

SECRETARY'S RECORD, PUBLIC SERVICE COMMISSION

BEFORE THE NEBRASKA PUBLIC SERVICE COMMISSION

In the Matter of the Nebraska) Application No. 911-075/
Public Service Commission, on its) PI-248
own motion, conducting an)
investigation into the 911)
service outage that began on)
August 31, 2023 in areas of)
Nebraska served by Lumen and its)
affiliates.)

In the Matter of the Nebraska) Application No. 911-077/
Public Service Commission, on its) C-5581/PI-252
own motion, conducting an)
investigation into 911 service) ORDER ISSUING FINDINGS AND
outages occurring in areas of) CLOSING INVESTIGATION
Nebraska served by Lumen and its)
affiliates.) Entered: January 14, 2025

BY THE COMMISSION:

The Nebraska Public Service Commission ("Commission") opened this docket on September 12, 2023, in order to investigate the 911 emergency telecommunications service outage that occurred over a wide area of the Lumen¹ network in Nebraska beginning at approximately 7:00 p.m. on Thursday, August 31, 2023, and ending at approximately 7:20 a.m. on Friday, September 1, 2023 ("August 2023 Outage"). During the Outage, callers who dialed 911 in the affected area received a busy signal and calls were not delivered to 911 call centers (also known as Public Safety Answering Points or "PSAPs").

The Nebraska Public Service Commission opened docket 911-077/C-5581/PI-252 on April 17, 2024, after service was again disrupted in Lumen service areas, impacting multiple Public Safety Answering Points ("PSAPs") across Nebraska ("April 2024 Lumen Outage") resulting in the Commission opening a second investigation. On July 9, 2024, ("July 2024 Lumen Outage") a third outage occurred impacting Lumen customers in Nebraska. On August 20, 2024, the Commission entered an Order Expanding Investigation

¹ In its response to the Commission's first set of data requests, which is present in the record as Exhibit 6, Lumen asserts that CenturyLink Communications, LLC d/b/a Lumen Technologies Group is the entity involved in this Outage investigation. Again, during the hearing, Kate McNamara representing Lumen confirmed this information. See Transcript at 89. To keep the record consistent, they will continue to be referred to as "Lumen".

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under Docket No. 911-077/C-5581/PI-252 to include both the April and July 2024 outages.

The Commission opened these investigations to determine the cause or causes of the Outages, including, without limitation, an evaluation of all aspects of the 911 system that were impacted, in order to ascertain what actions may be warranted by the Commission to respond to this Outage and prevent such occurrences in the future. The Commission also sought to determine why the Outages resulted in the loss of 911 service to varying areas and degrees across Nebraska.²

In conducting this investigation, the Commission conducted data requests, held two public hearings, and sought analysis from an outside expert. The initial public hearing was held January 4, 2024, and the second hearing occurred November 4, 2024.

T E S T I M O N I A L E V I D E N C E

Hearing on January 4, 2024

A hearing in this matter was held on January 4, 2024. Sallie Dietrich appeared on behalf of the Commission's State 911 Department ("Department"). Katherine McNamara appeared on behalf of Lumen. Exhibits numbered 1 through 52 were offered and accepted at hearing. Exhibit 53 was entered as a late-filed exhibit.

David Sankey, Director of the Commission's 911 Department³, testified on behalf of the Commission. Mr. Sankey stated that on August 31, 2023, at approximately 7:30 p.m. he received a phone call from Kathy Allen, the Director of the Douglas County Emergency Communication Center.⁴ Mr. Sankey stated that Ms. Allen told him that the Douglas County 911 Center was experiencing a disruption in 911 calls, apparently due to a Lumen outage.⁵ Mr. Sankey stated

² 911 service providers are required to maintain geographically diverse redundant connections between PSAPs and the telecommunications infrastructure that delivers 911 calls to their intended destinations. *See, e.g.*, 47 C.F.R. § 9.19.

³ Transcript at 16-17.

⁴ *Id.* at 12.

⁵ *Id.*

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that based on that phone call, he contacted Lumen officials to determine the cause and scope of the outage.⁶

Mr. Sankey stated that he then directed Department staff to begin contacting PSAPs to determine which PSAPs were affected by the 911 disruption.⁷ Mr. Sankey stated that he also contacted Commissioners and other officials to notify them of the outage, as well as the Commission's media coordinator in order to provide information to the public through the news media.⁸

Mr. Sankey stated that one of the first areas on which he sought clarification was whether the outage was due to an issue with the legacy 911 system, or whether it affected the Next Generation 911 ("NG911") System and the Emergency Services Internet Protocol Network ("ESInet").⁹ Mr. Sankey explained that in 2021, the Commission entered into a contract with Lumen to provide a statewide ESInet and NG911 Core Services, and to transition the sixty-eight PSAPs across the state to the NG911 system.¹⁰ Mr. Sankey testified that at the time the Outage occurred, thirty-nine of Nebraska's PSAPs had transitioned to the NG911 system.¹¹

Mr. Sankey stated that the initial reports the Department received appeared to show that the disruption was impacting both PSAPs that were still in the legacy 911 system, and PSAPs that had transitioned to NG911.¹² Mr. Sankey stated that some PSAPs were receiving calls intermittently; some were not receiving 911 calls, but their administrative lines were working; and some were not receiving calls on either their 911 or their administrative lines.¹³ Mr. Sankey stated that initial reports from both Lumen and most PSAPs indicated that the ESInet was not impacted by the

⁶ *Id.*

⁷ *Id.* at 13.

⁸ *Id.* Mr. Sankey also testified that Commission staff worked with representatives of PSAPs, the Nebraska Emergency Management Agency ("NEMA"), and the governor's office to notify the public using traditional news media, social media, and the Wireless Emergency Alert System. *Id.* at 15.

⁹ *Id.* at 13.

¹⁰ *Id.* at 13-14. See also State of Nebraska Service Contract Award, Contract Number 928504, available [here](#).

¹¹ Transcript at 14.

¹² *Id.* at 14.

¹³ *Id.*

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Outage.¹⁴ He further stated that it appeared that the PSAPs served by legacy Lumen 911 selective routers in Omaha and Grand Island were the most impacted.¹⁵ However, some of the PSAPs served by the Norfolk and Sioux City selective routers were also impacted.¹⁶ Initial reports indicated that forty-one of the state's PSAPs were impacted in some fashion.¹⁷

Mr. Sankey stated that during the evening hours of August 31st, Lumen officials informed Commission staff that they had preliminarily determined the cause of the Outage to be a fiberoptic cable that was severed by a third-party contractor in the Omaha area at approximately 7:05 p.m.¹⁸ Mr. Sankey testified that at approximately 5:30 a.m. the following day, Lumen reported that repairs had been made and services were beginning to restore.¹⁹ It took several hours for services to restore to all PSAPs.²⁰

Mr. Sankey stated that the Commission received an email from Al Lubeck, public policy director for Lumen, that advised there were two cable²¹cuts in Lumen's network.²² The email advised the first cut occurred in a secondary route in Minneapolis, Minnesota on August 30, 2023, and the second cut occurred on the primary route for their network in Omaha the next day.²³

Mr. Sankey stated that his team confirmed from Lumen officials that the repair to the fiber cut that occurred in Minnesota was completed about 5:30 am on September 1st but that it took time for all 911 calls to be restored.²⁴ Mr. Sankey further explained that

¹⁴ *Id.*

¹⁵ *Id.*

¹⁶ *Id.* at 14-15.

¹⁷ *Id.* at 15.

¹⁸ *Id.*

¹⁹ *Id.*

²⁰ *Id.* at 15-16.

²¹ Throughout this order and testimony cable cuts are used as a general generic term but the cuts in this case were to fiber optic cable and not legacy copper cable.

²² *Id.* at 16.

²³ *Id.*

²⁴ *Id.* at 18.

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some 911 Center Administrative lines were impacted.²⁵ Administrative lines, according to Mr. Sankey, are not used for 911 calls but are used for other business and everyday use²⁶ and are what is considered a typical landline. Mr. Sankey further explained that most of the PSAPs were up and running by 9:30 or 10:00 a.m. on September 1st.²⁷

Mr. Sankey asserted that another Commission employee sent a letter to every PSAP in Nebraska, of which there are 68, asking about their experience during the outage. Thirty-eight of those 68 PSAPs responded.²⁸ Mr. Sankey affirmed that the counties impacted by the 911 outage included, Alliance, Antelope, Boyd/Holt, Buffalo, Butler, Cass, Cedar, Chadron, Chase, Cheyenne, Columbus, Cuming, Dawson, Dixon, Douglas, Falls City, Fillmore, Dodge, Furnas, Hall, Hamilton, Hastings, Holdrege, Jefferson, Johnson, Keith, Knox, McCook, Mid-Rivers, Morrill, Nemaha, Norfolk, North Platte, Perkins, Saline, Sarpy, Thayer, Thurston, and Washington.²⁹ In addition, the cities of Lincoln and South Sioux City and Region 26 were impacted.³⁰

In response to a question from a Commissioner, Mr. Sankey stated that Nebraska is in a transition period and that the expectation is to have all 911 Centers connected to the Next Generation 911 system. Additionally, all carriers will be using internet protocol, and the Legacy 911 system will no longer be necessary for the purpose of 911 calls.³¹

Mr. Sankey further stated that RapidSOS is a third-party application that uses crowdsourcing to help locate wireless calls.³²

²⁵ *Id.*

²⁶ *Id.* at 18-19.

²⁷ *Id.* at 19.

²⁸ *Id.* at 20. *See also* Exhibits 8-49.

²⁹ *Id.* at 21.

³⁰ *Id.*

³¹ *Id.* at 23.

³² *Id.* at 24.

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In response to a question from Commissioner Mirch, Mr. Sankey confirmed that all parties have been forthcoming and provided the information requested.³³

Regarding possible lessons learned from this outage, Mr. Sankey confirmed that working groups, including the 911 Service System Advisory Committee, are working on ways to contact PSAP's on a state-wide scale to gather information in emergency outage situations and to provide a model policy to help 911 Centers with tools to provide public information.³⁴

Following Mr. Sankey's testimony, Neil Miller, the Buffalo County Sheriff also provided information to the Commission.³⁵ Sheriff Miller has been the Sheriff of Buffalo County for 33 years with a total of 48 years of law enforcement experience.³⁶ Sheriff Miller oversees the 911 operations for Buffalo County which is part of the South Central Panhandle Region.³⁷

Sheriff Miller stated that the South Central Panhandle Region has 22 PSAPs, two of which are hosts that ESInet circuits feed into.³⁸ One host is located in Dawson County and the other, which is the system's primary host, is located in Buffalo County.³⁹ Sheriff Miller explained that all 911 calls for the South Central Region come in through the ESInet circuits to either the Dawson or Buffalo County PSAP. From there, the 911 calls are distributed to the remaining 20 PSAPs.⁴⁰ Sheriff Miller further explained that Lumen is responsible for delivering the circuit for the ESInet and for maintenance of their Viper call handling equipment^{41, 42}

Sheriff Miller indicated that Kearney has Frontier Communications, Citizen Communications as the local exchange

³³ *Id.* at 25.

³⁴ *Id.* at 26.

³⁵ *Id.* at 28.

³⁶ *Id.*

³⁷ *Id.* at 29.

³⁸ *Id.* at 31-32.

³⁹ *Id.* at 32.

⁴⁰ *Id.* at 34.

⁴¹ Call handling equipment is further explained at *Id.* at 36-37

⁴² *Id.* 32-33 and 36.

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carrier that provides the administrative lines.⁴³ They also have phone lines through the cable company and some Voice Over IP Lines.⁴⁴

Sheriff Miller went on to describe how conditional routing works.⁴⁵

Sheriff Miller stated that the Buffalo County PSAP did experience a 911 outage on August 31, 2023.⁴⁶ He went on to further explain that he heard from another PSAP that was experiencing an outage, and that Verizon was also experiencing an outage.⁴⁷ Sheriff Miller and staff received a fast busy signal when trying to call Dawson County 911 indicating they too were experiencing the outage. Sheriff Miller explained that the calls were made using a "First Net" phone rather than a Verizon phone. Sheriff Miller explained that all of these circumstances together indicated that there were multiple paths down.⁴⁸ Sheriff Miller stated he received a call back from a Dawson County 911 dispatcher who said they were not getting 911 calls, and their administrative lines were down. However, they were able to identify people calling 911 through RapidSoS and were calling people back using their personal cell phones.⁴⁹

Sheriff Miller stated that service was restored to that region at approximately 5:30 am on September 1, 2023, and that the outage lasted around 10 hours.⁵⁰ Sheriff Miller also indicated that some PSAPs were receiving some calls and couldn't be sure whether their system was working or not.⁵¹

Sheriff Miller confirmed that he was initially made aware of an outage from the Douglas County 911 director. Sheriff Miller subsequently heard from Verizon's Network Operation Center ("NOC")

⁴³ *Id.* at 37-38.

⁴⁴ *Id.* at 38.

⁴⁵ *Id.* starting at 38, continuing 55, 62-63, 79-82

⁴⁶ *Id.* at 40.

⁴⁷ *Id.* at 41.

⁴⁸ *Id.* at 42.

⁴⁹ *Id.* at 43-44.

⁵⁰ *Id.* at 45.

⁵¹ *Id.* at 46.

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that Verizon also had an outage at 7:36 p.m.⁵² Sheriff Miller stated that the first notification Buffalo County received from Lumen was at 8:39 p.m. and that Buffalo County received a total of 14 notifications regarding the outage.⁵³

Sheriff Miller explained that one of the initial emails received from Lumen indicated the cable cut occurred in Lincoln. However, throughout the outage, emails both confirmed the cuts occurred in Omaha and Minneapolis and gave updated information regarding repairs.⁵⁴ Sheriff Miller also stated that some PSAPs put out information regarding the outage on social media, through traditional media outlets, and via the wireless emergency alerting system to ensure the public was aware of the situation.⁵⁵

Sheriff Miller went on to state that of their 22 PSAPs, 19 were impacted⁵⁶ and three remained in service: Scotts Bluff, Morrill, and Kimball.⁵⁷ Between what was in service and what wasn't and the equipment each center uses, Sheriff Miller opined that the ESInet was operational.⁵⁸ Sheriff Miller indicated that some long-distance calling was operational and some wasn't and cell service was dependent on the brand of cellphone.⁵⁹ Also, Sheriff Miller stated that Dawson County's "Plain Old Telephone Services" ("POTs") were also down.⁶⁰

Sheriff Miller also asserted that while Lumen informed them that service was restored at 5:30 a.m., some locations didn't come back up until around 7:30 a.m.⁶¹ Sheriff Miller also opined that Lumen correctly stated that there was a fiber cut in two locations and that 911 calls need to be taken off the selective routers and be sent directly to the ESInet points of interconnection.⁶²

⁵² *Id.* at 47.

⁵³ *Id.* at 48-49.

⁵⁴ *Id.* at 49-50.

⁵⁵ *Id.* at 54.

⁵⁶ *Id.* at 55.

⁵⁷ *Id.* at 57.

⁵⁸ *Id.* at 56-57.

⁵⁹ *Id.* at 58.

⁶⁰ *Id.* at 59.

⁶¹ *Id.* at 60.

⁶² *Id.*

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In terms of lessons that could be learned from this outage, Sheriff Miller stated that one would be ensuring that administrative lines are serviced by different carriers, efficient methods for notifying PSAPs when there is an outage, how to use a Wireless Emergency Alert to the public.⁶³

Sheriff Miller also explained in detail what would have happened should there be a failure after a 911 call reaches the ESInet.⁶⁴

Sheriff Miller confirmed that there was one hour and three minutes between the time that Sheriff Miller knew of the outage and when the first notification was received from Lumen.⁶⁵

Sheriff Miller also opined that due to the importance of the underground fiber, that persons who dig and are negligently responsible for cable cuts should be held accountable and that due to the various ways fiber may be cut, location, and how soon a splicing crew can get to the location of the cut will impact the duration of an outage.⁶⁶

On behalf of Lumen, attorney Kate McNamara summarized the evidence presented up until that point. Ms. McNamara stated that the outage started at approximately 7:05 p.m. on August 31, 2023 and went until approximately 5:32 am on September 1, 2023.⁶⁷ She stated that neither the legacy 911 network nor the ESInet was impacted by the cable cuts. She asserted that this was an ingress outage caused by two separate fiber cuts in two different geographic locations.⁶⁸ The first was in Minneapolis and was referred to as fiber cut one and the second in Omaha referred to as fiber cut two.⁶⁹ Ms. McNamara further stated that the outage impacted Lumen's Transport Network which transports 911 calls from an aggregation point in Grand Island, Nebraska to the Intrado 911

⁶³ *Id.* 61-64.

⁶⁴ *Id.* 70-72

⁶⁵ *Id.* at 74.

⁶⁶ *Id.* at 75.

⁶⁷ *Id.* at 90.

⁶⁸ *Id.*

⁶⁹ *Id.* at 90-91.

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core.⁷⁰ Ms. McNamara further asserted that once the cut in Minnesota was repaired, the issue was resolved and that Lumen had the appropriate redundancy measures in place and that the outage was caused by third-parties and events outside Lumen's control.⁷¹

Mr. Drew Groff, Director for Lumen's network operations center, public safety services and compliance, and Lumen employee for approximately 23 years, provided pre-written testimony as exhibit 51 and answered questions at the hearing.⁷²

Mr. Groff stated that fiber cut one occurred on August 30, 2023, at approximately 1:05 p.m. near railroad tracks in Minneapolis, Minnesota by a contractor even though the fiber had been properly located by Lumen's third-party contractor hired to locate buried fiber.⁷³ Lumen submitted a claim for reimbursement due to the contractor's mistake.⁷⁴

Mr. Groff stated that fiber cut two occurred on September 1, 2023, at approximately 7:05 p.m. in Omaha, Nebraska and caused by an Allo Communications contractor.⁷⁵ The same third-party company contracted by Lumen to locate in Minnesota, failed to locate the buried fiber in this case.⁷⁶

Mr. Groff further stated that these two fiber cuts did not impact either the E-911 or the NG911 networks and was instead an ingress outage, meaning it was an interruption on the network that transports 911 calls from the aggregation point to the Intrado NG-911 core and that the 911 network is separate from the signaling network and its these two networks that complete calls to 911.⁷⁷

Mr. Groff also explained more information about the ESInet and the infrastructure that routes emergency calls.⁷⁸

⁷⁰ *Id.* at 91.

⁷¹ *Id.*

⁷² *Id.* at 92.

⁷³ Exhibit 51, page 3, lines 6-14, Transcript

⁷⁴ *Id.*

⁷⁵ Exhibit 51, page 3, lines 15-25, Transcript

⁷⁶ Exhibit 51, page 3-4, lines 21-22, lines 1-2

⁷⁷ Exhibit 51, page 4, lines 17-21 and page 5, 1-5

⁷⁸ Exhibit 51, pages 4-5, lines 7-16.

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Mr. Groff explained SS7 signaling technology and what role it played in the August outage.⁷⁹

Mr. Groff also identified additional diverse routes on common protected fiber rings terminating in Omaha that were able to be groomed that increased diversity as of September 8, 2023.⁸⁰

Mr. Groff further explained that the impacted PSAPs were notified except the Boone County Sheriff.⁸¹ Mr. Groff indicated in his verbal statement that the fiber cut in Minneapolis "inhibited visibility to alarms for the type of alarms" that there are automated notifications for and therefore it took time to determine the impact and that caused the approximately one-hour delay for an initial manual notification to the PSAPs.⁸² Mr. Groff states that they have added additional diversity so that there is not a single path from Minneapolis to trigger automated alarms.⁸³

Mr. Groff stated that there are at least two paths from the NG-911 Core or Selective Router (Legacy 911 to the last service office) with additional layers of redundancy at different locations from the NG-911 Core to each PSAP.⁸⁴ In addition, Lumen identified additional fiber rings in the Grand Island area that may improve diversity by eliminating certain sections of the path over common rings.⁸⁵

Mr. Groff explained that in Grand Island there is an E911 selective router that is also serving as an aggregation switch that allows both wireline and wireless service providers to transport their voice traffic from their existing location to the Next Gen 911 network without having to move to a new location.⁸⁶

Mr. Groff went on to explain that the SS7 links that allow wireline voice calls to be placed from a switch, as a common point, direct where the call should go, and when SS7 is not available,

⁷⁹ Exhibit 51, pages 5, lines 18-21, page 6, lines 1-22.

⁸⁰ Exhibit 51, page 8, lines 10-20.

⁸¹ Exhibit 51, page 8, *See also*, Transcript at 137, 152.

⁸² Transcript 96, 152.

⁸³ *Id.* at 97.

⁸⁴ Exhibit 51, pages 9

⁸⁵ *Id.* at page 9

⁸⁶ *Id.* at 99.

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calls across a local transport area cannot be processed.⁸⁷ Therefore, the fiber cuts impacted both Lumen callers and any other providers that utilized Lumen, SS7, or Lumen switches.⁸⁸ Further, Mr. Groff stated that the fiber cuts impacted both paths causing the ingress outage.⁸⁹

Mr. Groff stated that he oversees the Network Operations Center that handles all 911 calls, both legacy and NextGen 911.⁹⁰

Mr. Groff stated that Lumen provides E911 service and holds the state contract to eventually provide service to all 68 PSAPs in the state with Next Gen 911.⁹¹ Mr. Groff stated that they provide 911 services to approximately 15 states and that they maintain information of all locations of physical facilities through a PSAP profile database that aggregates all the reference information.⁹² Mr. Groff further said that they do have access to all paths for fiber and cables but is not in a format that Mr. Groff's team would be directly interfacing with, and they would be working with Lumen's transport team in the case of an outage.⁹³

Mr. Groff was not familiar with Lumen's locate process but confirmed that it was conducted by a third-party contractor. In Nebraska, that contractor is Stake Center. Mr. Groff stated that he believed Stake Center is also the contractor in Minnesota, but admitted the contractor varies from state to state and does not have comprehensive knowledge of the vendors involved.⁹⁴ While Mr. Groff confirmed that Lumen tracks the average time repair a cable cut, he did not know what that time was but thought the target repair time is 12 hours.⁹⁵

Mr. Groff did not know how many technicians worked in Nebraska nor if there were technicians dedicated to any regions in Nebraska

⁸⁷ Id.

⁸⁸ Id.

⁸⁹ Id.

⁹⁰ Id. at 102.

⁹¹ Id. at 104.

⁹² Id. at 105.

⁹³ Id. at 106.

⁹⁴ Id. at 112.

⁹⁵ Id. at 113.

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nor if there were technicians dedicated to repairing fiber cuts.⁹⁶ Mr. Groff confirmed that Lumen does contract with third parties for the repair of cables but was unaware whether a third-party contractor was responsible for repairs in Nebraska or Minnesota.⁹⁷

For the first cut in Minneapolis, Mr. Groff stated that if Lumen opened a repair ticket, it would have been opened soon after an alarm was sounded after the cut, however he did not have those details.⁹⁸ Mr. Groff stated that generally with their automation, the ticket will be auto-generated when there is a disruption in service, a potential disruption in service, or a hazard condition.⁹⁹ Mr. Groff confirmed that any out-of-service impact, whether it was 911 or any other Lumen services, would be a priority over a loss of redundancy or hazardous-type condition.¹⁰⁰

Mr. Groff stated that a cable cut could impact IP, transport, and voice services for all Lumen customer types, including wholesale, but was not certain what services were affected for this event.¹⁰¹ Mr. Groff then explained how they troubleshoot and identify the location of an event.¹⁰² He then stated that they can usually locate a cut within a few feet.¹⁰³ However, Mr. Groff didn't know how long it took to get someone on site in Minnesota for that cut.¹⁰⁴ Mr. Groff confirmed that the repairs were completed at 5:31 a.m. on September 1, 2023.¹⁰⁵ Mr. Groff believed the repairs were delayed by concerns with the railroad, waiting for flaggers, and determining the length of fiber that needed to be replaced.¹⁰⁶

Regarding the second cut that occurred in Omaha on August 31, 2023, Mr. Groff confirmed that was also along a railroad and was national fiber in that it traverses the continental United States

⁹⁶ *Id.* at 114.

⁹⁷ *Id.* at 117.

⁹⁸ *Id.* at 119.

⁹⁹ *Id.* at 120.

¹⁰⁰ *Id.*

¹⁰¹ *Id.* at 123.

¹⁰² *Id.* at 124.

¹⁰³ *Id.* at 125.

¹⁰⁴ *Id.* at 126.

¹⁰⁵ *Id.* at 130.

¹⁰⁶ *Id.*

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and beyond.¹⁰⁷ Mr. Groff explained that this cut occurred because the fiber was mislocated.¹⁰⁸ Mr. Groff was unfamiliar with the details of that cut but reported that a claim was filed against a contractor. He did not know the status of the claim.¹⁰⁹

Similar to the comments Mr. Goff made on the Minneapolis cut, he believed delays in repairs were caused by the complexity of the cut occurring near the railroad and again requiring flaggers but did not know how many technicians were on site, nor where they were coming from when called out to complete the repairs.¹¹⁰ Mr. Groff stated that the repair crew was coming from Kansas but was unable to answer why they came from Kansas. Mr. Groff further indicated that there were contractors in Nebraska, but all crews were working on other emergencies and had no knowledge as to why other repairs were prioritized over this cut.¹¹¹ Mr. Groff stated that he was not aware of any other 911 outages at that time.¹¹²

Mr. Groff was once again unable to determine what services were impacted by these cuts or whether customers in other states may have been impacted. He did confirm that the 911 outage was limited to Nebraska.¹¹³ Mr. Groff also confirmed that PSAPs who were not impacted did receive a notification.¹¹⁴

Mr. Groff explained that Lumen contacts PSAPs individually to determine whether it was impacted by an outage and also conducts an actual network analysis and looking at facilities to determine the locations impacted.¹¹⁵

Mr. Groff stated that the first notification required by the FCC should occur as soon as possible and should include the impact of the outage, the location, the PSAP impacted, and the number of lines or population impacted.¹¹⁶

¹⁰⁷ *Id.* at 132-133.

¹⁰⁸ *Id.* at 133.

¹⁰⁹ *Id.* at 135.

¹¹⁰ *Id.* at 140.

¹¹¹ *Id.* at 143-144.

¹¹² *Id.* at 144.

¹¹³ *Id.* at 147.

¹¹⁴ *Id.* at 147-148.

¹¹⁵ *Id.* at 150.

¹¹⁶ *Id.* at 156.

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Mr. Goff stated they do an annual diversity assessment to provide to the FCC in which they assess their 911 networks from their selective router or their core to PSAPs and identify diversity opportunities.¹¹⁷

Mr. Groff identified that the fiber cuts have two different impacts for a voice caller and used a Lumen landline caller as an example.¹¹⁸ For Lumen customers, their voice track aggregates 911 calls and there were several different locations and switches in that area.¹¹⁹ If a person made a phone call, the SS7 protocol provides the dial tone and the call is handled by the local switch (local office or local exchange). A person within their local exchange is able to make a call to a neighbor or anyone else in that same local exchange independent of SS7.¹²⁰

Mr. Groff went on to explain that unlike a call within the same local exchange, a call to the next town or a call to Nebraska's 911, the local switch needs to know where to send the call and then SS7 would be required to tell the switch where the call should go and, in the scenario that Mr. Groff was using, that call would end up in Grand Island.¹²¹ The circuits that talk to Lumen's signal transport points for Grand Island are located in Minneapolis and St. Paul and acts as the brains for where to send calls.¹²² So calls that were SS7 isolated would be prevented from reaching Grand Island which would have prevented them from making a 911 call.¹²³

In addition, as Mr. Groff stated, that same fiber cut would have also impacted the actual path from Grand Island to Lumen's Legacy Network Gateways in Chicago and Highlands Ranch.¹²⁴ Mr. Groff also stated that there was one area of about 600 callers that were still on E911 that were not impacted by the ingress network to the Next Gen 911 network and therefore weren't impacted on the ingress network but were still impacted from an SS7 perspective in their

¹¹⁷ *Id.* at 158.0

¹¹⁸ *Id.* at 166.

¹¹⁹ *Id.*

¹²⁰ *Id.*

¹²¹ *Id.* at 166-167.

¹²² *Id.* at 167.

¹²³ *Id.*

¹²⁴ *Id.*

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ability to reach 911.¹²⁵ So, those calls could still not call outside of their local exchange.¹²⁶ The impact was to anyone who was live on the SS7 and connected to Grand Island.¹²⁷

Mr. Groff confirmed that even with the changes Lumen has implemented since the outage, if the two cuts were to happen today, the outage still would have occurred.¹²⁸ Mr. Groff confirmed that there are two paths to any individual PSAP in Nebraska, one in Miami and the other in Longmont with different components for each PSAP due to their distinct geographic locations.¹²⁹ However they may have common facilities within the Next Gen network and all of them are connected to Miami and Longmont.¹³⁰ Mr. Groff also confirmed that Lumen looked at the possibility of contracting with other carriers in Nebraska for the ingress network to improve diversity, but Mr. Groff stated that Lumen didn't identify any carriers that could assure additional diversity beyond what Lumen already has.¹³¹

Mr. Groff, once again, confirmed that 911 PSAPs in Nebraska started being notified of the outage at 8:37 p.m. Central time.¹³² He explained that while there may be an immediate alert that is triggered from a cable cut, that alert shows there is an interruption in the transport but not the 911 service specifically until Lumen is able to manually isolate the services on that cut network.¹³³ Mr. Groff stated that Lumen is working on a project to improve automatic notification of an interruption in 911 service.¹³⁴

Mr. Groff explained that during the hour and a half delay in notifying PSAPs, peer and technical support teams were to assess what alarms they had and what impact those alarms had to the

¹²⁵ *Id.* at 167-168.

¹²⁶ *Id.* at 168.

¹²⁷ *Id.*

¹²⁸ *Id.* at 174-175.

¹²⁹ *Id.* at 177.

¹³⁰ *Id.*

¹³¹ *Id.* at 180.

¹³² *Id.* at 183.

¹³³ *Id.*

¹³⁴ *Id.* at 184-185.

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network. These teams also conducted test calls and contact to various PSAPs.¹³⁵

Mr. Groff further stated that that they were getting mixed messages since some PSAPs were functional, and others were not.¹³⁶ However, because they didn't know the exact impact, they notified all PSAPs.¹³⁷ Lumen did know that once they restored one of the two cuts, they could restore the ingress voice network.¹³⁸

Mr. Groff confirmed that the initial notification contained standard language and that the only specific information that the notification contained was the word "Nebraska."¹³⁹ Mr. Groff stated that the outage specific information from an initial notification is going to depend on how much information they have at that time.¹⁴⁰ He further stated, that while Lumen did know there were specific PSAPs that were down, if they tried to do individualized notification to specific PSAPs it would have delayed notification.¹⁴¹

Mr. Groff also confirmed that Lumen conducted a review of the PSAP notifications after the fact and that is when they discovered that one PSAP was inadvertently left off of the notification.¹⁴² Mr. Groff stated that every single notification ends up being reviewed for accuracy to determine whether it needs to be withdrawn and whether it was timely.¹⁴³ Mr. Groff asserted that Lumen met FCC requirements for ingress voice outages, which requires carriers to notify as soon as possible, so he asserted the notifications were timely.¹⁴⁴ Mr. Groff stated that they generally review to look at timeliness and coverage and do not conduct a quality review per se based on the FCC standard which are also Lumen standards.¹⁴⁵

¹³⁵ *Id.* at 187.

¹³⁶ *Id.*

¹³⁷ *Id.* at 187-188, 192.

¹³⁸ *Id.* at 188.

¹³⁹ *Id.* at 197, Exhibit 11

¹⁴⁰ *Id.* at 197.

¹⁴¹ *Id.*

¹⁴² *Id.* at 199.

¹⁴³ *Id.* at 200.

¹⁴⁴ *Id.*

¹⁴⁵ *Id.* at 201-202.

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Mr. Groff confirmed that in addition to the 911 services impacted, voice services were impacted as well but he was not aware of any VoIP or internet services being impacted.¹⁴⁶ Mr. Groff also confirmed that if there were carriers who utilized SS7 out of Grand Island and utilized Lumen's network, they would have also been impacted.¹⁴⁷

Mr. Groff indicated the Omaha calls were not aggregated to Grand Island and did not have the SS7 impact, but the trunks eventually ended up on the same fiber routes on the national network.¹⁴⁸ The Omaha area calls utilized different equipment, but the fiber cables the network path used were the same as the Grand Island area with multiple aggregation points.¹⁴⁹

Mr. Groff stated that the switches used in Grand Island are maintained by Lumen and are TDM Class 5 switches, DMS-100's, or 5Es. These switches would have probably been first available in the 70's or 80's.¹⁵⁰ Mr. Groff stated that Lumen provides points of interface ("POI") outside of the Legacy selective routers or switches and are making them available to all providers in Nebraska.¹⁵¹ Mr. Groff further stated he recommends that all carriers connect directly to the POI's.¹⁵²

Mr. Groff stated that it is still possible that the cable cuts in this case could still impact 911 service even if all carriers delivered calls directly to the POI utilizing time division multiplexing ("TDM"), that are established in each Local Access Transport Area ("LATA"), if those providers still relied upon SS7 because a call is not converted to IP until it hits the Legacy Network Gateway.¹⁵³

Mr. Groff further confirmed that when carriers are delivering calls to the Next Gen system utilizing Session Initiation Protocol

¹⁴⁶ *Id.* at 204-205.

¹⁴⁷ *Id.* at 205-206.

¹⁴⁸ *Id.* at 209.

¹⁴⁹ *Id.* at 210.

¹⁵⁰ *Id.* at 211.

¹⁵¹ *Id.* at 211-212.

¹⁵² *Id.* at 212.

¹⁵³ *Id.* at 212-213.

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("SIP")¹⁵⁴, the SS7 Network is not applicable.¹⁵⁵ Mr. Groff stated that once a carrier is using SIP, the carrier is in the IP network and therefore less reliant on Legacy phone trunks and no longer relying on Public Switched Telephone Network ("PSTNs").¹⁵⁶

Mr. Groff stated that Lumen is consistently looking at ways to improve response time to outages. However, it would be difficult to prevent fiber cuts from happening.¹⁵⁷ The locators must correctly locate the fiber in a timely manner and it is a case-by-case basis holding locators accountable when they do not locate correctly or timely.¹⁵⁸ Mr. Groff opined that more visibility on how the impact cuts occurred would be helpful.¹⁵⁹

Mr. Groff confirmed that there is no evidence of any intentional acts or cyber security concerns regarding these two cable cuts.¹⁶⁰

Shane Ayers, Director of Compliance for Stake Center, stated that for the Omaha cable cut, Allo Communications call in 35 tickets in a two and one-half square mile radius for a larger fiberoptic rebuild and, due to the large amount of locating required, did not locate this area by the due date and time required and was subsequently terminated from employment.¹⁶¹

Craig Panter, Director of Operations for Stake Center, stated that Stake Center currently has seven employees in Nebraska but that varies based on the time of year.¹⁶² In addition, Mr. Panter stated at the time of this cable cut, they had 12 employees in Nebraska. Mr. Panter further explained that locating around railroad tracks takes specialized training and there is emphasis

¹⁵⁴ SIP is the Application Layer (Layer 7 of the OSI Reference Model) protocol for the establishment, modification and termination of conferencing and telephony sessions of an IP-based network.

¹⁵⁵ *Id.* at 213.

¹⁵⁶ *Id.* at 214.

¹⁵⁷ *Id.* 216-217.

¹⁵⁸ *Id.* at 217.

¹⁵⁹ *Id.* at 218.

¹⁶⁰ *Id.* at 221.

¹⁶¹ *Id.* at 226.

¹⁶² *Id.* at 229.

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put on ensuring the work gets completed in a timely manner.¹⁶³ Of the 35 tickets, Mr. Panter stated that three were located along the railroad but did not know if any of the railroad locates occurred.¹⁶⁴

Mr. Groff also later clarified that the cut in Minneapolis was three relatively large cables which may have contributed to the delay in completing the repair while the Omaha cut was a single fiber cable.¹⁶⁵

Mr. Groff also clarified that callers using POTS, Plain Old Telephone Service, will still rely on SS7 when making calls but that will not impact calls that make it to SIP or reach the Next Gen 911 Network.¹⁶⁶

Mr. Groff explained the services that Intrado provides.¹⁶⁷ Mr. Groff stated that Intrado provides what would be considered selective routing in the E911 space but it is IP selective routing in the NG911 space.¹⁶⁸ The calls route to one of two cores, one in Longmont and the other in Miami and that is the point in which the system determines which PSAP to route to and also picks up the location information.¹⁶⁹

Mr. Groff stated that SS7 will still be an issue for a Lumen landline carriers for 911 calls because the calls will still be utilizing SS7 until the call is handed off the Local Network Gateway which converts the calls to IP.¹⁷⁰ He further explained that LATAs will still be a part of any voice service utilizing a public network.¹⁷¹ Mr. Groff went on to state that all kinds of services run on the same fiber; IP, voice, SS7, and other technologies will run on the same fiber.¹⁷² Mr. Groff also explained that SIP means session initiated protocol which is the term used

¹⁶³ *Id.* at 231.

¹⁶⁴ *Id.* at 233.

¹⁶⁵ *Id.* at 235-236.

¹⁶⁶ *Id.* at 249.

¹⁶⁷ *Id.* at 263.

¹⁶⁸ *Id.*

¹⁶⁹ *Id.*

¹⁷⁰ *Id.* at 266.

¹⁷¹ *Id.* at 267-268.

¹⁷² *Id.* at 273.

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when a call reaches the LNG and converts the call to an IP-based voice call.¹⁷³

That hearing was then concluded with Mr. Groff's testimony and the commission was adjourned.

Hearing on November 4, 2024

A subsequent hearing was held on November 4, 2024, to address additional questions from the August 2023 hearing along with two additional outages that occurred in April and July 2024. Sara Hulac and Sallie Dietrich appeared on behalf of the 911 Department of the Commission ("Department"). Katherine McNamara and Josh Trauner appeared pro hac vice on behalf of Lumen. For docket 911-075/PI-248, exhibits 54-61, 65-67 were offered and received. For docket 911-077/C-5581/PI-252, exhibits 1-14, 18-21 were offered and received during the hearing and exhibit 22 was offered and received as a late-filed exhibit.

Unlike the hearing that occurred in January, witnesses were sworn, and cross-examination was allowed for each party's witnesses. The Department called David Sankey, State 911 Director for the Public Service Commission.

Mr. Sankey testified that the Department retained 911 Authority, LLC ("911 Authority") to assist in the technical aspects of the investigations.¹⁷⁴ Mr. Sankey stated that 911 Authority has expertise in working with state and local governments implementing Next Generation 911 systems and have engineers and other staff who have worked for telecommunication companies with specific 911 experience and training.¹⁷⁵ Mr. Sankey testified that since the State 911 Department started working with the 911 Authority in February 2024, they have provided guidance on all three outages.¹⁷⁶

Mr. Sankey testified that on April 17, 2024 at approximately 8:30 pm in the evening, he was notified that some Nebraska PSAPs were experiencing intermittent disruptions receiving 911 calls. This was carrier dependent both on their 911 lines and on their

¹⁷³ *Id.* at 283.

¹⁷⁴ November 4, 2024, Transcript at 18

¹⁷⁵ *Id.*

¹⁷⁶ *Id.*

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administrative lines.¹⁷⁷ Mr. Sankey said approximately 21 PSAPs had some sort of service interruption, some reported issues with Verizon calls, while others reported issues with wireline calls, and some with other wireless carriers with service restoration occurring at 11:00 p.m. that same evening.¹⁷⁸ Mr. Sankey learned from other state 911 administrators that all of the PSAPs in South Dakota and some in Nevada were impacted at the same time.

Mr. Sankey further stated that he received the official Reason for Outage or RFO from Lumen which identified that fiber optic cable between Topeka, Kansas and Kansas City, Missouri was damaged by a boring device used to install a utility pole.¹⁷⁹

Mr. Sankey then testified that on July 9, 2024, after 7:00 p.m., the Buffalo County Sheriff, Neil Miller, called and informed Mr. Sankey that their PSAP was having difficulty receiving calls from Verizon customers.¹⁸⁰ Mr. Sankey and field coordinator, James Almond, contacted other PSAPs in Nebraska along with Lumen and learned that Lumen was experiencing issues with their national network and that 14 Nebraska PSAPs were experiencing 911 service disruptions.¹⁸¹ More specifically, Douglas County's PSAP was experiencing issues receiving calls from T-Mobile customers but was receiving calls from other carrier customers.¹⁸²

Mr. Sankey further testified that Lumen's Reason for Outage document indicated that the July 9 disruptions were caused by a power disruption at their facility in Houston impacted by Hurricane Beryl and that this service disruption also impacted South Dakota.¹⁸³ After being restored briefly at around 9:30 p.m., service was disrupted again with service being fully restored at approximately 1:45 a.m.¹⁸⁴

Next the 911 Department called Brian Rosen to testify. Mr. Rosen testified as to the foundation for his curriculum vitae, and

¹⁷⁷ *Id.* at 19.

¹⁷⁸ *Id.*

¹⁷⁹ *Id.*

¹⁸⁰ *Id.* at 20.

¹⁸¹ *Id.*

at *Id.* at 21.

¹⁸² *Id.*

¹⁸³ *Id.*

¹⁸⁴ *Id.*

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the two reports provided by 911 Authority.¹⁸⁵ Mr. Rosen has 30 years of experience in the telecommunications industry, and over 25 years working with issues surrounding 911 systems.¹⁸⁶ Mr. Rosen is the co-chair of the National Emergency Number Associations i3 architecture and has contributed to APCO/NENA and multiple other 911 standards.¹⁸⁷ Mr. Rosen testified that the outage that occurred in August of 2023 was caused by fiber cuts that caused the SS7 signaling traffic between the aggregation switch and the legacy network gateway to fail. Mr. Rosen testified that Lumen installed the SS7 links as part of their transition plan from the local 911 network to the NG-911 network.¹⁸⁸

Mr. Rosen then described how that signaling failure was depicted on page one of confidential Exhibit 67 and confirmed that the service interruptions were caused by a failure between the SS7 links between the Grand Island aggregation switch and the LNGs.¹⁸⁹

Mr. Rosen explained that the April 2024 outage was depicted in the diagram on page 2 of that same exhibit.¹⁹⁰ Mr. Rosen stated that the diagram demonstrated that the trunking that goes between the aggregation and the LNG's failed. In this case, it wasn't the signaling connections that failed it was the trunk connections that were impacted.¹⁹¹

Mr. Rosen then went on to discuss the third page of exhibit 67 which shows the entire path of the SS7 signaling transfer connections depicting how SS7 messages may route through St. Louis, Rancho Cordova, Houston, Kansas City, to Spokane and depicts the outage that occurred in July of 2024 and confirmed that, once again, that the service interruptions were caused by a failure to transmit SS7 signaling between an aggregation switch and the LNGs.¹⁹²

Mr. Rosen explained that in the E-911 system, each subscriber is connected to a switch, called a selective router, and each PSAP

¹⁸⁵ *Id.* at 22-28

¹⁸⁶ Exhibit 60 (911-075) and Exhibit 11 (911-077).

¹⁸⁷ *Id.*

¹⁸⁸ *Id.* at 30.

¹⁸⁹ *Id.* at 34-

¹⁹⁰ *Id.* at 37.

¹⁹¹ *Id.* at 37-38.

¹⁹² *Id.* at 39.

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is also connected to that selective router.¹⁹³ In the NG911 system, LNGs convert the old signaling to IP signaling so there must be a way to connect the subscriber connections to the ESInet or emergency services IP network.¹⁹⁴ Mr. Rosen testified that how Lumen chose to connect the subscribers to the out-of-state LNGs is aggregate all of the 911 trunks from each of the subscriber switches to get them to the LNG.¹⁹⁵ In each of the three service interruptions that are the subject of the hearing, the aggregation was working, but calls could not connect between the aggregations switch and the LNG.¹⁹⁶

Mr. Rosen then described that SS7 signaling, which stands for Signaling Systems Number 7, was designed in the 60's or 70's and serves as the mechanism for connecting the trunk side between switches. Each connection contains both the trunks and the signaling network which signals calls between switches. This signaling is how a call is routed from the origination to the destination point.¹⁹⁷

Mr. Rosen then explained that five nines is a term used in 911 systems to determine reliability of a 911 system, and the term refers to a 911 system being available 99.999% of the time.¹⁹⁸ Mr. Rosen said there are two ways to determine availability. One way is to determine the actual availability of the system based on the period of time the system has been operational.¹⁹⁹ In the alternative, availability can be determined by calculating two quantities: the mean time between failures and the mean time to repair for each component in the network. Networks are made to be redundant to increase reliability and reliability is determined by a numeric calculation.²⁰⁰ Mr. Rosen stated that 911 systems must be designed to meet the five nines.²⁰¹

¹⁹³ *Id.* at 40.

¹⁹⁴ *Id.* at 40-41.

¹⁹⁵ *Id.* at 41.

¹⁹⁶ *Id.*

¹⁹⁷ *Id.* at 42-43.

¹⁹⁸ *Id.* at 44-45.

¹⁹⁹ *Id.* at 45.

²⁰⁰ *Id.* at 46.

²⁰¹ *Id.* at 47.

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Mr. Rosen explained that a fiber optic ring is used to increase reliability by connecting stations to multiple points such that the last point in a network is connected to the first point and effectively forms a ring and gives two paths for network traffic. In case of a fiber cut, the traffic can still traverse the route because there is still an available path.²⁰² Mr. Rosen explained that a node is a connection between two points and that the more nodes on a ring, the less reliable the ring because there are more points of failure. Therefore, the number of nodes on a given ring is relevant to determine the reliability of the system. Question 7 in Exhibit 56 asked during discovery, which Lumen objected to on relevancy grounds, sought to assist in determining reliability of the network.

Mr. Rosen said that a common pattern in 911 system in order to achieve five nines reliability is to have four instances of each piece network component in two different physical locations which necessitates four connections between the network components.²⁰³ Mr. Rosen stated that question 10 in Exhibit 56 was asked to attempt to determine additional information about Lumen's determination of reliability.²⁰⁴ Mr. Rosen testified that two redundant paths is insufficient for carrying 911 traffic in a ring and is considered to be only one connection between two points.²⁰⁵

Mr. Rosen identified three main areas that Lumen needs to work on to improve the reliability of their network--redundancy, reliability assessment, and auditing.²⁰⁶

In order to improve redundancy, Mr. Rosen testified that Lumen needs more paths for network traffic to be able to traverse.²⁰⁷ Mr. Rosen stated that the same path failed three times and there should be many more paths to achieve a five nines system.²⁰⁸ Mr. Rosen testified that only a single fiber cut severed the network in April of 2024.²⁰⁹

²⁰² *Id.* at 48.

²⁰³ *Id.* at 51-52.

²⁰⁴ *Id.* at 52.

²⁰⁵ *Id.* at 56.

²⁰⁶ *Id.* at 57-58.

²⁰⁷ *Id.* at 58.

²⁰⁸ *Id.*

²⁰⁹ *Id.* at 60.

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Mr. Rosen also testified that Lumen needs to undergo a reliability assessment. Mr. Rosen reiterated that a reliability assessment is a calculation based on the mean time between failures and the mean time to repair completed by a reliability engineer.²¹⁰ The reliability assessment should review all network components (links, boxes, switches) from the subscriber switch all the way through the network to the input of the PSAP, and the expectation would be that the network would meet five nines reliability throughout.²¹¹ Mr. Rosen further stated that these assessments are not new and have been done for decades.²¹²

Mr. Rosen testified that he recommends Lumen undergo an audit to determine if the physical environment of the network meets Lumen's expectations. Such an audit would include having every single connection reviewed to determine if there is geographic diversity and ensure that a single fiber cut will not take down part of the network.²¹³

Mr. Rosen further opined that because of the three failures occurring between the aggregation point and the LNG, the aggregation switch should be eliminated and the LNGs moved closer to the subscriber switch so that the subscriber switches connect directly to the LNGs.²¹⁴

In the alternative, Mr. Rosen testified that after the August 2023 outage, Lumen could have conducted an audit, determined how many links or connections there were, and improved redundancy.²¹⁵ Mr. Rosen testified that Lumen could have utilized a multiplexer which is intrinsically more reliable with less parts between the subscriber switches and the LNG, which would have eliminated all signaling issues while the trunk issue would require proper distribution.²¹⁶

While Mr. Rosen applauded the efforts that Lumen has engaged in thus far, Mr. Rosen opined that the remedial steps outlined by

²¹⁰ *Id.* at 60-61.

²¹¹ *Id.* at 61.

²¹² *Id.*

²¹³ *Id.* at 63.

²¹⁴ *Id.*

²¹⁵ *Id.* at 64.

²¹⁶ *Id.* 64-65.

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Drew Groff in his pre-filed testimony are insufficient to address the issues that caused the three service interruptions.²¹⁷ Specifically, Mr. Rosen stated that the audits identified would not identify the collapsed ring that existed and contributed to the incident that occurred in Kansas City in April of 2024.²¹⁸

In response to cross-examination, Mr. Rosen acknowledged that the FCC regulations only require auditing of critical 911 circuits and that the current FCC regulations have not been updated since the adoption of NG911 systems.²¹⁹

In response to a question by Commissioner Schram, Mr. Rosen testified that the five nines standard has been around since the 1980's and has been adopted by both the National Emergency Number Association ("NENA") and the Association of Public-Safety Communications Officials ("APCO").²²⁰ Mr. Rosen went on to explain how calls were routed in an E911 system and a NG911 system.²²¹ Mr. Rosen stated that both of the LNGs that convert a call to IP protocol are located out of state therefore all calls are routed out of state from the aggregation switch to the LNG.²²² In response to another question, Mr. Rosen confirmed that if one or more LNG were located within Nebraska, that could potentially reduce the number of outages.²²³ Mr. Rosen confirmed that for a reliable 911 system, the system would have two geographically diverse locations for two data centers, and four connections between each data center. Mr. Rosen recommended that the LNGs be geographically close to the subscriber switches without aggregation between them.²²⁴ Mr. Rosen confirmed that Lumen was less than forthcoming with information, and some information wasn't received until the pre-filed testimony of Mr. Groff.²²⁵

In response to a question from Commissioner Watermeier, Mr. Rosen explained that telecommunications companies usually employ

²¹⁷ *Id.* at 65.0

²¹⁸ *Id.*

²¹⁹ *Id.* at 83

²²⁰ *Id.* at 90-91.

²²¹ *Id.* at 91-92.

²²² *Id.* at 93.

²²³ *Id.* at 95.

²²⁴ *Id.* at 96.

²²⁵ *Id.* at 97.

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a Reliability Engineer whose job is to determine the reliability of a network which involves learning about all the components of a network, obtaining records from vendors and carriers, generating an estimate for each component for the mean time between failures and the mean time to repair, and then analyzing the network as a whole to determine the reliability in terms of the percentage that it will likely be operational.²²⁶ The engineer looks at how many redundant components there are, how far away the technicians are that will be tasked with repairs, the location of spare parts, how long it will take a technician to get to the location of the component, how long it will take to diagnose it and repair it--all of which contribute to the calculation using a formula to determine the predicted availability of the network.²²⁷

In response to a question from Commissioner Stocker, Mr. Rosen stated that 75 to 80% of the reliability of a network is based on the overall design, with about 20% of reliability being based on whether a company deployed what they designed and the upfront calculations to determine predicted reliability are generally accurate.²²⁸ Mr. Rosen also stated that the large majority of failures in 911 systems can be contributed to inadequate redundancy although software failures are becoming more prevalent than they used to be.²²⁹

In response to another question, Mr. Rosen confirmed that, due to a prior problem, there had been a temporary repair along the network route that included the Kansas City route connected to the April 2024 outage. This repair rerouted all network traffic through a single path creating what is known as a "collapsed ring." A collapsed ring creates a single point of failure because the network traffic can only move in one direction. Because the workaround was never rerouted after the temporary repair, this collapsed ring existed for 11 years.²³⁰ While Mr. Rosen couldn't be definitive because of the lack of information provided, he opined that the audits referred to in the pre-filed testimony would not find additional collapsed rings.²³¹

²²⁶ *Id.* at 99.

²²⁷ *Id.* 99-100.

²²⁸ *Id.* at 104- 105.

²²⁹ *Id.* 106-107.

²³⁰ *Id.* at 109.

²³¹ *Id.* at 109-110.

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Mr. Rosen confirmed the report authored by 911 Authority, LLC determined that for the time span covering August of 2023 to August 2024, Lumen's 911 system was down for over eight hours making their actual reliability less than three nines, rather than five nines. Mr. Rosen reiterated that if people relying on 911 services cannot call and have their call answered, whether the core services was down or not is irrelevant.

Kate McNamara then called Mr. Drew Groff to testify. Mr. Groff stated that he is employed by Lumen Technologies as their Public Safety Services and Compliance Director.²³² Mr. Groff testified that the technology limitations on the ingress side of the network that involve Time Division Multiplexing, or TDM, are limited and there is no automatic rerouting to admin lines or backup PSAPs because you are aggregating calls to the NG911 network.²³³ Mr. Groff further testified that a backhaul outage occurred in both the first outage in 2023 and the April Kansas City outage meaning that the failures occurred on the national transport connectivity to the LNGs.²³⁴ Mr. Groff stated that if the outages occurred on the ESInet side of the network, the calls could have been rerouted to either administrative lines or to an alternative PSAP.²³⁵ Mr. Groff testified that the ingress side has less resiliency because of the technology but that Lumen does look at both logical diversity and location diversity. Mr. Groff referred to his written testimony to identify steps Lumen has taken to improve logical redundancy and location diversity. These steps included a physical audit which identified every fiber system on Lumen's national network that carried 911 traffic to discover situations, like the one that happened in Kansas City, where a single fiber cut took down part of the network.²³⁶ The second initiative is looking at ingress voice paths and determining where there are locations in common. Finally, an SS7 audit to identify and rectify common locations was also completed.²³⁷ Mr. Groff stated that in Kansas City, alternate routes have been identified and the circuits have been groomed as of August 9, 2024.²³⁸ In addition, Mr. Groff stated that Lumen

²³² *Id.* at 119.

²³³ *Id.* at 132-133.

²³⁴ *Id.* at 134.

²³⁵ *Id.*

²³⁶ *Id.* at 135-136.

²³⁷ *Id.* at 137.

²³⁸ *Id.*

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identified a building in Omaha that could potentially impact Norfolk, Council Bluffs, and Sioux City ingress points. A solution to this situation has been identified and Lumen is in the process of ordering circuits to complete the groups.²³⁹ Mr. Groff stated that Lumen completes the critical 911 circuits as required by the FCC which Lumen interprets to mean the Next-Gen 911 core to the last serving office, or the point of interface where Lumen hands off to the last mile provider.²⁴⁰

Mr. Groff acknowledged that Lumen does not routinely test network diversity redundancy but instead tests the network daily through routine maintenance and when an outages occur.²⁴¹ Mr. Groff stated that regular testing "would not be practical"²⁴⁷ and that Lumen doesn't "want to unnecessarily impact our production network."²⁴² According to Mr. Groff, the three outages that are the subject of this investigation are the only outages that impacted 911 in Nebraska.²⁴³

Mr. Groff testified that Lumen anticipates that the three audits--physical fiber audit, 911 trunk diversity, and the SS7 diversity audits--would be completed the first quarter of 2025.²⁴⁴

Mr. Groff acknowledged that Lumen does not employ a reliability engineer but stated that all of engineers and employees focus on reliability which would include planning teams engaged in audits and the remediation for location diversity and a weekly reliability call for reactive corrective action and proactive initiatives.²⁴⁵ Mr. Groff stated he has difficulty determining what the diagrams within the reports provided by the 911 Authority represent because the components are not labeled.²⁴⁶ Mr. Groff then went through and described the three diagrams provided by Lumen as

²³⁹ *Id.* at 137-138.

²⁴⁰ *Id.* at 139.

²⁴¹ *Id.*

²⁴⁷ *Id.* at 140

²⁴² *Id.*

²⁴³ *Id.* at 142.

²⁴⁴ *Id.* at 154.

²⁴⁵ *Id.* at 155.

²⁴⁶ *Id.* at 157.

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Exhibit 67 and how the audits being conducted might impact similar issues in the future.²⁴⁷

In response to a question regarding whether a data center in Nebraska would change the three outages that occurred, Mr. Groff acknowledged that for the August 2023 outage, calls that did not rely on the Grand Island aggregations may have been delivered to the ESInet.²⁴⁸ Mr. Groff testified that collapsed rings are common when the intent is not to have physical diversity but that they are susceptible to a single damage point.²⁴⁹

Mr. Groff testified that for the outage in July of 2024, the network had four links which all traversed Houston and, while they were on different circuits and equipment, there was a power failure at the common location which caused all four links to be down simultaneously.²⁵⁰ Lumen has rectified the failure in location diversity and now there is an alternate route to carry the SS link through San Francisco.²⁵¹ Mr. Groff stated that two of the TD switches in Nebraska are served by the same location. However, the Scottsbluff, Sioux City, and Council Bluffs TDM switches were not impacted because they were served by different signal transfer points with different quad links.²⁵⁸ Mr. Groff then reviewed a diagram contained within the Lumen contract with the State of Nebraska which is the Nebraska in-state design showing the ingress aggregation, the Next-General Core Services, and identified that the outages occurred in the ingress part of the network.²⁵²

Mr. Groff then testified regarding what actions Lumen took when the Houston outage occurred in July of 2024, included looking at the opportunity to build a new circuit and reroute traffic away from Houston to restore services.²⁵³ Mr. Groff stated that for the Kansas City cut, they also looked for opportunities for alternative routes, but they were able to splice the fibers faster than

²⁴⁷ *Id.* at 158-161.

²⁴⁸ *Id.* at 161.

²⁴⁹ *Id.* at 162-163.

²⁵⁰ *Id.* at 167-168.

²⁵¹ *Id.* at 168-169.

²⁵⁸ *Id.* at 169

²⁵² *Id.* at 172.

²⁵³ *Id.* at 173.

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rerouting traffic.²⁵⁴ Mr. Groff stated that the Lumen network is not just one big ring but includes many rings and many fiber routes.²⁵⁵

Mr. Groff testified that Lumen has contingency plans including Lumen's business continuity plan--which is in the record as late filed Exhibit 53--emergency incident management teams, individual job aids, processes for each technology, and NOC teams, including 911, which all existed prior to 2023.²⁵⁶

During cross-examination, Mr. Groff acknowledged that each of the three incidents occurred between the point in the network where traffic is aggregated and the LNG.²⁵⁷

Mr. Groff acknowledged that the April outage was caused by a single fiber cut.²⁵⁸ He stated that the temporary repair that created the single point of failure occurred over 10 years ago, but that Lumen cannot determine why the ring was in that state for so long.²⁵⁹ Mr. Groff admitted that the routine "testing" that Lumen does would not identify a collapsed fiber ring.²⁶⁰ Mr. Groff testified that there are situations where you would have one conduit fiber going in or out of a building and, for such an instance, Lumen does not intentionally design a ring to be in the same conduit or cable.²⁶¹ Mr. Groff testified that the physical fiber audit Lumen is conducting is designed to identify additional collapsed rings.²⁶² However, Mr. Groff did not know when the last physical fiber audit was conducted, but acknowledged it would have had to have been 11 or more years ago since Lumen was unaware of the collapsed ring in Kansas City.²⁶³

Mr. Groff testified that originating service providers ("OSPs") are moving off of the aggregation switches and connecting

²⁵⁴ *Id.* at 173.

²⁵⁵ *Id.* 174-175.

²⁵⁶ *Id.* at 175-176.

²⁵⁷ *Id.* at 178.

²⁵⁸ *Id.*

²⁵⁹ *Id.* at 178-179.

²⁶⁰ *Id.* at 179.

²⁶¹ *Id.* at 180.

²⁶² *Id.* at 182.

²⁶³ *Id.* at 184.

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to one of the two points of interconnect ("POIs") available in each LATA, and that 57% of OSPs have migrated to one of the POIs.²⁶⁴ Mr. Groff testified that whether or not an OSP connects to a POI or to the aggregation switch, unless the OSP originates in IP, the call isn't converted to internet protocol until they reach the data centers out of state. Mr. Groff further acknowledged that for Lumen's own customers for whom Lumen is the OSP, those calls will remain TDM POTS lines, unless Lumen is offering SIP or VoIP services.²⁶⁵ Mr. Groff further stated that this is not part of a transition plan and that Lumen customers will remain on TDM voice POTS services utilizing the TDM switches.²⁶⁶

Mr. Groff testified the network between the POIs and the LNG is generically referred to as a TDM network which, from a voice perspective, will continue to rely on SS7 signaling until it reaches the LNG for POTS-type TDM services.²⁶⁷

Mr. Groff explained that failover testing occurs when a part of the network is not operational. A network provider can review what happens to determine if the network is behaving as expected.²⁶⁸ Mr. Groff stated that Lumen does failover testing every time there is an organic failure in the network or for planned maintenance but they do not intentionally take down parts of their network to see whether the redundancies and diversities in place act as they expect them to.²⁶⁹ Mr. Groff acknowledged that Lumen could conduct failover testing in their testing environment as opposed to their production or live environment and could simulate certain events, and take off certain network components to see what happens. Mr. Groff maintained that the organic testing they do is regular but did not identify the three issues that were identified following each of the three outages.²⁷⁰

Mr. Groff refused to answer whether Lumen's 911 system was designed to meet five nines reliability identifying it as a

²⁶⁴ *Id.* at 185.

²⁶⁵ *Id.* at 187.

²⁶⁶ *Id.* at 188.

²⁶⁷ *Id.*

²⁶⁸ *Id.* at 191-192.

²⁶⁹ *Id.*

²⁷⁰ *Id.* at 192.

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contractual question even though the contract was not mentioned.²⁷¹ Mr. Groff reluctantly agreed with the testimony from Mr. Rosen and the information contained in the 911 Authority report stating the sum of Lumen outages was "in the ballpark" of eight hours from August of 2023 to August of 2024.

Mr. Groff testified that he is unaware of any testing Lumen may have conducted to determine the predicted availability of Nebraska's 911 system that Lumen designed.²⁷² Mr. Groff testified that he does not have any Lumen employees on his team that are trained to calculate mean time between failures nor mean time to repair.²⁷³ Mr. Groff testified that when the power failed in Houston for the July 2024 outage, the circuit failure were the D-links that carried the SS7 signaling, but did not know how long the backup power was operational prior to the failure.²⁷⁴ Mr. Groff testified that the facility in Houston that experienced the power failure was a gateway facility that contained multiple types of equipment for multiple services and carried four SS7 D-links but could not identify specifically what was in that office nor could Mr. Groff identify how long the battery back-ups in that location were designed to be operational. Mr. Groff also did not know when the last time the fuel pump that failed at that facility was tested.

At this point in the testimony a late filed exhibit was requested for this information. The late-filed exhibit does not directly answer how long the batteries were operational before failing. The document states that the facility started utilizing the battery backup at 11:55 a.m. on July 8th and that the 4 SS7 D-links first failed at 6:54 p.m. on July 9th, meaning that they were functioning on back-up battery power for just shy of 31 hours. The late-filed exhibit indicates that one of the links was temporarily restored but failed again with no indication of how or why the second failure occurred.

The document also states that the two generators ran without issue for 20 minutes on May 13, 2024, during a widespread commercial power outage. The last time they were tested was December 7, 2024, with no indication of how long they were tested.

²⁷¹ *Id.* at 193.

²⁷² *Id.* at 194.

²⁷³ *Id.* at 195.0

²⁷⁴ *Id.* at 204-209.

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Regarding the fuel for the generators, the Exhibit indicates the most recent preventative maintenance was completed in February of 2023. Therefore, it appears that Lumen takes the same approach to testing generators and back-up power equipment that it does with its network which is essentially that they will figure out that things don't work when they break. However, Lumen will conduct preventative maintenance to include full fuel analytics annually beginning in 2025.

Mr. Groff confirmed that Lumen has no written policies regarding testing of networks that carry 911 traffic and have no program for testing.²⁷⁵

In response to a question from Commissioner Mirch, Mr. Groff indicated that within the Service Level Agreements or SLAs contained in Exhibit 59, the term N+1 model means from a network perspective that at least a +1 of each component.²⁷⁶ Mr. Groff went on to explain you could have one card that backs up seven cards on a multiplexer so the term is supposed to signify different numerical backup protection schemes.²⁷⁷

Commissioner Mirch then asked about a diagram within the SLAs and read from the SLA which stated all network routing infrastructure and equipment is designed and deployed in an N+1 model. N+1 redundancy provides a minimum of one additional unit module, path, or system in addition to the minimum required to satisfy the base connectivity ensuring that the failure of any single component at a given diverse site, such as an LNG, will not render the location inoperative making our network more reliable. Mr. Groff then confirmed that the network should have at least one backup whether it be equipment or physical.²⁷⁸ Mr. Groff then acknowledged that there was no N+1 backup for the path in Kansas City.²⁷⁹

Commissioner Watermeier then asked whether it was the intention of Lumen to design a five nines system and Mr. Groff affirmed that it was.²⁸⁰

²⁷⁵ *Id.* at 215.

²⁷⁶ *Id.* at 218-219.

²⁷⁷ *Id.* at 219.

²⁷⁸ *Id.* at 221-222.

²⁷⁹ *Id.* at 224.

²⁸⁰ *Id.* at 226.

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In response to a question from Commissioner Stocker, Mr. Groff stated he doesn't have direct oversight of a repair team but generally Lumen has both in-house repair teams and contractors to repair fiber but added that he did not have any knowledge of what might be contractually required for a repair team when emergencies occur and did not know how many contractors Lumen has.²⁸¹ Pursuant to the late-filed exhibit, Lumen has agreements with 87 contractors across the United States with four contractors within the state of Nebraska to perform fiber repair in an emergency.

In response to another question, Mr. Groff stated that the weekly reliability calls he referred to earlier in his testimony are held on Fridays and the purpose is to review significant outages over the past week which includes some routine outages such as replacing a card, or splicing a fiber but also those that are of significant duration and involved an error or needed corrective action.²⁸² In addition, the call could include guest speakers to go over different initiatives that are going on in the company.²⁸³ Mr. Groff stated that Lumen as a whole is looking at proactive steps to address cyber-attacks but how that will be accomplished is network-specific and handled by security teams.²⁸⁴

In response to a question from Commissioner Schram, Mr. Groff then explained that the difference between a collapsed ring and a fiber cut is that a collapsed ring is referring to the efficacy of the physical network route, and a fiber cut refers to the condition of the fiber itself. Mr. Groff went on to explain the response time to get a cable cut repaired depends on the situation and how far away the damage is to the nearest office which could be minutes or hours.²⁸⁵ Mr. Groff also again acknowledged there could be a benefit to the state if there was an LNG within the state, but also indicated that the Next-Gen core services are handled in Colorado and Florida through a third party contractor.²⁸⁶

Mr. Rosen was recalled and clarified that with an SS7 network, whether it's the trunks that fail or the signaling that fails, the same thing occurs, and that calls don't get completed and that

²⁸¹ *Id.* at 227.

²⁸² *Id.* at 231.

²⁸³ *Id.*

²⁸⁴ *Id.* at 232.

²⁸⁵ *Id.* at 240.

²⁸⁶ *Id.* at 242-243

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these failures all occurred in the same place in the network.²⁸⁷ Mr. Rosen also stated in his expert opinion that Lumen has shown they cannot maintain SS7 reliability and that they should eliminate the SS7 network from their 911 system and went on to state that any attempt to keep an SS7 network between the OSPs and the LNG will not be able to meet five nines.²⁸⁸ He also opined that Lumen should not aggregate the traffic in any form.²⁸⁹ He pointed to the three outages to support his opinion.²⁹⁰

Mr. Rosen stated Lumen could put a small LNG at the aggregation switch, i.e. a couple of T-1s that connect directly from the output in the aggregation switch to the trunks, use CAMA signaling for which 1Gs can handle in most cases which is straightforward for a 911 system.²⁹¹ In other words, SS7 signaling is not required.²⁹² While such a design is not optimal, it's a reasonable back up for a network that keeps failing over and over again.²⁹³ Mr. Rosen also noted that they could have used a technology called SIGTRAN which allows you to use an IP network to supply a link between STPs. Lumen could add more links using SIGTRAN.²⁹⁴ Mr. Rosen explained that by CAMA trunks he is referring to the traditional 911 signaling where the signaling and the voice channel are on the same 64-bit digital channel or the same TDM channel so there is no separate signaling mechanism required and, while it is not as flexible or powerful as SS7 signaling, it avoids having both an SS7 signaling network and a trunk network.²⁹⁵

Mr. Rosen also stated that Lumen could engineer the network so that if they needed, they could have a direct connection between the STPs that are serving the aggregation switch to the STPs that are serving the LNG. Additionally, not going through the national network or even a large portion of the local network would avoid having the network fail.²⁹⁶

²⁸⁷ *Id.* at 246-247.

²⁸⁸ *Id.* at 247.

²⁸⁹ *Id.*

²⁹⁰ *Id.*

²⁹¹ *Id.* at 248.

²⁹² *Id.*

²⁹³ *Id.*

²⁹⁴ *Id.*

²⁹⁵ *Id.* at 250.

²⁹⁶ *Id.* 248-249.

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In addition to the testimony, there were several exhibits offered and received, and relevant exhibits will be more fully set forth in the findings below.

O P I N I O N A N D F I N D I N G S

August 2023 Outage

There is no factual dispute that the outage that began on August 31, 2023, was caused by two separate fiber cuts, one in Minnesota and the other in Omaha, Nebraska, which impacted several PSAPs and the ability for Nebraskans to reach 911 for over 10 hours.²⁹⁷

The second cut caused the SS7 network between the aggregation switch and the LNG to fail which impacted 911 calls in many areas.

While the Commission acknowledges that multiple fiber cuts are rare, they happen. The fact that network traffic carrying 911 calls were disrupted by two cuts is unacceptable to the Commission. As the report by the 911 Authority, LLC points out, along with the testimony of Brian Rosen, eliminating the aggregation points and adding small LNGs, utilizing SIGTRAN could have avoided this failure. The lack of diversity and redundancy was the root cause of this failure.

The Commission further notes that during these investigations the notice to PSAPs often lacked any substantive information that would allow for the PSAPs to adequately respond to outages.²⁹⁸

April 2024 Outage

On April 17, 2024, a single fiber cut in Kansas City, Missouri disrupted 911 service for a minimum of two hours in Nebraska, impacted South Dakota and Nevada, and revealed a single point of failure that was caused by a repair that was put in place about a decade ago which was supposed to be temporary, but had not been fully restored.²⁹⁹ These facts are not in dispute.³⁰⁰

²⁹⁷ 911-075/PI-248, Exhibits 6, 8-49, 50, 57, 58, 67

²⁹⁸ 911-075/PI-248, Exhibits 8-49, 1-4-24 transcript 48-49, 199-200

²⁹⁹ 911-077/C-5581/PI-252, Exhibits 6, 8, 9, 12, 67

³⁰⁰ *Id.*

According to the 911 Authority Report, which we find persuasive, and Lumen's own testimony, the secondary route that was intended to provide diversity and redundancy was unavailable due to the temporary repair. Lumen has not completed a full physical fiber audit in at least 11 years and was ignorant of this potential single point of failure.³⁰¹ Once again, this event reveals a failure point between the aggregation point and the LNG impacting the SS7 network and demonstrates that Lumen's network has inadequate diversity and redundancy.

July 2024 Outage

On July 9, 2024, yet another disruption occurred impacting 911 traffic and various PSAPs in Nebraska and South Dakota for over three and a half hours.³⁰² While a natural disaster was the catalyst for this failure, a lack of adequate back-up power and equipment in a facility in Houston, Texas once again cascaded to a failure in Nebraska's 911 system between the aggregation point and the LNG impacting the SS7 network. In this case, while there were four links, all four met in the same facility in Houston. Once again, the facts are undisputed and shows Lumen's inadequate diversity and redundancy.

Further Findings & Recommendations

The Commission finds that a modern and reliable 911 system is in the interest of all Nebraskans and that shall be the priority for the State 911 Department.

The Commission finds that Brian Rosen has the experience and training to be qualified as an expert in the field of 911 and telecommunications networks. His testimony was credible, persuasive and is given substantial weight in the Commission's findings.

The Commission further finds that Lumen has been less than forthcoming providing information to the 911 Department.³⁰³

Nebraska's 911 service was interrupted no less than 15 hours over three interruptions between August 1, 2023 and August 1, 2024,

³⁰¹ 911-077/C-5581/PI-252, Exhibits 6, 8, 9, 11-4-24 transcript 184.

³⁰² 911-077/C-5581/PI-252, Exhibits 7, 8, 9, 13, 18.

³⁰³ 911-075/PI-248, Exhibits 7, 56, 911-077/C-5581/PI-252, Exhibits, 6, 7

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as evidenced by Lumen's own documentation.³⁰⁴ The Commission finds that three outages in less than a 12-month period with over 15 hours of service interruption is unacceptable for Nebraska's 911 system.

When reviewing the limited data in isolation, this shows Lumen's system at best performed at three nines and not the five nines guaranteed by Lumen.³⁰⁵ While the Commission recognizes the failures were all between the aggregation point and the LNG, and not the ESInet nor core services, Lumen designed, installed and implemented this system and continues to be responsible for the its failing infrastructure.

In addition to the lack of redundancy and diversity shown repeatedly throughout these outages, what is also revealed is Lumen's willful ignorance of its own network and its unwillingness to conduct planned regular testing designed to identify weaknesses in their network nor engage in regular and routine auditing of available pathways for 911 traffic.

Lumen has engaged in substantial work to improve their network and should be commended for their efforts. However, more work must be done.

The Commission finds there is sufficient evidence that Lumen has failed to meet the level of service prescribed within the state contract with Lumen. More specifically, Lumen has failed to deliver sufficient redundancy and reliability as bargained for within the contract. Therefore, the Commission supports further action being taken by the State 911 Department to ensure all enforcement mechanisms contained within the contract are utilized to the fullest extent available.

The Commission finds that, to ensure that Nebraska's 911 system is robust and reliable and meets five nines availability, the 911 Department should identify potential changes to the state's current 911 system which may include, but not be limited to, ensuring sufficient geographically diverse connections with redundant network components, eliminating all aggregation points, obtaining an LNG or a data center or both in Nebraska, eliminating the use of SS7 networks, and/or adding additional components such as multiplexers.

³⁰⁴ 911-075/PI-248 Exhibit 50, 911-077/C-5581/PI-252, Exhibits 12, & 13.

³⁰⁵ 911-075/PI-248, Exhibit 57, 59.

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Once a cost-efficient and reliable system is identified, the State 911 Department should consider whether Lumen is capable and willing to provide a more robust system. If the State 911 Department determines Lumen is an appropriate partner, any agreements must include significant penalty provisions should Lumen continue to fall short of bargained-for minimum network system requirements. If Lumen is unwilling or incapable, the 911 Department should initiate the process for obtaining proposals to transform Nebraska's 911 system to meet industry standards and ensure that Nebraska's 911 is reliable.

While the Commission recognizes that any fines collected from a complaint process and deposited into the State School fund will do little to achieve a modern and reliable 911 system, should Lumen continue to be uncooperative with the State 911 Department's attempts to resolve the issues identified throughout these investigations, nor obtain sufficient satisfaction to enforce and/or amend the current contract or engage in a future contract, the Commission would support the initiation of a complaint against Lumen but the priority remains supporting the State 911 Department in ensuring there is a modern and reliable 911 System for all Nebraskans.

O R D E R

IT IS THEREFORE ORDERED by the Nebraska Public Service Commission that this investigation shall be closed.

ENTERED AND MADE EFFECTIVE at Lincoln, Nebraska, this 14th day of January 2025.

NEBRASKA PUBLIC SERVICE COMMISSION

COMMISSIONERS CONCURRING:

Eric M. Hamler
[Signature]
Kevin Stocker
[Signature]

Tim Schram
Chair

ATTEST:

Thomas W. Golden
Executive Director