combines the power of tests of means and tests of variance. Thus, if the test proposed by LCUG is used, there would be no need to develop a separate test of the equality of variances.<sup>8</sup>

18. Use of the LCUG modified z-statistic, rather than the more conventional form that uses a "pooled" variance, is appropriate here because the problem here is different from

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<sup>7</sup> The LCUG proposal is to use  $S^2 = S^2_{ILEC}$ . The resulting test statistic has the same distribution theory as the conventional one (using  $S^2_{pooled}$ ) except for changing the "degrees of freedom" from  $m+n-2$  to  $m-1$ . The effect of this change will be small if the parity hypothesis holds, since as the incumbent monopolist, the ILEC sample is likely to be much larger than the CLEC sample.

<sup>8</sup> See Notice, Appx. B, ¶ 4. It should also be noted that the use of separate tests for differences in averages and differences in variance would reduce the power of each separate test. Thus, it is preferable to use a single test that is sensitive to cases where both the mean and variance can increase.

that addressed in the standard texts. In the standard development, it is assumed that if the null hypothesis fails, it is only because the population means are different; the population variances are assumed to stay equal. This assumption is not appropriate here, because an increase in the CLEC variance would be a violation of parity, and the test should be able to detect it.<sup>9</sup>

19. As described above, the denominator of the formula for the z-statistic requires use of a figure for variance. Contrary to the suggestion of some ILECs,<sup>10</sup> the most appropriate variance to use in this case is the variance of the ILEC's performance for itself during the reporting period. This sample variance is the best available estimate of the variance of the ILEC process. Moreover, the entire purpose of the examination is to determine whether the ILEC is providing CLECs at least the same level of service as it provides to itself and its retail customers. Thus, for this

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<sup>9</sup> Another standard form of the z-statistic is designed for the case where the two population variances may differ even under the null hypothesis. In this case one replaces

$$\left(\frac{1}{m} + \frac{1}{n}\right)S^2 \text{ by } \frac{S^2_{ILEC}}{m} + \frac{S^2_{CLEC}}{n}$$

This form of the statistic is inappropriate here since under the parity hypothesis the two population variances are equal. Use of this form would reduce the probability of detecting violations of parity.

<sup>10</sup> I am informed that some BOCs have suggested that the variance used in the formula should be based solely on the variance experienced by the CLECs, and others have suggested the use of the pooled variance.

purpose, variance in the ILEC's performance is the standard against which the performance for CLECs should be measured.

**B. The Error Probability Should Be Based On A One-Tailed Test With Type I Error At No More Than The 5% Level.**

20. In determining an appropriate Type I error probability for the statistical test, it is important to recognize that any probability rate above 0% means that the statistical test will produce errors.<sup>11</sup> It is also important to understand that there are two distinct types of testing errors. "Type I" errors occur when a statistical test shows that two sets of results (here for the ILEC and CLEC) are inconsistent with the null hypothesis (i.e., are not in parity) when in fact the null hypothesis is true. "Type II" errors are the opposite. They occur when a statistical test indicates that the outcomes are in parity, but parity does not in fact exist. Both types of errors are possible.

21. There are two "tails" to Type I errors, but the Notice (Appx. B, n.3) correctly notes that only one is pertinent here: errors relating to cases in which the ILEC's performance for CLECs is worse than its performance for itself. Under the Commission's rules, CLECs are entitled to performance that is "at least equal" to the performance the ILEC provides to itself. Those rules are not concerned with

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<sup>11</sup> AT&T Statistical Ex Parte, p. B-1.