4 ILEC RESPONSES TO SERVICE OUTAGES

Key findings addressed in this Chapter

- ETI's analysis of the condition of AT&T and Frontier's networks in California is, among other things, based upon the approximately eight million Customer Trouble Report records submitted by the two companies over the 2010-2017 Study Period.
- The source of most service outages is being attributed by the ILECs to weather-driven and other failures in outside plant rather than to their central office switches or associated equipment.
- Telephone service outages appear to be highly dependent upon weather conditions, specifically, the amount of precipitation in the area served.
- The strong relationship between rainfall and the rate of service outages provides a strong indication that the AT&T distribution network is not as robust as it needs to be, and lacks the resiliency to withstand significant weather events.
- FCC data indicate that, for California, the demand for all wireline voice services provided by all carriers combined decreased by 30.1%,from 20.9 million in 2008 to 14.6 million in 2016. During the same period, the number of wireless subscriptions in California increased by 32.7%, from 32.2 million to 42.7 million. Overall, there are 3.4 million more wireless subscriptions than the total population in California, which was 39.3 million people at the end of 2016.
- The decline in customer demand for legacy POTS over the 2010-2017 period has been greatest in the larger, more metropolitan wire center areas. These same metropolitan area wire centers also exhibit the highest levels of service quality and greatest availability of alternative wireless and broadband services.
- Over the full period, there has been a net increase of approximately 15.5% in the trend of OOS incidents per 100 POTS lines in service over the full study period.

ILEC RESPONSES TO SERVICE OUTAGES

TABLE OF CONTENTS

Introduction: Organization of this Chapter

Chapter 4 is organized into three sections. The first, Chapter 4, provides a general overview of the Commission's Trouble Report and Out-of-Service reporting requirements, the types of data that has been submitted by AT&T California and by Verizon/Frontier California in response thereto, and a general description of the types of analyses that ETI has undertaken with respect to these submissions.

The second section, Chapter 4A, provides our detailed analysis of AT&T Trouble Report and Out-of-Service performance over the 2010-2017 study period. The third section, Chapter 4F, provides out analysis of the Verizon California (pre-sale) and Frontier California (post-acquisition) service quality reporting and performance.

Data collection and reporting pursuant to General Order 133-C and subsequent 133-D

General Order ("GO") 133-C was adopted by Decision (D.) 09-07-019 effective as of July 9, 2009, in Rulemaking (R.) 02-12-004, to become effective for purposes of service quality reporting as of January 1, 2010.[64] GO 133-C, in relevant part, requires that all "facilities-based URF [Uniform Regulatory Framework[65]] Carriers with 5,000 or more customers" report various service quality performance metrics on a monthly basis and submitted quarterly to the Commission. Both Pacific Bell (d/b/a AT&T California, hereinafter "AT&T") and Frontier California (formerly Verizon California, hereinafter "Frontier"), are "facilities-based URF Carriers with 5,000 or more customers" and are thus subject to this requirement. Under the provisions of GO-133-C §§ 3.3(c) and 3.4(c), both AT&T and Frontier (Verizon) have been obligated to provide reports as well as the underlying ("raw") trouble ticket data on all customer Trouble Reports and Out-of-Service records occurring on and after January 1, 2010.[66] In August 2016, the CPUC, by D.16-08-021 in R.11-12-001, adopted GO 133-D as a revision to the prior version of the same General Order.[67]

64. *Order Instituting Rulemaking into the Service Quality Standards for All Telecommunications Carriers and Revisions to General Order 133-B*, R. 02-12-004, D. 09-07-019 issued and effective as of July 9, 2009.

65. Order Instituting Rulemaking on the Commission's Own Motion to Assess and Revise the Regulation of Telecommunications Utilities, R.05-04-005, *Opinion*, D.06-08-030, August 24, 2006.

66. G.O. 133-C, §§ 2, 3.

67. *Order Instituting Rulemaking to Evaluate Telecommunications Corporations Service Quality Performance and Consider Modification to Service Quality Rules*, R. 11-12-001, *Decision Adopting General Order 133-D*, D.16-08-021 August 18, 2016.

GO 133-C §3.3. Customer Trouble Reports – Applies to ... facilities-based URF Carriers with 5,000 or more customers ... Trouble reports apply to residential and small business customers (those that purchase five or fewer lines).

a. Description. Service affecting, and out of service trouble reports, from customers and users of telephone service relating to dissatisfaction with telephone company services. Reports received will be counted and related to the total working lines within the reporting unit in terms of reports per 100 lines.

b. Measurement. Customer trouble reports received by the utility will be counted monthly and related to the total working lines within a reporting unit.

c. Minimum Standard Reporting Level. Report number of trouble reports per 100 working lines (excluding terminal equipment reports). ... Six trouble reports per 100 working lines for reporting units with 3,000 or more working lines, eight reports per 100 working lines for reporting units with 1,001-2,999 working lines, and 10 reports per 100 working lines for reporting units with 1,000 or fewer working lines.

d. Reporting Unit. Exchange or wire center, whichever is smaller. A wire center with fewer than 100 lines should be combined with other central offices within the same location. A remote switching unit with fewer than 100 lines should also be added to its host switch. URF CLECs that do not have exchanges or wire centers shall report at the smallest reporting unit. All reporting carriers shall submit the raw data included in the report.

e. Reporting Frequency. Compiled monthly, reported quarterly.

GO 133-C §3.4. Out of Service Repair Intervals – Applies to ... facilities-based URF Carriers with 5,000 or more customers ....

a. Description. A measure of the average interval, in hours and minutes from the time of the reporting carrier's receipt of the out of service trouble report to the time service is restored for residential and small business customers.

b. Measurement. Commitment is measured by taking the total number of the repair tickets restored within less than 24 hours divided by the total outage report tickets. In addition, the system average outage duration is measured by summing each repair interval, expressed in clock hours and minutes, between the time the customer called to report loss of service and when the customer regains dial tone, divided by the total outage report tickets. These measurements include only residential and small business customer tickets. The measurements exclude Sundays and federal holidays and tickets when maintenance is delayed due to circumstances beyond the carrier's control. Typical reasons for delay include, but are not limited to: outage caused by cable theft, third-party cable cut, lack of premise access when a problem is isolated to that location, absence of customer support to test facilities, or customer's requested appointment. Changed appointments shall be reported separately by identifying the number of such appointments and the time, in hours and minutes, associated with these appointments. When reporting includes a delay for one or more months, the carrier shall provide supporting information as to why the month should be excluded and work papers that show the date(s) of the catastrophic event and/or widespread outage and how the adjusted figure was calculated. A catastrophic event, an event where there is a declaration of a state of emergency by a federal or state authority, and a widespread service outage (an outage affecting at least 3% of the carrier's customers in the state) are circumstances beyond the carrier's control.

c. Minimum Standard Reporting Level. 90% of all out of service trouble reports within 24 hours is the set minimum standard. Both the percentage of outages meeting the 24-hour standard and the actual system-wide average outage duration should be reported.

d. Reporting Unit. Reporting is at the state-wide level. However, carriers shall submit with the report the underlying data at the exchange or wire center level, whichever is smaller, that supports the information being reported. A wire center with fewer than 100 lines should be combined with other central offices within the same location. A remote switching unit with fewer than 100 lines should also be added to its host switch. URF CLECs that do not have exchanges or wire centers shall report at the smallest reporting unit. All reporting carriers shall submit the raw data included in the report.

e. Reporting Frequency. Compiled monthly and reported quarterly for those reporting units.

As it pertains to the subject matter of this Network Study, GO 133-D §3.4(b), Measurement, is revised to include an expanded enumeration of causes resulting in Out-of-Service conditions that are beyond management's control. A new §9 has been added setting forth fines to be imposed upon carriers under certain protracted or excessive Out-of-Service conditions other than those caused by factors beyond management's control. GO-133-D became effective as of August 18, 2016, except for §9 (fines), which became effective as of January 1, 2017. Since at least 6 years and 7 months out of the total of 8 years under examination were subject to GO-133-C, the analysis provided here is based upon the reporting requirements of that earlier version of the General Order. The nearly eight million individual Trouble Report data records submitted by AT&T and Verizon/Frontier over the period provided a solid basis for ETI's comprehensive assessment of the condition of the ILECs' California networks and their performance in maintaining service quality and in responding to service problems.

ETI's analysis of the condition of AT&T and Frontier's networks in California is, among other things, based upon the approximately eight million Customer Trouble Report records submitted by the two companies over the 2010-2017 Study Period.

Trouble Reports, in general

A Trouble Report (also referred to as a Trouble Ticket) is generally created when a customer contacts the telephone company to report a service problem. Service problems arise from any number of conditions, many of which fall outside of the responsibility of the ILEC or can be easily resolved by means of a help desk or technical support function. For example, a customer might be encountering difficulty using a custom calling feature such as three-way calling, voice mail, or caller id (where the calling number is displayed on a device owned by the customer and connected to the ILEC network). Although a Trouble Ticket may be created in such situations, they are typically resolved quickly by providing assistance to the customer as to how the feature operates and how to use it.

In other cases, the customer might be experiencing a service problem that is the result of faulty inside wiring or customer premises equipment (CPE), such as a problem with a handset owned by the customer. Here, the telephone company is often able to test the customer's access line remotely and can frequently determine whether the problem is on the customer or the utility side of the demarcation, typically the Standard Network Interface ("SNI") that is installed on the customer's premises that isolates the drop wire from the customer premises inside wiring.

If the problem is identified as occurring on the customer's side of the demarcation and the customer has purchased an inside wire or CPE maintenance plan from the utility, a service appointment may be made and a technician sent to the customer's premises to make the repair. If the customer has not purchased an inside wire or CPE maintenance plan but asks for an on-site repair visit, the customer will be advised that charges will apply if the technician determines that the fault is on the customer's side of the demarcation.

GO 133-C/D established minimum standards and reporting levels for service on the network side of the demarcation. Not all network problems reported by a customer constitute out-of-service conditions. For example, the customer may report noise on the line, but is still able to originate and receive calls. For those that do involve an out-of-service condition, the Trouble Report record includes an "out-of-service indicator" as well as the date/time when the outage is reported and the date/time when it is ultimately cleared. From these date/time stamps, we are able to create a range of metrics regarding the duration of the out-of-service condition. ETI has developed a series of such metrics, as are summarized in Table 4.1 below:

Table 4.1

QUANTITIES OF TROUBLE REPORTS AND ACTUAL OUT-OF-SERVICE CONDITIONS JANUARY 2010 THROUGH DECEMBER 2017

Condition	AT&T	Verizon/Frontier
Trouble Reports – all types	6,219,742	1,736,815
Out-of-Service – all types	5,001,270	1,201,469
Out-of-Service – less than one (1) hour	328,357	137,921
Out-of-Service – more than one (1) hour	4,672,913	1,063,548
Out-of-Service – more than 6 hours	3,814,579	835,938
Out-of-Service – more than 12 hours	3,541,959	762,873
Out-of-Service – more than 24 hours	2,480,593	505,176
Out-of-Service – more than 1 week	272,465	62,708

NOTES: (1) AT&T did not provide records of non-OOS Trouble Reports in 2010
(2) Some post-acquisition Frontier data may not include non-OOS Trouble Reports

Table 4.1 provides counts for all types of Trouble Reports and Out-of-Service conditions. However, GO-133-C/D allow adjustments and exclusions where the OOS condition, or some portion of it, is considered to be beyond management's control.

One such situation arises where the outage commences, ends, or includes a Sunday or a legal holiday. For example, if an outage is reported at 10am on a Friday and is cleared at 3pm the following Monday, the total duration of the outage (77 hours) is adjusted to exclude the 24 Sunday hours, putting the "official" outage duration for this example at 53 hours (i.e., 77–24). From the customer's perspective, however, the duration was 77 hours, not 53. ETI has analyzed and organized the OOS metrics using both the "actual" and "CPUC" durations. Table 4.2 provides OOS counts based upon the adjusted "CPUC" durations. Notably, even after removing these "excluded" Sunday/Holiday hours, both ILECs still fell far short of meeting the GO 133-C/D requirement that 90% of outages be cleared within 24 hours.

Table 4.2

QUANTITIES OF TROUBLE REPORTS AND OUT-OF-SERVICE CONDITIONS ADJUSTED TO EXCLUDE SUNDAYS AND HOLIDAYS PER GO 133-C/D JANUARY 2010 THROUGH DECEMBER 2017

Condition	AT&T	Verizon	Frontier
Trouble Reports – all types	6,219,742	1,575,920	124,185
Out-of-Service–all types	5,001,270	1,083,067	91,626
Excluded due to cause beyond management's control	830,780	161,938	3,247
Out-of-service conditions within management's control	4,170,490	921,130	88,379
Out-of-Service–less than one (1) hour	31,805	136,943	706
Out-of-Service–more than one (1) hour	3,852,439	946,124	90,920
Out-of-Service–more than six (6) hours	3,101,288	734,828	78,349
Out-of-Service–more than twelve (12) hours	2,873,377	669,946	71,936
Out-of-Service–more than twenty-four (24) hours	1,954,453	441,439	49,155
Out-of-Service–more than one (1) week	194,104	42,307	3,480

NOTES: (1) AT&T did not provide records of non-OOS Trouble Reports in 2010
(2) Some post-acquisition Frontier data may not include non-OOS Trouble Reports

In addition to the Sunday/Holiday adjustments, certain out-of-service conditions "when maintenance is delayed due to circumstances beyond the carrier's control," such as "outage caused by cable theft, third-party cable cut, lack of premise access when a problem is isolated to that location, absence of customer support to test facilities, or customer's requested appointment" have also been treated as "excluded" even though, from the customer's perspective, the service is nevertheless not functioning.[68] ETI does not believe that it is appropriate to entirely exclude all instances where the customer has requested an appointment date/time at the customer's convenience. Instead, the delay in the ultimate restoration of service attributable to the additional time needed to satisfy the customer's request for an appointment should be

68. GO 133-C/D, at §3.4.

adjusted out of the total out-of-service duration; ETI has been advised that such an adjustment is already reflected in the "CPUC Duration" calculation provided on the raw Trouble Report data.

Each Trouble Report record also includes a "Cause Code." Notably, the "cause" of nearly one-third (1.37-million) of all AT&T out-of-service conditions was coded as "Unknown – Trouble condition cannot be determined" Another 16.8% of AT&T out-of-service conditions were attributed to "Heavy Rain," "Weather," "Moisture," or "Wet Plant." More than 40% are attributed to problems with "ILEC Plant or Equipment," although there is no detail as to exactly what type(s) of ILEC Plant and Equipment are at fault. The AT&T Cause Codes that arise most frequently are summarized in Table 4.3. In determining whether an individual record should be "excluded," ETI has relied upon the "Excluded" flag rather than the Cause Code.

Table 4.3

MOST COMMON AT&T CAUSE CODES AND THE NUMBER OF OCCURRENCES 2010-2017

Cause code and description	Occurrence
300 ILEC Plant or Equipment	2,089,225
600 Unknown – Trouble condition cannot be determined	1,367,019
421 Heavy rain	474,887
310 Overload – excessive demand	303,759
400 Weather	128,518
319 Wet plant not storm-related	124,815
100 Caused or overlooked by AT&T Employee	113,706
420 Moisture	112,706
322 Out of Adjustment	109,881
541 Out of Adjustment	95,929
304 Plant Conditioning	95,253
204 Customer request to move or remove equipment	77,694
120 Outage caused by ILEC employee during outside plant construction	65,759
550 Damage to plant caused by animals or insects	56,697
313 (Cause code not defined)	55,112
NOTE: AT&T did not provide records of non-OOS Trouble Reports in 2010	

It appears that all of these most common Cause Codes refer to failure in outside plant, not to central office switch or associated equipment. In Chapter 3 above, we noted that both carriers' central office switch inventories are quite old, some in the 20-30 year old range. Despite their age and reliance upon generations-old computer technology, these ancient switches do not appear to be the source of many, if any, recorded service outages.

Following the exclusions of trouble conditions deemed beyond the utility's control, the AT&T dataset consisted of 4,170,490 remaining out-of-service records, 921,130 for Verizon, and 88,379 for Frontier.

The source of most service outages is being attributed by the ILECs to weather-driven and other failures in outside plant rather than to their central office switches or associated equipment.

The "raw" Trouble Report data

As noted, GO 133-C/D requires the URF ILECs to provide the underlying ("raw") Trouble Report data for every service-related contact initiated by a customer. This "raw data" is used by the ILEC to prepare the quarterly Trouble and Out-of-Service reports that are required by GO 133-C/D. Over the period January 2010 through and including December 31, 2017, AT&T provided the Commission with approximately 6.1-million individual Trouble Report records, roughly 5.0-million of which were associated with Out-of Service ("OOS") conditions of varying lengths. Prior to the transfer of Verizon California to Frontier on April 1, 2016, Verizon California had provided approximately 1.6-million individual out-of-service data records to the CPUC covering the period from January 2010 through December 2015. After the transfer, Frontier California provided the Commission with the last three months (January - March 2016) of Verizon out-of-service records (approximately 0.2-million). Subsequently, Frontier provided an additional 1.5-million out-of-service records covering the period April 2016 through December 2017. Variations in content and format over the 96 months included in these datasets required that the individual trouble report data be refined and made comparable over the full time frame. While the specific formats and content of the individual Trouble Report and Out-of-Service data records differed, all provided some form of the following elements, shown in Table 4.4 below.

Table 4.4

PRINCIPAL TROUBLE REPORT DATA ELEMENTS

Element	Description
Trouble Ticket	Serial number assigned to Trouble Ticket
Billing Telephone Number	
Circuit ID	Usually the billing telephone number except for multiline customers
Wire Center	6-digit AT&T wire center code or industry standard Common Language Location Identification (CLLI) code
Class of Serv Name	Residential or Business customer
Receive Date Time	Date/Time trouble report was received by the ILEC
Receive Day of Week Number	Day of week that report was received
Restored Date'/Time	Date/Time when service was restored
Closed Date/Time	Date/Time when trouble ticket was closed
Cause Code	
Disposition Code	
Out of Service Indicator	"1" if service was interrupted; "0" if other type of trouble condition
CPUC Receipt to Clear Duration	Date/time of restoration as adjusted for Sundays/holidays
Request Flag	Indication that customer has requested a specific appointment time for on-site visit; used to adjust actual duration for any customer-initiated delay
Excluded for cause code	Excluded ticket / not within carrier's control
Hours to Clear	Computed actual duration
Adjusted Hours to Clear	Computer duration adjusted for Sundays/Holidays, customer appointment request, or other source of delay in restoration

The California ILEC Market Environment

Both AT&T and Frontier provide basic local telephone service across extensive geographic footprints throughout California. AT&T operates 615 wire centers, and provides service in 51 of the State's 58 counties. Frontier operates some 270 wire centers, and provides service in 26 counties. Both companies have experienced a massive erosion of the legacy circuit-switched local "Plain Old Telephone Service" ("POTS") customer base over the eight year period covered by this Study. This erosion has been driven by a number of factors, including actions of the two companies and their affiliates:

- In the residential market, demand for POTS has eroded due to the growth of competitive wireline offerings – primarily from cable TV multi-system operators ("MSOs") who provide bundles of basic wireline voice telephone service, broadband Internet access, and a variety of video programming packages.

- The two ILECs have introduced and heavily promoted similar service bundles of their own under the brand names of *U-verse* (AT&T) and *FiOS* (Verizon, now Frontier). In 2015, AT&T acquired the satellite television provider DirecTV,[69] and since that acquisition has introduced telephone/broadband/video service bundles that utilize both its legacy ILEC network assets as well as satellite-based video distribution and content. In June 2018, AT&T completed its merger with content-provider Time Warner, Inc. (not to be confused with Time Warner Cable, a separate company that was acquired in 2016 by Charter Communications, Inc.[70]), further enhancing AT&T's ability to offer expansive bundles of voice, broadband, video distribution and video content.[71] To the extent that promotion of these new service bundles by the ILECs has been successful, its effect has been to further cannibalize the companies' legacy POTS customer base.[72]

- Large numbers of households have "cut the cord" entirely, replacing their wireline local telephone service (in any form) with wireless. Prior to the 2016 sale of Verizon's California ILEC operations to Frontier, wireless affiliates of both AT&T California and Verizon California together controlled roughly 70.5% of the US wireless market.[73] Thus, while these companies' ILEC affiliates suffered massive "cord-cutter" losses, much of that demand was replaced by offsetting increases in these same companies' sales of wireless services.

- Of somewhat less impact, certain "over-the-top" Internet-based Voice over IP ("VoIP") services from providers such as Vonage, MagicJack, Skype and Ooma have developed, and have captured a relatively small (when compared with cable or wireless) but not insignificant share of the residential voice market.

- Viewed across the entire business market, the erosion of demand for legacy wireline voice telephone services has been even more dramatic – most large businesses and multiple location enterprise customers have largely replaced their circuit-switched voice (PBX and Centrex)

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69. "AT&T Completes Acquisition of DIRECTV," AT&T Press Release, July 24, 2015.

70. "AT&T Completes Acquisition of Time Warner Inc.," AT&T Press Release, June 14, 2018.

71. See Joe Flint, Drew Fitzgerald, "Fresh Off Time Warner Deal, AT&T Plans Aggressive Content Strategy,"*Wall Street Journal*, June 15, 2018, https://www.wsj.com/articles/fresh-off-time-warner-deal-at-t-plans-aggressive-content-strategy-1529078051

72. In 2012, the California legislature adopted a new §710 of the California Public Utility Code whose effect was to remove most aspects of any VoIP service from the CPUC's jurisdiction. Stats. 2012, Ch 733, Sec 3. (SB 1161) Effective January 1, 2013. Repealed as of January 1, 2020, by its own provisions. §710 created an additional incentive for ILECs to migrate customers away from regulated POTS services and over to VoIP, so as to further narrow the scope of the Commission's regulatory jurisdiction over their operations. GO 133-C/D is not applicable to VoIP.

73. *Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services.* FCC Docket No.16-137, September 23, 2016, Market Shares for Mobile Wireless Service Providers Based on Service Revenues, 2012–2015, at 15. State-level wireless market share data is not available.

services with VoIP services typically furnished by entities other than ILECs. However, for small (up to five voice lines) businesses, the drop-off in demand, while less than that for POTS in the residential segment, has still been quite substantial.

*

FCC data indicate that, for California, the demand for all wireline voice services provided by all carriers combined decreased by 30.1%,from 20.9 million in 2008 to 14.6 million in 2016. During the same period, the number of wireless subscriptions in California increased by 32.7%, from 32.2 million to 42.7 million. Overall, there are 3.4 million more wireless subscriptions than the total population in California, which was 39.3 million people at the end of 2016.

Figures 4.1 through 4.4 illustrate these demand shifts and erosions for California statewide over the period 2008-2016, based upon data published semiannually by the FCC. Because this data covers the entirety of California, it covers all California service providers, including AT&T and Verizon/Frontier.

Figure 4.1 shows the change in total ILEC circuit-switched (POTS) voice lines together with the growth of interconnected VoIP subscriptions (ILEC and non-ILEC) over the period. Although the 66.6% drop in POTS lines has been slightly offset by the increase in ILEC-provided VoIP services, overall ILEC lines decreased by 56.5% over the period.

Figures 4.2 and 4.3 show ILEC legacy service losses to non-ILEC competitor-provided services, separately for residential (4.2) and business (4.3) customers. In the residential segment, ILEC POTS lines decreased by 62.6%; whereas business POTS lines dropped by only 43.2%.

Figure 4.4 illustrates how the demand for voice services has shifted away from wireline (circuit-switched and VoIP) to wireless. Wireless lines in California increased by 10.5-million, up 32.7%, from 32.2-million in 2008 to 42.7-million in 2016. The State's total population at the end of 2016 was 39.3-million – i.e., 3.4-million more wireless phones than people (including infants and newborns). Over the same time period, total *wireline* voice service demand saw a 6.3-million decrease, down 30.1%, from 20.9-million in 2008 to 14.6-million in 2016.[74]

74. The average number of working lines reportable under GO 133-C/D (which includes all ILEC and CLEC voice access lines) decreased from 11.48-million in 2010 to 6.15-million in 2017. CPUC staff compilation of carrier-reported data.

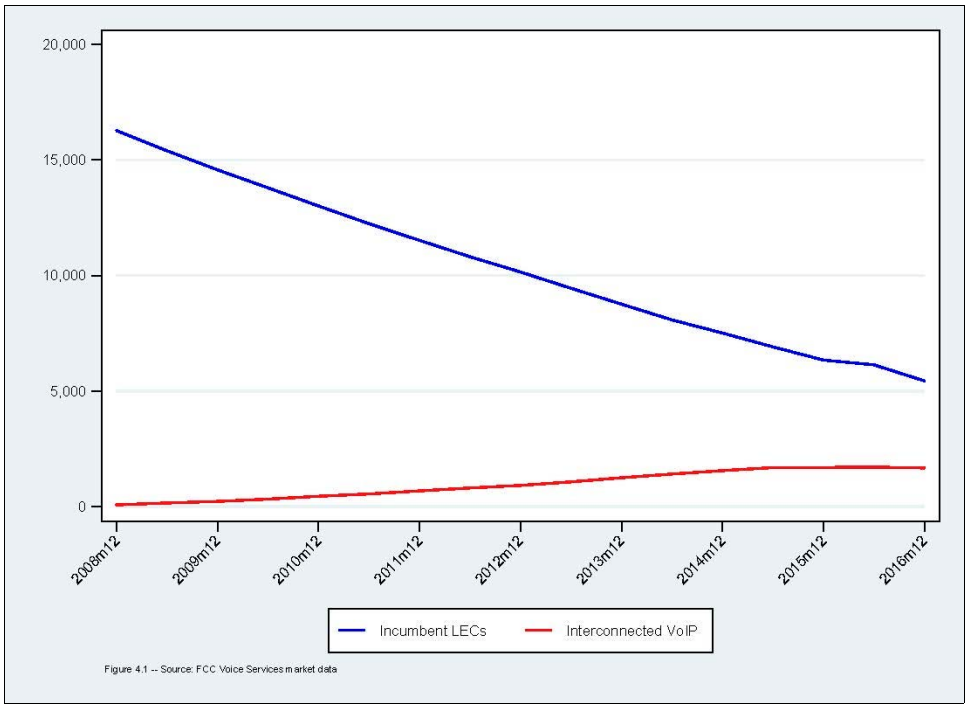


Figure 4.1. California ILECs saw a precipitous drop in demand for circuit-switched legacy voice access lines over the 2010-2017 period, only a portion of which were replaced by ILEC-provided VoIP services.

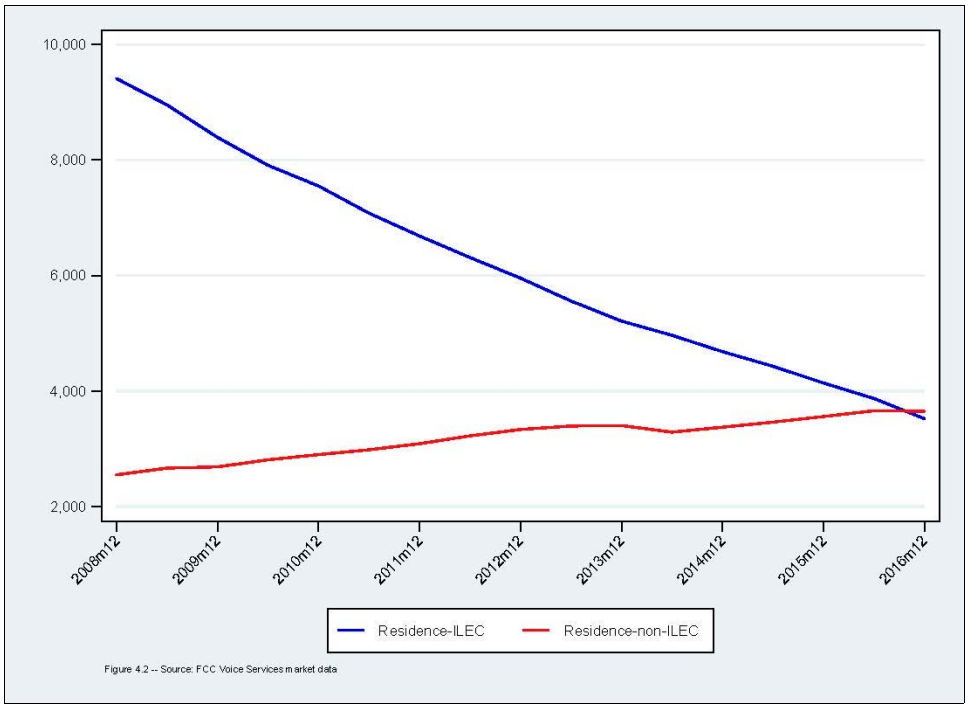


Figure 4.2. A substantial share of California ILEC residential line losses was the result of customer migrations to cable MSOs and other ILEC competitors.

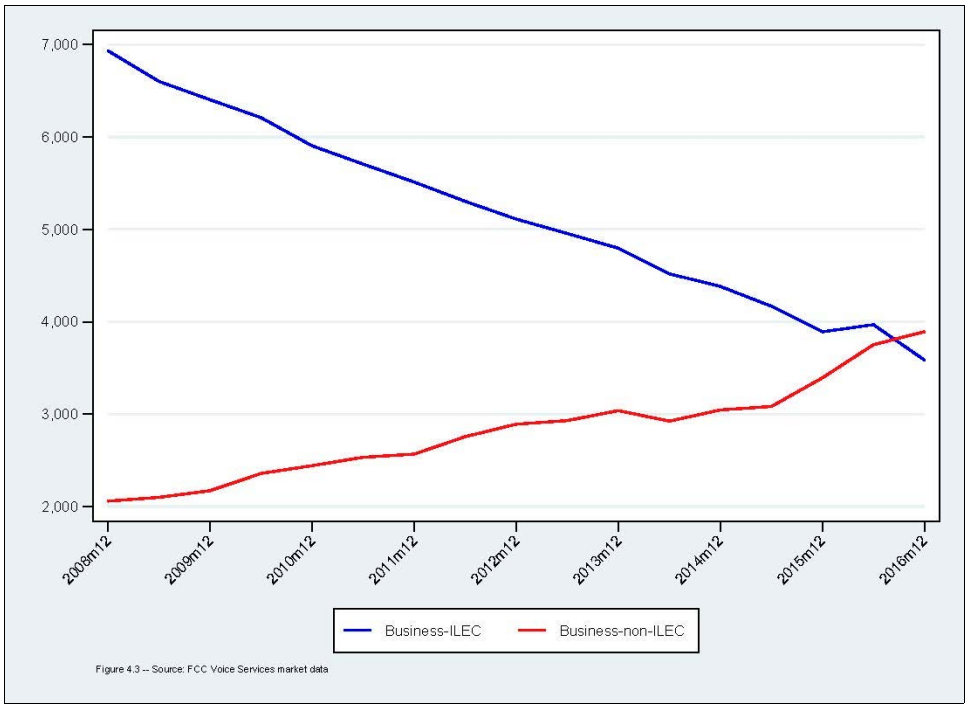


Figure 4.3. ILEC business customers also migrated to competing service providers that offer SIP trunking, virtual PBX, and other VoIP services.

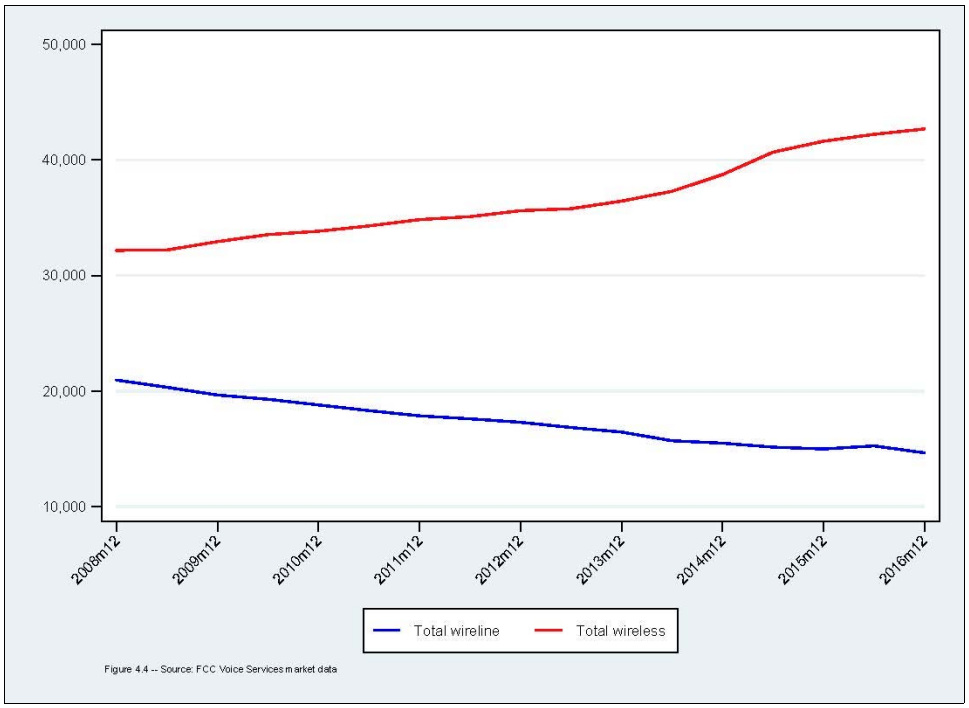


Figure 4.4. Perhaps the largest source of the shift in demand away from ILEC and other wireline voice services in California has been the mushrooming growth in demand for wireless.

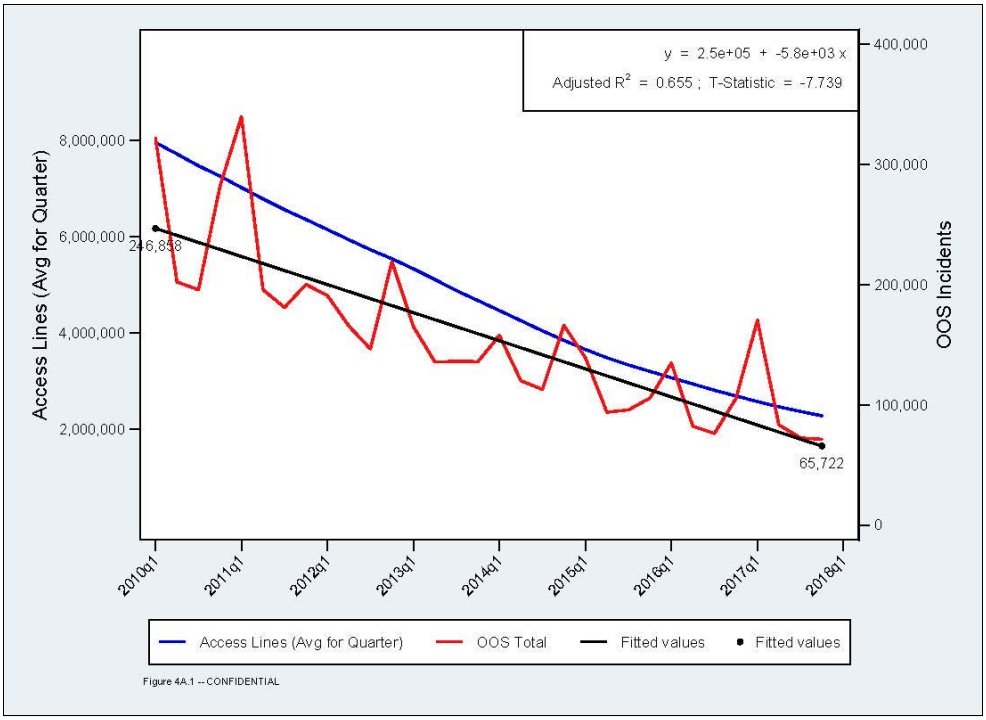


Figure 4.5. While the absolute number of AT&T California out-of-service incidents has decreased over the 2010-2017 study period, that drop has been less than in proportion to the drop in demand for legacy wireline services.

GO 133-C/D established a standard metric for assessing the service quality for local exchange service providers – Trouble Reports and Out-of-Service incidents per 100 POTS lines in service.[75] It is reasonable to expect that the number of reported maintenance and out-of-service issues will bear some fairly linear relationship with the number of POTS lines being provided. With the large decrease in the number of POTS lines in service over the study period, one would expect a corresponding decrease in the number of Trouble Reports and the number of out-of-service conditions, in proportion to the fall-off in access line demand.

As shown in more detail in Chapters 4A and 4F, the decrease in each of the ILEC's POTS lines in service and the fitted trend of total OOS incidents have been similar. Because there is considerable variation in the actual number of trouble reports received in any given month or quarter, Figure 4.5 provides a long-term trend line based upon the actual trouble report counts over time and compares this with a corresponding long term trend in POTS demand over the same period.

Notably, and for AT&T and Verizon/ Frontier, the rate of decrease in the total number of trouble reports over the full study period is of a similar magnitude to the rate of drop-off in

75. GO 133-C/D, §3.3, §3.4

access line demand. As discussed further in Chapters 4A and 4F for AT&T and Verizon/ Frontier, respectively, the drop-off in POTS demand has been greatest in the larger, metropolitan wire centers than in those serving the smaller rural areas. Ironically, it is also these larger metropolitan wire centers that have experienced the best levels of service quality overall.

The decline in customer demand for legacy POTS over the 2010-2017 period has been greatest in the larger, more metropolitan wire center areas. These same metropolitan area wire centers also exhibit the highest levels of service quality and greatest availability of alternative wireless and broadband services.

Identifying long-term trends from actual month-to-month experience

As noted, there is considerable month-to-month variation across all of AT&T's 615 California wire centers, and for AT&T California overall, in the number of trouble reports received and out-of-service situations reported. Figure 4.6 provides the number of AT&T out-of-service conditions per hundred POTS lines in service ("TRPH") on a quarterly basis from the first quarter of 2010 through the fourth quarter of 2017; there is considerable variation in this metric from period to period. For this reason, inspection of individual quarterly data over an extended period of time is not a useful means for identifying the long-term trend in this or other service quality metrics.

For example, in this instance, the number of OOS per 100 POTS lines in service in the first quarter of 2010 is actually greater than the corresponding metric for the last quarter of 2017. A simple comparison of the first and last quarters of the series without considering any of the intervening values would lead to the erroneous conclusion that the incidence of OOS had actually improved over the full study period. It is possible, however, to extract a long-term trend from data that exhibits considerable variation from period to period, as is the case here. This is accomplished by using statistical techniques, known as linear regression analysis that permit the calculation of a long-term trend by mathematically "fitting a line or curve" to the individual data points in the series, in effect, smoothing out the period-to-period variation so as to permit the observation of a long-term trend over the entire period. Figure 4.6 includes such a calculated trend line. The slope of the line is slightly negative – i.e., its direction is from lower-left toward upper-right – indicating that the number of out-of-service conditions per 100 POTS lines is *increasing* over time. Similar trend lines have been plotted on all of the time-series charts included in this report.

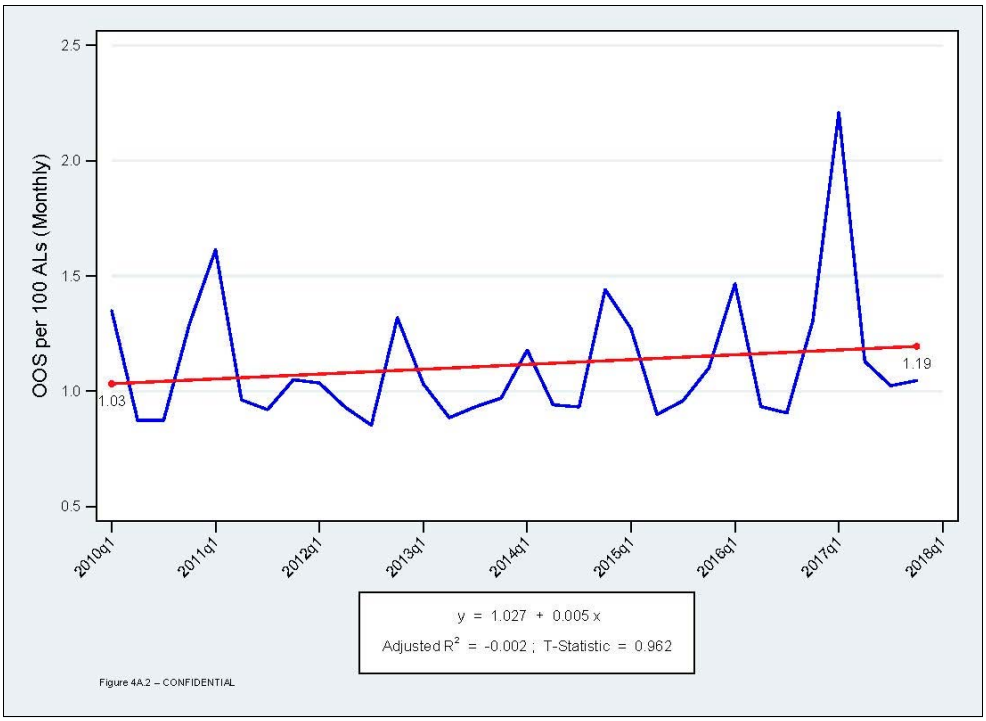


Figure 4.6. In order to examine how service quality metrics evolve over time, we use statistical techniques to calculate long-term trends from the pattern of month-to-month variations in the data.

A simple comparison of the beginning and ending values of the trend line (as distinct from the values of the data for the first and last quarters) provides an indication of the extent of the change over the study period. For the AT&T companywide OOS per 100 POTS lines in service shown on Figure 4.6, the trend line value for the first quarter of 2010 is 1.03 whereas the corresponding trend line value for the last quarter of 2017 is 1.19, indicating a net *increase* of approximately 15.5% in the number of OOS incidents per 100 POTS lines in service taken over the full study period.

☞ Over the full period, there has been a net increase of approximately 15.5% in the trend of OOS incidents per 100 POTS lines in service over the full study period.

Physical and Environmental Factors Affecting ILEC Service Quality

Over the full study period, there is a seemingly erratic pattern of out-of-service incidents. Rather than exhibiting minimal variation over time, instances of Trouble Reports resulting in a customer's loss of telephone service appear to be highly variable from one period to the next. Moreover, similar month-to-month and quarter-to-quarter variation appears to exist among multiple wire centers, suggesting that some exogenous or outside condition or event is having a similar effect upon the ILECs' networks across a fairly broad geographic area. One such exogenous source might well be weather or other environmental factors. In an attempt to explain the source of this variation, ETI compared the incidence of out-of-service with weather conditions extant at the time, specifically, with the amount of precipitation that occurred in the area being served by a given wire center.

Figures 4.7 and 4.8 compare the pattern of AT&T and Verizon/Frontier out-of-service conditions, respectively, in the greater Los Angeles area with the number of inches of precipitation experienced in the Los Angeles area on a monthly basis. We calculated the "coefficient of determination" (R^2) between these two series. R^2 represents the percentage of variation in the "dependent" variable (number of out-of-service incidents in this case) that can be explained by variation in the independent or "explanatory" variable, precipitation in this instance. For AT&T, the R^2 was 0.4221, indicating that roughly 42.21%, of the variation in the incidence of an out-of-service condition is attributable to the amount of rainfall occurring in any given period. The *t*-statistic associated with the Precipitation coefficient was 8.29, placing the computed relationship between precipitation and out-of-service incidents well in excess of the 99% confidence level. For Verizon/Frontier, the R^2 was almost the same, at 0.3976, and the *t*-statistic associated with the Precipitation coefficient was 7.75, also placing the computed relationship between precipitation and out-of-service incidents well in excess of the 99% confidence level. There are, to be sure, other weather and environmental factors as well, such as wind, earthquakes, fires, floods, mudslides, etc., that may have a bearing upon the incidence of an out-of-service situation. Weather conditions may help to explain the variations in OOS situations, but they do not explain the long-term upward trends both in numbers and average duration that the data appear to suggest.

In certain cases, out-of-service incidents attributable to adverse weather conditions may be deemed beyond ILEC management's control, resulting in such events being "excluded" for purposes of GO 133-C/D service quality measurements and tracking. But while the precise dates and extent of such conditions cannot be known in advance, *the fact that these events will arise at some point over time is well known and highly predictable, and certainly should be a major consideration in the engineering and construction of telecommunications distribution networks*.

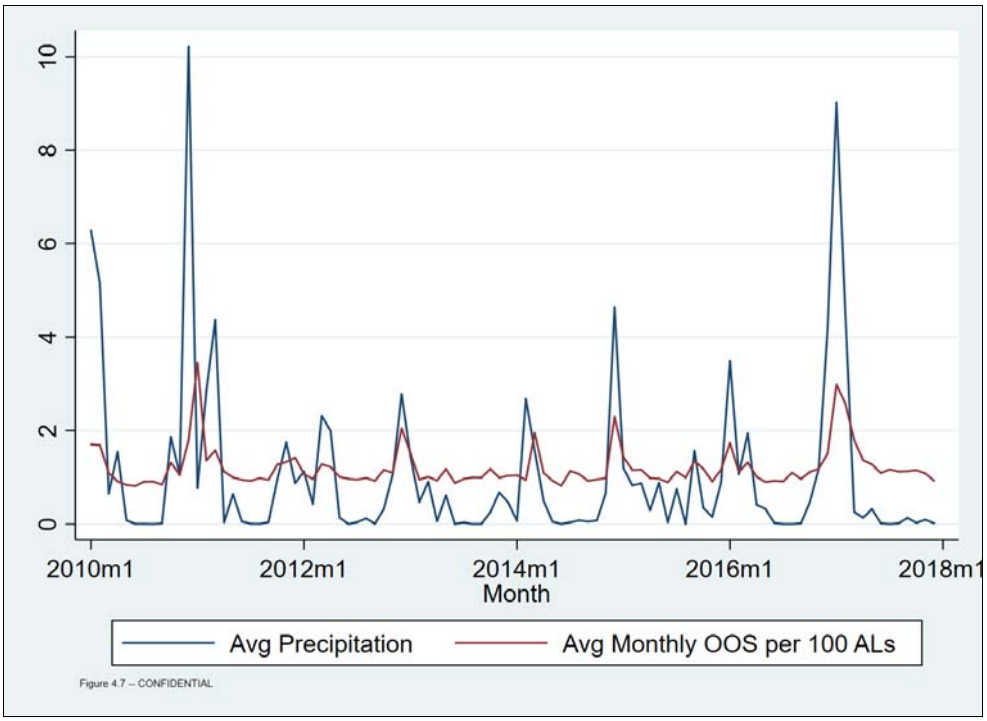


Figure 4.7. The incidence of AT&T service outages is highly correlated with weather conditions – particularly with precipitation.

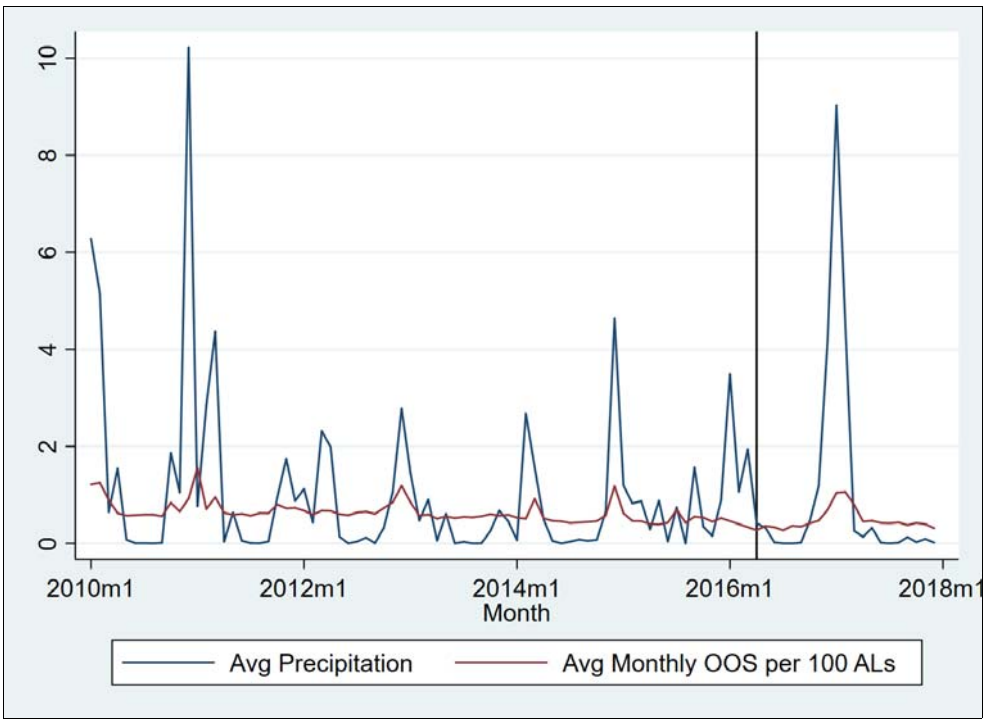


Figure 4.8. The incidence of service outages is highly correlated with weather – Los Angeles area precipitation and Verizon/Frontier LA-area out-of-service incidents (2010-2017).

The strong relationship between rainfall and the rate of service outages as shown on Figures 4.7 and 4.8 is a strong indication that both ILECs' distribution networks in the greater Los Angeles area are not as robust as they need to be to account for local weather conditions over time. Weather or any other environmental factors that "caused" a particular out-of-service incident may (arguably) make that event "beyond management's *immediate* control," but the design and construction of the distribution network must account for these types of weather conditions. And that is certainly well within the scope of "management's control" and responsibilities.

☞ Telephone service outages appear to be highly dependent upon weather conditions, specifically, the amount of precipitation in the area served.

☞ The strong relationship between rainfall and the rate of service outages provides a strong indication that the AT&T distribution network is not as robust as it needs to be, and lacks the resiliency to withstand significant weather events.

Analysis of Principal Service Quality metrics: Service Quality at the individual wire center level

GO 133-C/D directs URF ILECs to report, at the wire center level and on a monthly basis, the total number of Trouble Reports received during the month, the total number of working residential and small (up to five lines) business POTS lines being served by each wire center during the month, and a calculation of Trouble Reports per Hundred (100) POTS Lines in service ("RPHL") for the month.[76] Reports are to be submitted on a quarterly basis within 45 days following the end of the quarter.[77] The ILECs are required to report out-of-service conditions only at the statewide level, not on an individual wire center basis.[78] However, carriers are nevertheless required to submit the underlying ("raw") Trouble Report data, i.e., the individual out-of-service records.[79] Using this individual Trouble Report data, ETI has been able both to reconstruct the RPHL results for each wire center/month, but also to develop out-of-service per 100 POTS lines in service on a monthly, per wire center basis.

76. GO-133-C, §3.3(d).

77. *Id.*, §6.2.

78. *Id.*, §3.4(d).

79. *Id.*

Appendices 4A-1, 4V-1,and 4F-1 contain the actual out-of-service statistics for each of the AT&T, Verizon, and Frontier wire centers on a quarterly basis for the entire 96-month period, from January 2010 through and including December 2017. A sample of one such wire center report, for the AT&T Calistoga wire center, is shown in Table 4.5 below. Although monthly data for each wire center is available in the raw Trouble Report datasets, ETI has prepared these reports on a quarterly basis in order to smooth out month-to-month variations as well as to provide a more convenient tabulation.

Details of ETI's analysis of AT&T and Verizon/Frontier Trouble Report and Out-of-Service data is provided for each company in Subchapters 4A and 4F following.

AT&T
Trouble Report and Out-of-Service Data
2010, Q1 - 2017, Q4

Wire Center Name - CALISTOGA

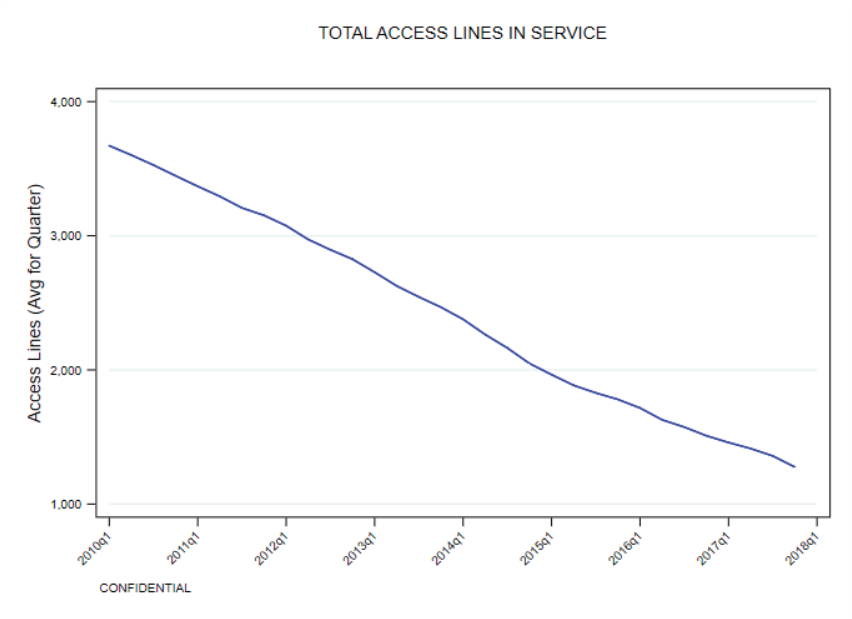
Wire Center Number - CALISTOGA

CLLI Code - CLSTCA11

Table

Quarter	Access Lines (Avg. for Quarter)	TR Total	OOS Total	Pct Cleared w/in 24 Hours (Actual)	Pct Cleared w/in 24 Hours (Adjusted)	Days to 90% OOS Cleared (Actual)	Days to 90% OOS Cleared (Adjusted)	Average Duration OOS>1 Hour (mins) (Actual)	Average Duration OOS>2 4 Hours (mins) (Actual)	TRs per 100 ALs	OOSs per 100 ALs	OOS>2 4 per 100 ALs	Average Duration OOS (mins) (Actual)	Median Duration OOS (mins) (Actual)	OOS <= 1 Hour (Actual)	OOS > 1 Hour (Actual)	OOS > 6 Hours (Actual)	OOS > 12 Hours (Actual)	OOS > 24 Hours (Actual)	OOS > 1 Week (Actual)	Average Duration OOS (mins) (Adjusted)	Median Duration OOS (mins) (Adjusted)	OOS <= 1 Hour (Adjusted)	OOS > 1 Hour (Adjusted)	OOS > 6 Hours (Adjusted)	OOS > 12 Hours (Adjusted)	OOS > 24 Hours (Adjusted)	OOS > 1 Week (Adjusted)	Average Duration OOS>2 4 hours (mins) (Adjusted)
2010q1	3,672	224	224	23.66	24.55	7	6	4644	5641	2.03	2.03	1.55	4479	3282	8	216	204	197	171	28	3904	3044	8	216	204	195	169	23	4945
2010q2	3,601	140	140	22.86	22.86	7	6	4833	5623	1.30	1.30	1.00	4454	3503	11	129	120	119	108	19	3831	2933	11	129	120	119	108	13	4816
2010q3	3,527	111	111	39.64	46.85	5	4	3674	5172	1.05	1.05	0.63	3378	1679	9	102	90	85	67	8	2928	1638	9	102	90	83	59	6	4904
2010q4	3,447	189	189	32.28	34.39	9	7	4951	6640	1.83	1.83	1.24	4768	2642	7	182	170	163	128	33	4174	2062	7	182	169	157	124	27	5946
2011q1	3,369	268	206	33.01	62.62	5	3	3361	4479	2.65	2.04	1.37	3247	2223	7	199	181	173	138	18	2234	1538	6	126	116	108	77	2	3263
2011q2	3,294	188	147	39.46	59.86	3	2	2585	3521	1.90	1.49	0.90	2392	1587	11	136	125	113	89	6	1758	1449	11	103	93	82	59	1	2788
2011q3	3,208	127	96	67.71	83.33	2	1	1482	2897	1.32	1.00	0.32	1420	1184	4	92	69	64	31	0	1061	952	5	76	54	48	16	0	2624
2011q4	3,152	141	103	45.63	72.82	5	3	3057	4836	1.49	1.09	0.59	2939	1573	4	99	84	76	56	5	1803	1232	4	70	55	48	28	1	3679
2012q1	3,075	144	115	49.57	65.22	3	2	1925	2952	1.56	1.25	0.63	1808	1454	7	108	88	82	58	1	1402	1280	8	90	72	65	40	0	2540
2012q2	2,972	157	125	55.20	68.00	3	3	2500	4500	1.76	1.40	0.63	2441	1362	3	122	108	93	56	4	2291	1383	3	85	74	68	40	2	4071
2012q3	2,896	112	90	55.56	70.00	4	3	2765	4855	1.29	1.04	0.46	2612	1373	5	85	76	70	40	2	2114	1307	5	74	66	58	27	1	4629
2012q4	2,825	201	155	35.48	55.48	6	5	3784	5275	2.37	1.83	1.18	3662	2572	5	150	135	129	100	14	2793	1640	5	114	102	92	69	5	4315
2013q1	2,728	179	123	53.66	60.98	4	3	2414	4033	2.19	1.50	0.70	2258	1376	8	115	102	89	57	2	1840	1325	8	101	87	74	48	1	3343
2013q2	2,626	152	111	49.55	63.06	3	2	1989	2851	1.93	1.41	0.71	1829	1459	9	102	92	88	56	0	1501	1399	10	81	73	69	41	0	2397
2013q3	2,544	153	114	34.21	47.37	4	3	2868	3856	2.00	1.49	0.98	2742	2599	5	109	97	89	75	2	2068	1759	5	94	84	74	60	0	3021
2013q4	2,467	121	92	47.83	60.87	4	3	2476	3577	1.63	1.24	0.65	2234	1454	9	83	77	72	48	2	1797	1387	9	66	61	56	36	2	2947
2014q1	2,377	166	130	20.00	37.69	7	6	5215	6023	2.33	1.82	1.46	4935	4089	7	123	120	114	104	25	3809	2827	7	101	98	93	81	8	4867
2014q2	2,264	99	98	47.96	70.41	6	4	3389	5482	1.46	1.44	0.75	3113	1471	8	90	70	67	51	9	2485	1325	8	54	45	41	29	4	4697
2014q3	2,164	88	59	37.29	61.02	5	4	3128	4166	1.36	0.91	0.57	2810	1799	6	53	46	44	37	2	2333	1623	6	33	30	29	23	1	3593
2014q4	2,048	174	141	23.40	55.32	9	7	6682	8166	2.83	2.29	1.76	6398	4417	6	135	124	120	108	48	4682	2957	6	85	75	72	63	20	6513
2015q1	1,965	204	167	20.96	50.30	14	10	9079	10789	3.46	2.83	2.24	8644	5996	8	159	146	144	132	63	6518	3144	8	109	96	94	83	25	8976
2015q2	1,885	90	61	31.15	50.82	4	3	4437	5958	1.59	1.08	0.74	4365	2536	1	60	56	54	42	4	3056	1741	1	51	47	44	30	1	4682
2015q3	1,829	72	54	35.19	48.15	5	4	3053	4139	1.31	0.98	0.64	2941	1751	2	52	47	45	35	3	2361	1532	2	48	42	40	28	2	3665
2015q4	1,780	129	92	28.26	45.65	6	5	4385	5559	2.42	1.72	1.24	4147	2714	5	87	79	74	66	15	3567	2679	5	66	58	56	50	7	4863
2016q1	1,716	205	165	24.24	47.88	8	7	5582	6850	3.98	3.20	2.43	5379	4378	6	159	150	145	125	40	4363	3322	6	114	105	101	86	22	5824
2016q2	1,628	85	68	48.53	63.24	3	2	3973	6684	1.74	1.39	0.72	3740	1486	4	64	52	47	35	3	3695	1455	4	46	36	33	25	2	6839
2016q3	1,574	100	86	39.53	81.40	3	4	2386	3480	2.12	1.82	1.10	2303	2286	3	83	68	59	52	1	1909	1367	3	31	23	22	16	0	3428
2016q4	1,509	133	101	12.87	40.59	6	5	4996	5490	2.94	2.23	1.94	4848	4490	3	98	93	92	88	12	4186	4414	2	70	65	64	60	4	4918
2017q1	1,459	236	191	16.75	79.06	13	12	9054	10511	5.39	4.36	3.63	8817	8953	5	186	171	164	159	106	8215	7222	0	47	40	40	40	21	9613
2017q2	1,414	92	69	34.78	63.77	5	4	3364	4568	2.17	1.63	1.06	3169	2789	4	65	53	53	45	2	2518	1628	4	43	35	35	25	0	4177
2017q3	1,359	67	48	41.67	66.67	5	3	2797	4168	1.64	1.18	0.69	2681	1732	2	46	37	35	28	3	2115	1422	2	30	22	21	16	1	3671
2017q4	1,276	165	149	19.46	63.76	45	39	19842	23352	4.31	3.89	3.13	18910	5913	7	142	133	129	120	66	15620	3693	7	69	63	59	54	26	21818

Figures



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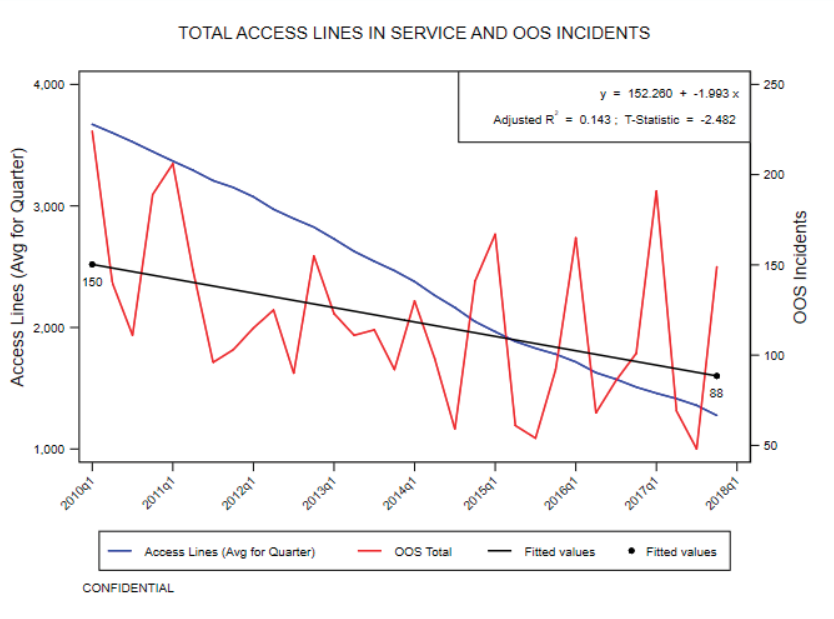

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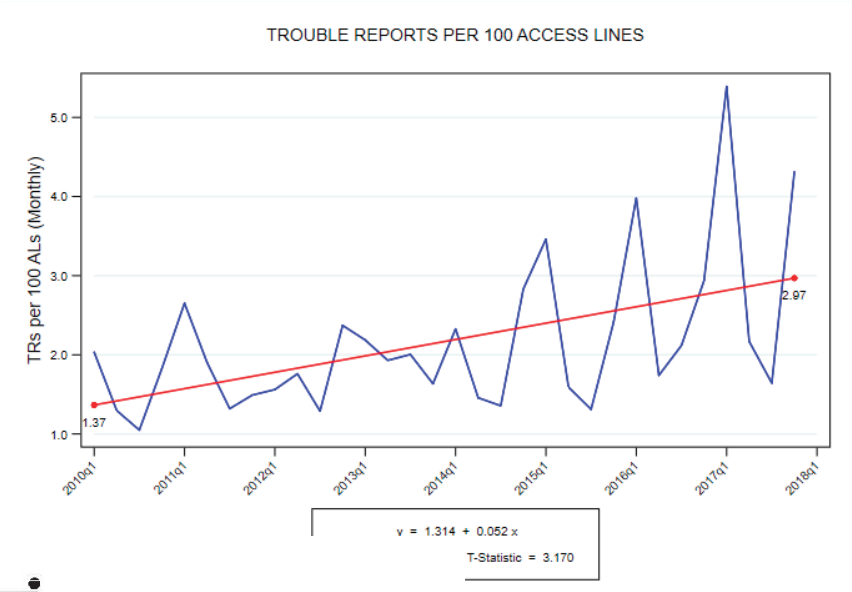

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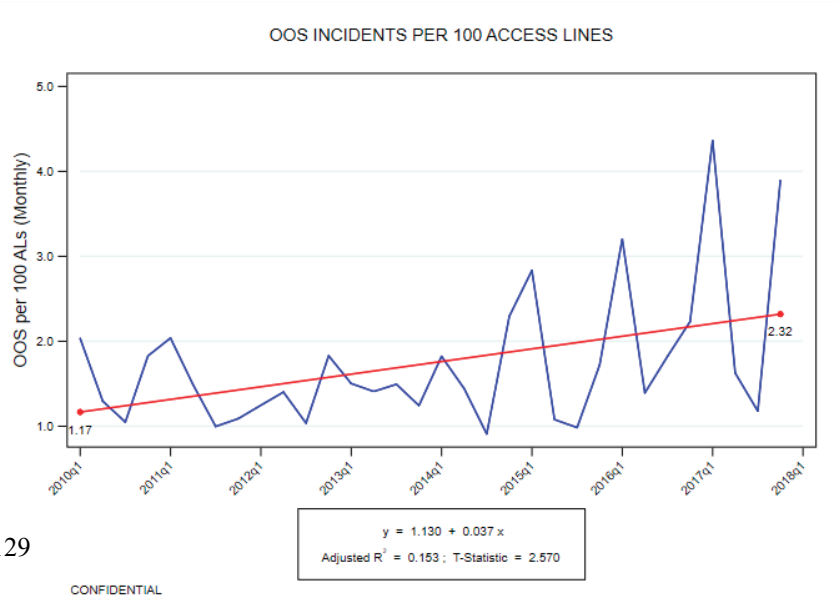

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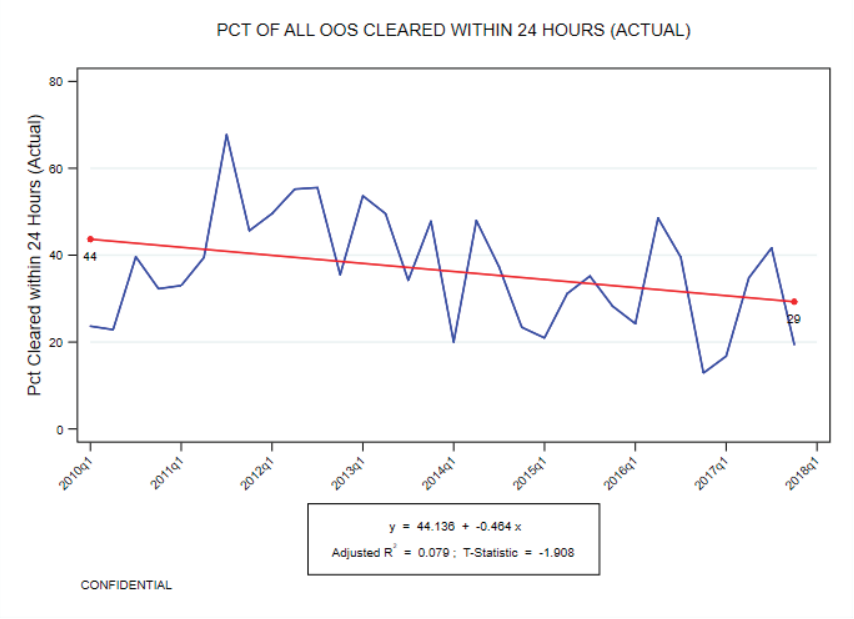

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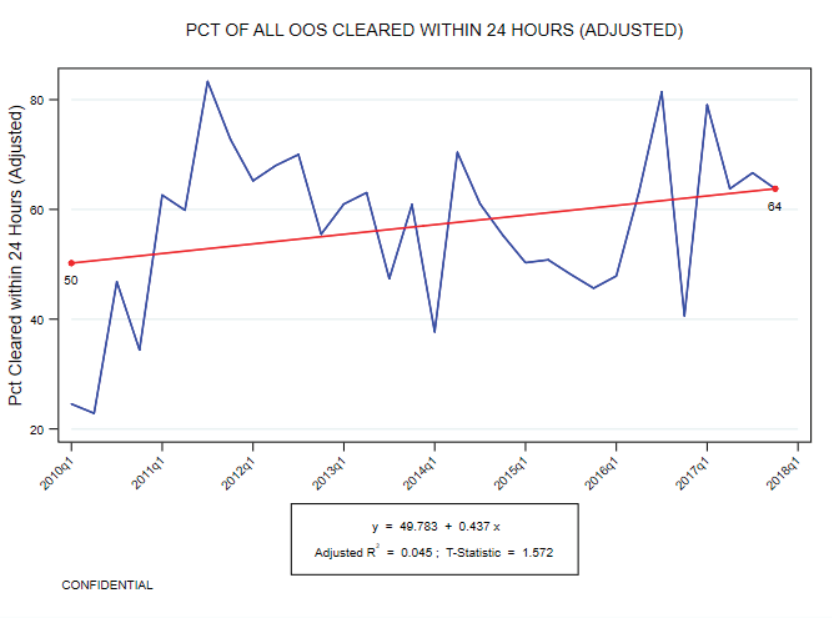

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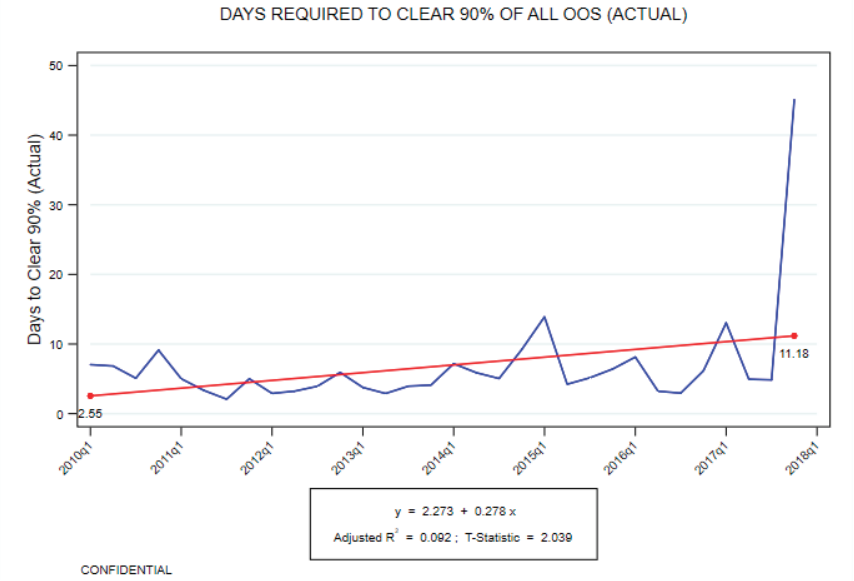

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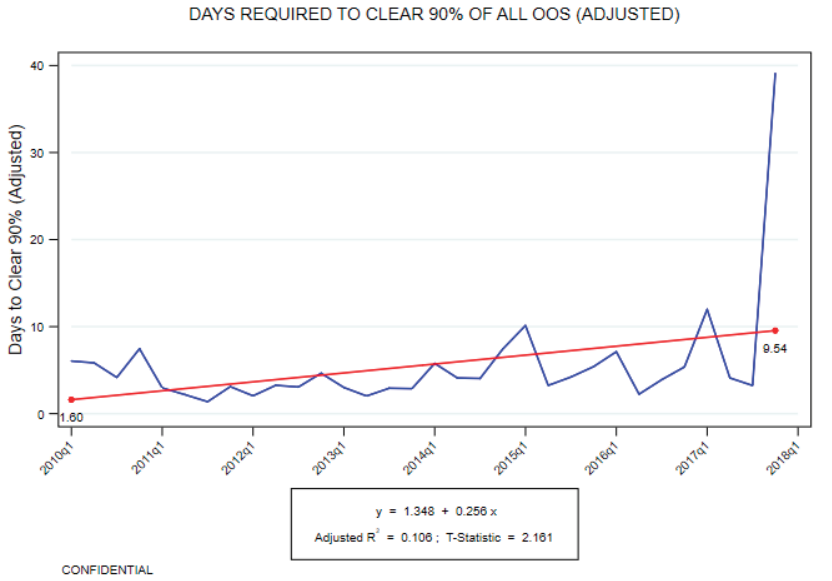

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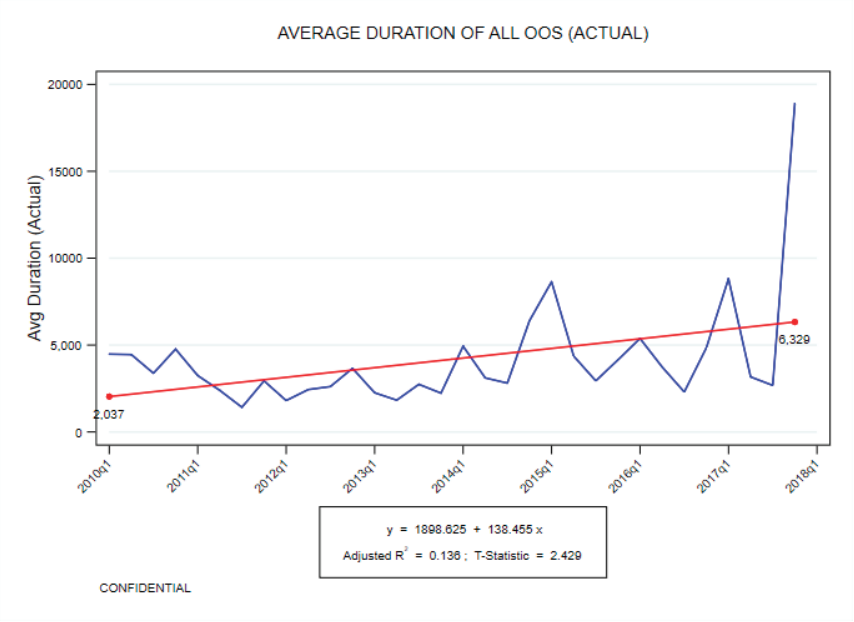

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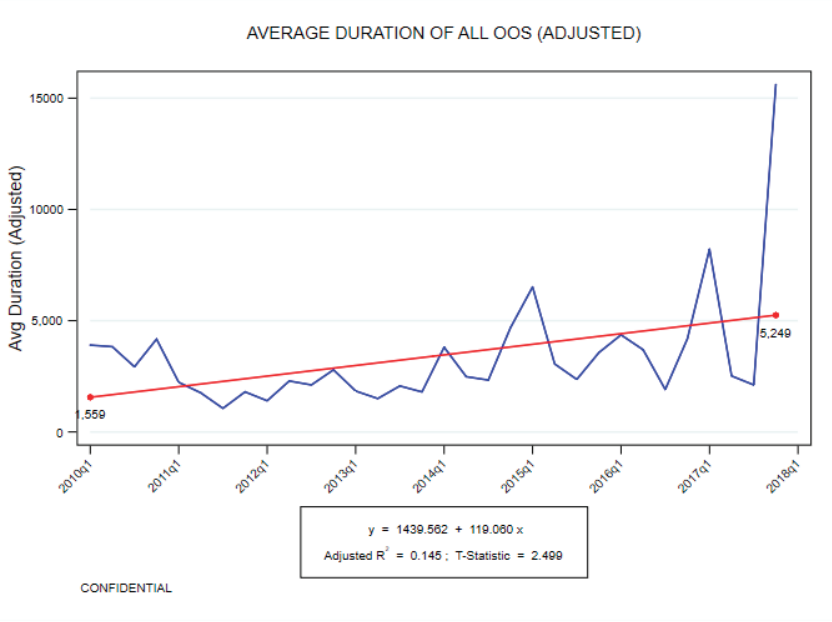

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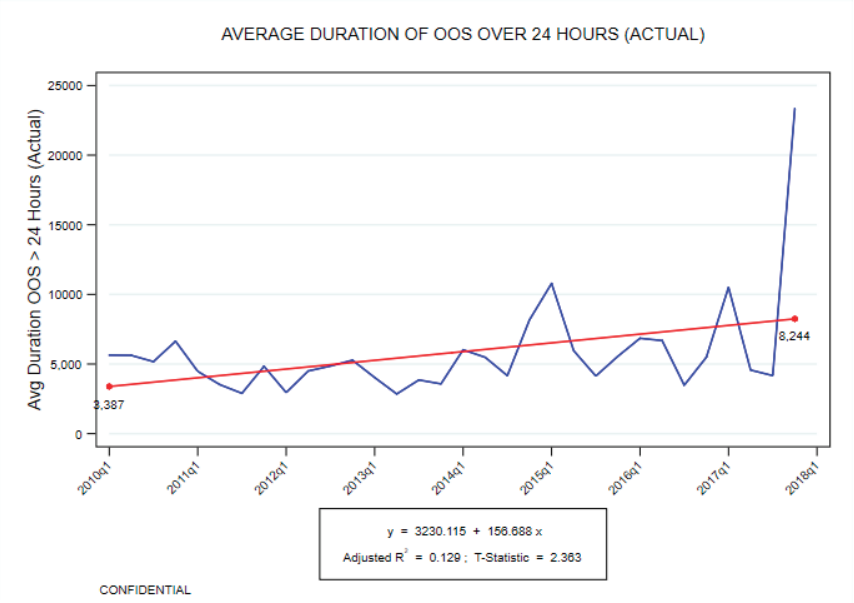

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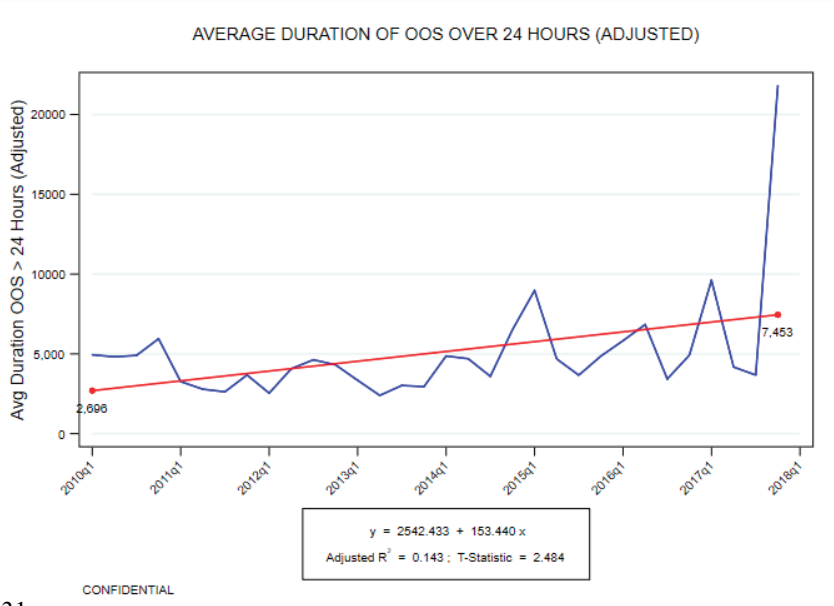

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