



Debugging PDC to PDC data flows

Oncor Electric Delivery

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NASPI Working Group Meeting

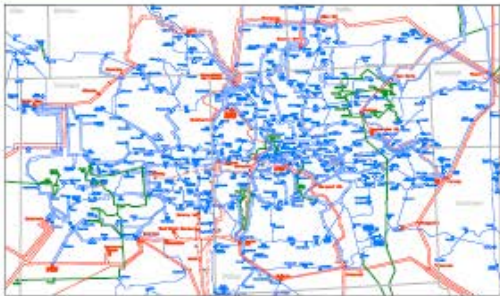
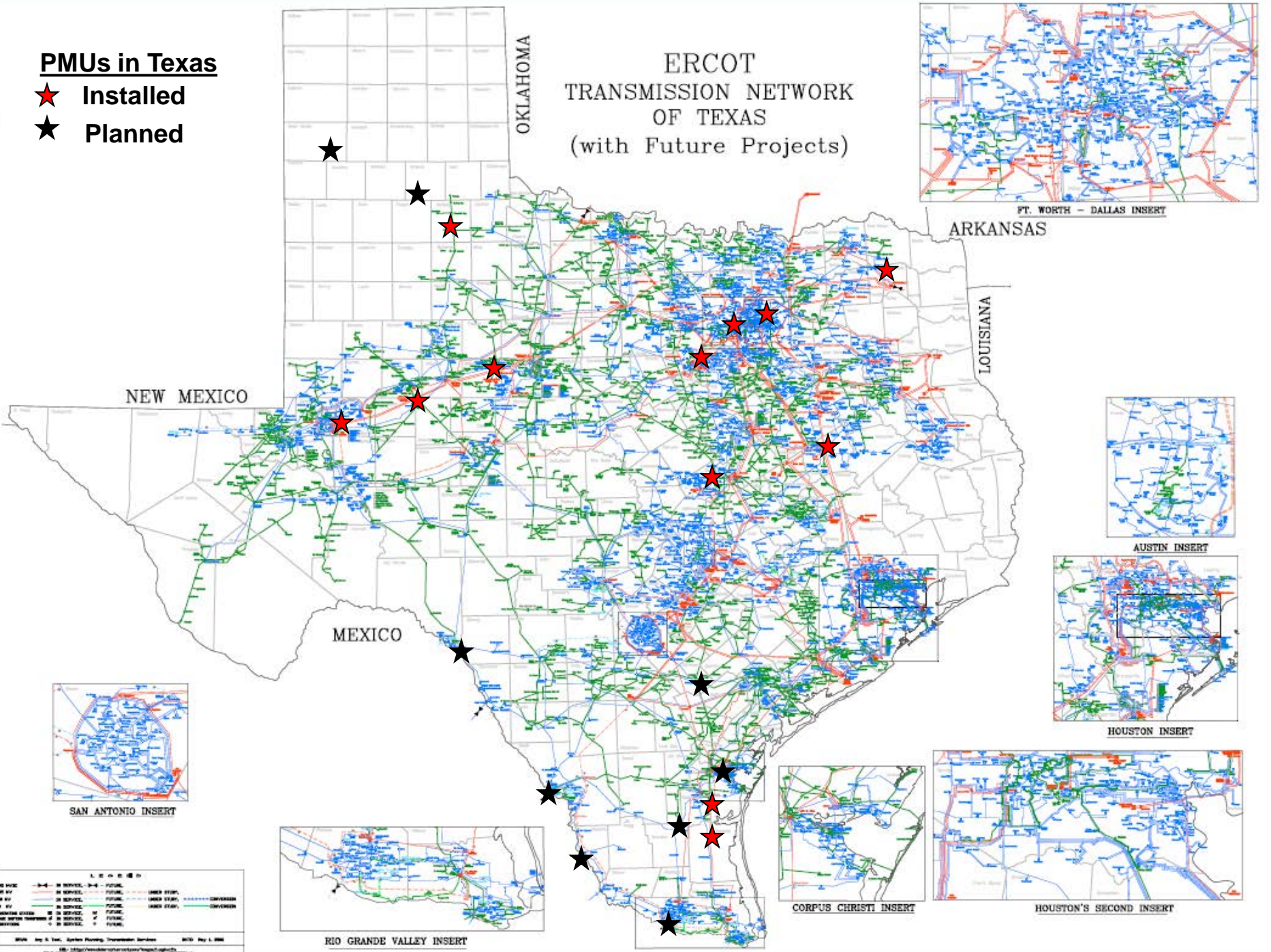
June 8-9, 2011

Toronto, Ontario, Canada

PMUs in Texas

- ★ Installed
- ★ Planned

ERCOT TRANSMISSION NETWORK OF TEXAS (with Future Projects)



FT. WORTH - DALLAS INSERT



AUSTIN INSERT



HOUSTON INSERT



HOUSTON'S SECOND INSERT



CORPUS CHRISTI INSERT



RIO GRANDE VALLEY INSERT

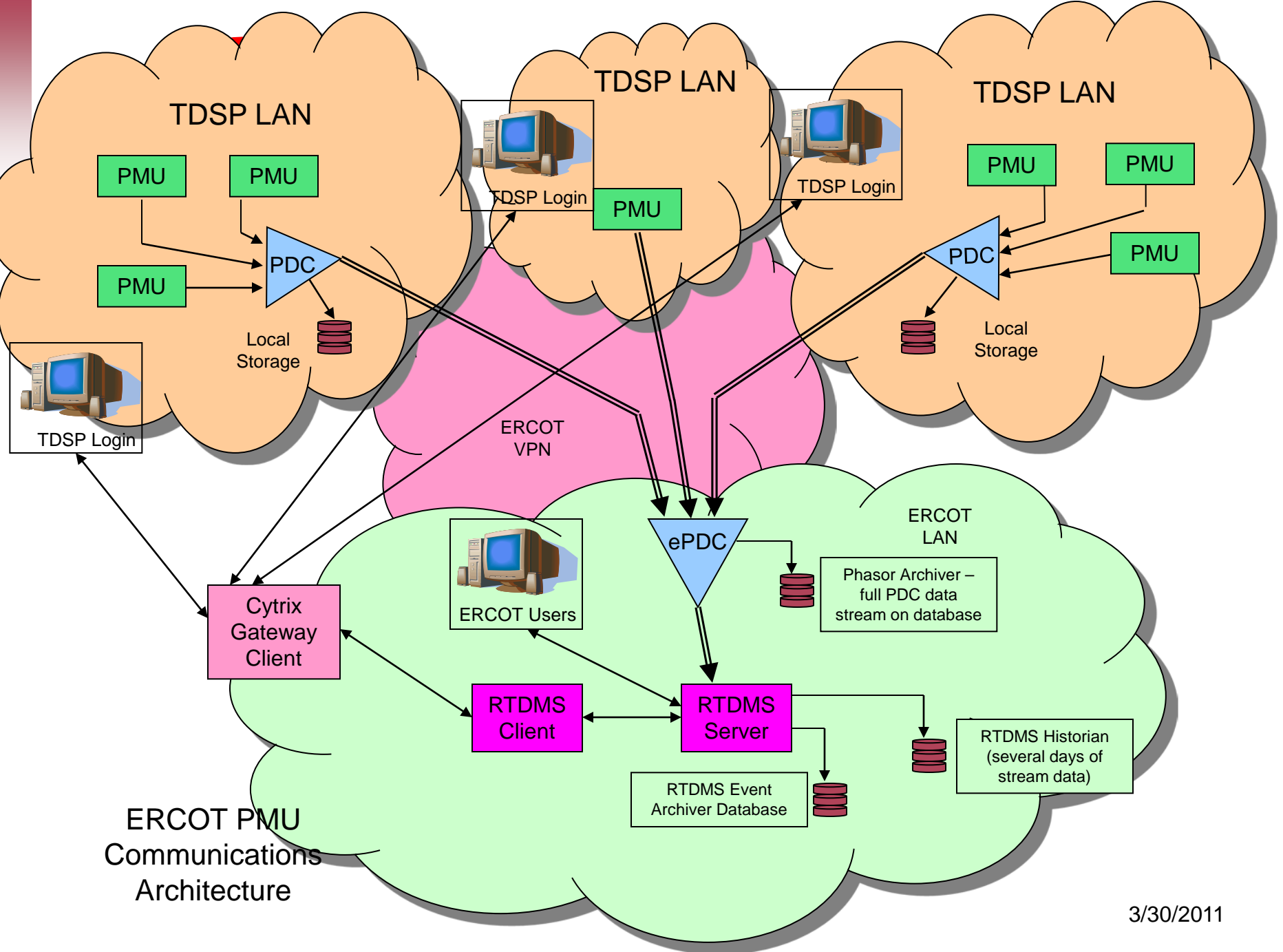


SAN ANTONIO INSERT

LEGEND

DC HVDC	3-4	IN SERVICE	3-4	FUTURE
500 KV	IN SERVICE	FUTURE	UNDER STUDY	
500 KV	IN SERVICE	FUTURE	UNDER STUDY	CONVERSION
500 KV	IN SERVICE	FUTURE	UNDER STUDY	CONVERSION
500KV HVDC	IN SERVICE	FUTURE		
500KV HVDC	IN SERVICE	FUTURE		
500KV HVDC	IN SERVICE	FUTURE		

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ERCOT PMU Communications Architecture

Synchrophasor Problem Summary

- Prior to 1/21/2011, the missing sample rate was very low (less than 100 out of 108,000 samples). We had 8 PMUs reporting, 6 network connected and 2 modem connected.
- After 1/21/2011, the missing sample was greater than 200 samples over one hour (we had made no configuration changes or added new PMUs).
- 2/11/2011, the connection between Oncor and ERCOT was dropped as we moved to a new PDC server. Upgraded synchrophasor software was also installed on the new server. When the connection between Oncor and ERCOT came up, there was a 70% missing sample rate. We began working with SEL to fix the problem.
- 2/15/2011, SEL made some setting adjustments in the new software, and the missing sample rate improved to 2-4% (several hundred to several thousand samples over one hour).
- The remaining missing data problem may have been due to the ERCOT PDC timing out before the Oncor data packet was received and the ERCOT PDC zero-filling the entire dataset from Oncor. We experimented by increasing the Oncor PDC wait time while also increasing the ERCOT PDC wait time and this had no effect.

ERCOT Debugging Efforts

+Incompatible PDC setting?

- ONCOR and ERCOT engineers checked the PDC setting on both sides. Made changes that improved data latency and timing.

+Time Latency Setting?

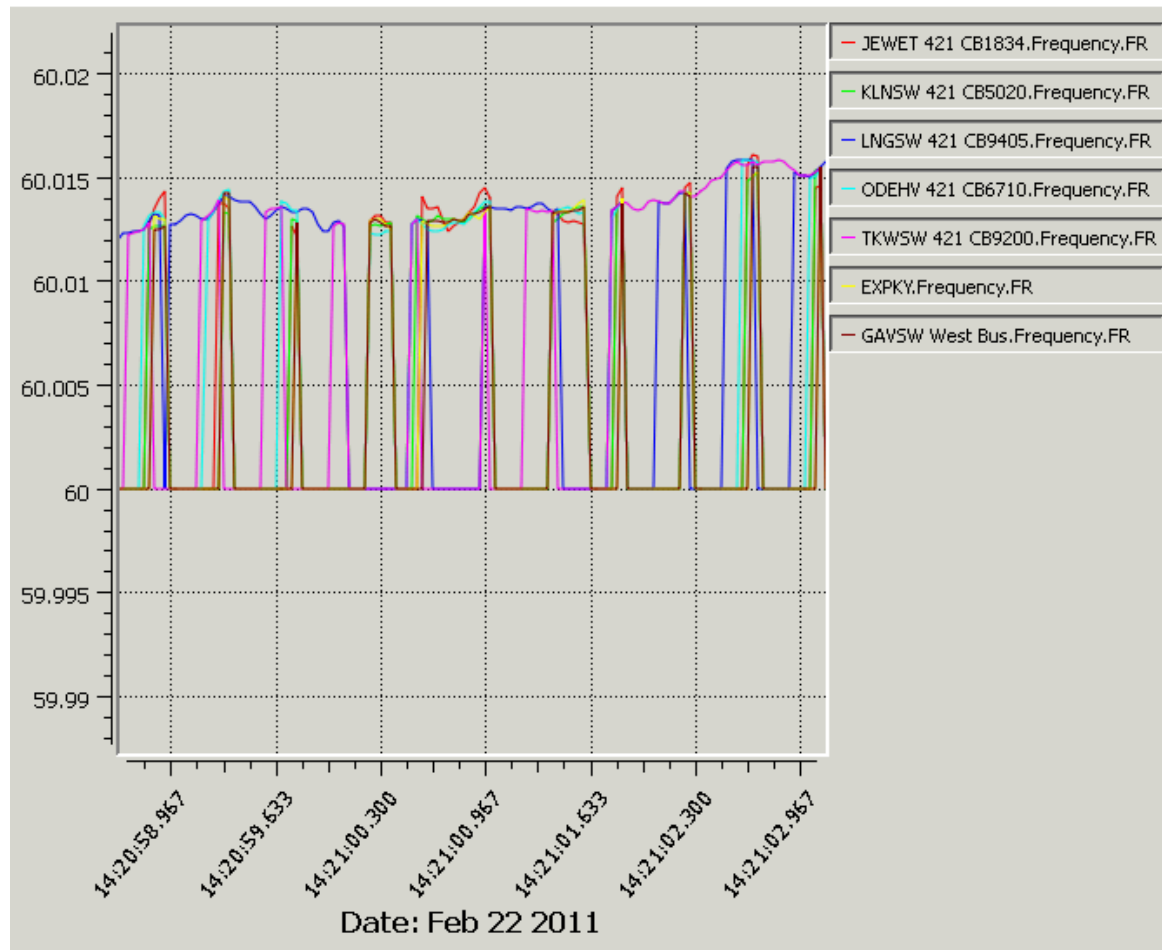
- ERCOT changed the Max Latency to a very large value (~5 seconds), the issue of losing data improved but still existed.

+Time Stamping Errors?

- For example, same timestamp for two samples.

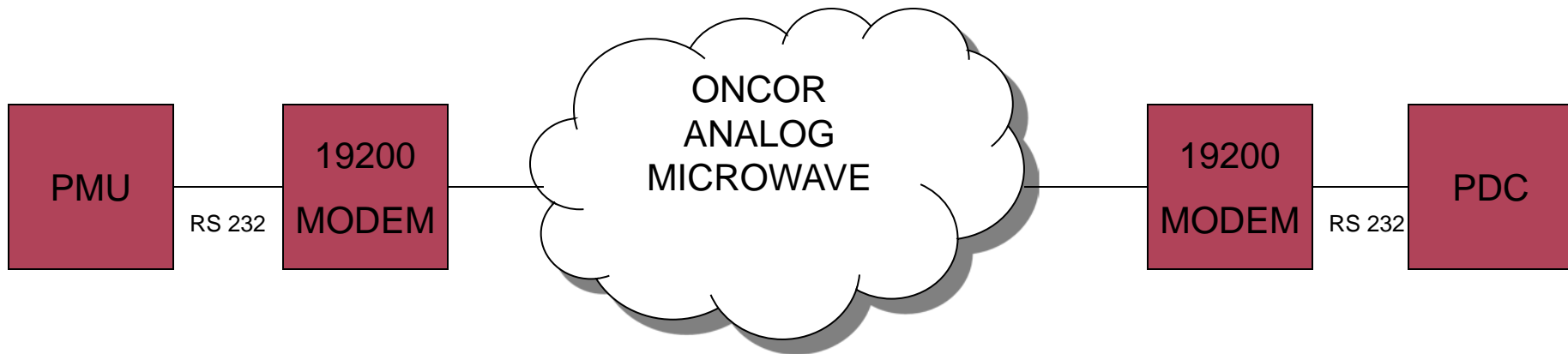
+Communications Delays

What ERCOT Saw



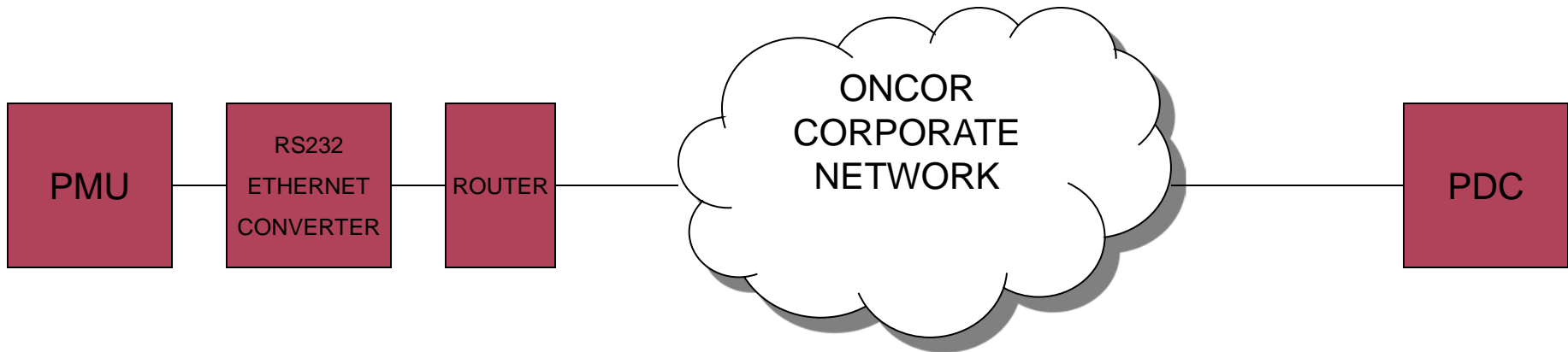
Communication Difference Between Oncor's PMU locations

- Two PMU Locations



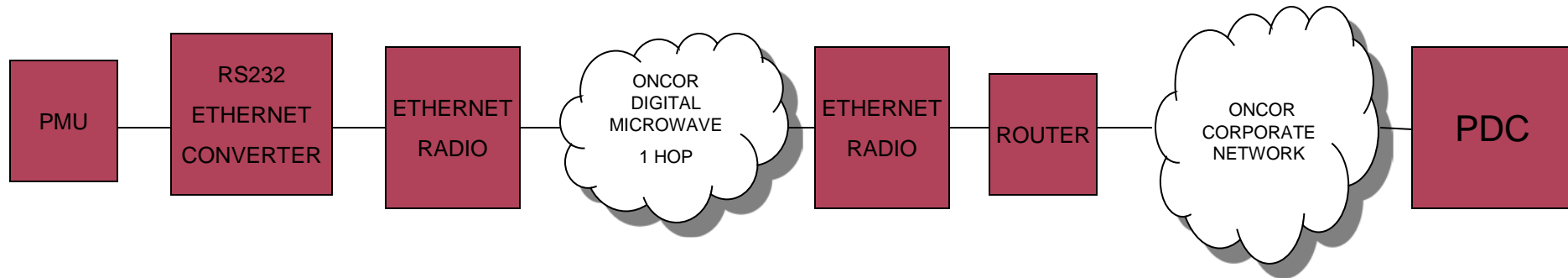
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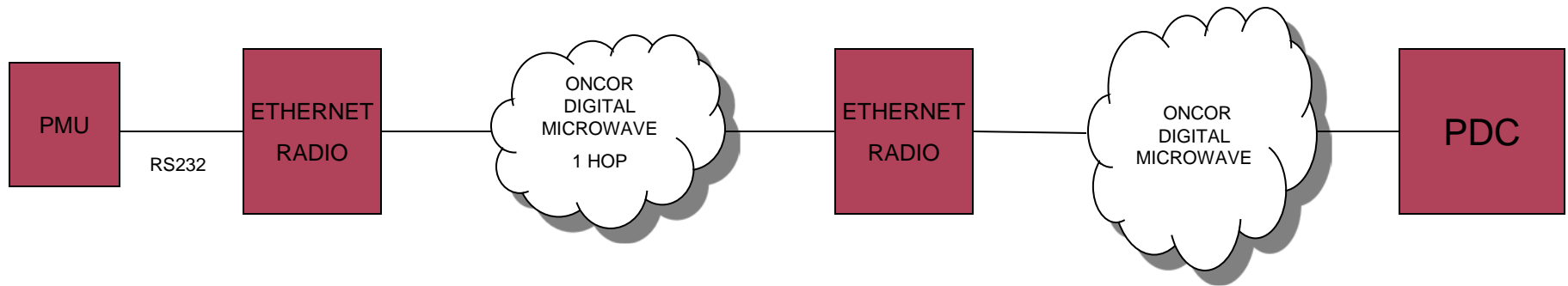
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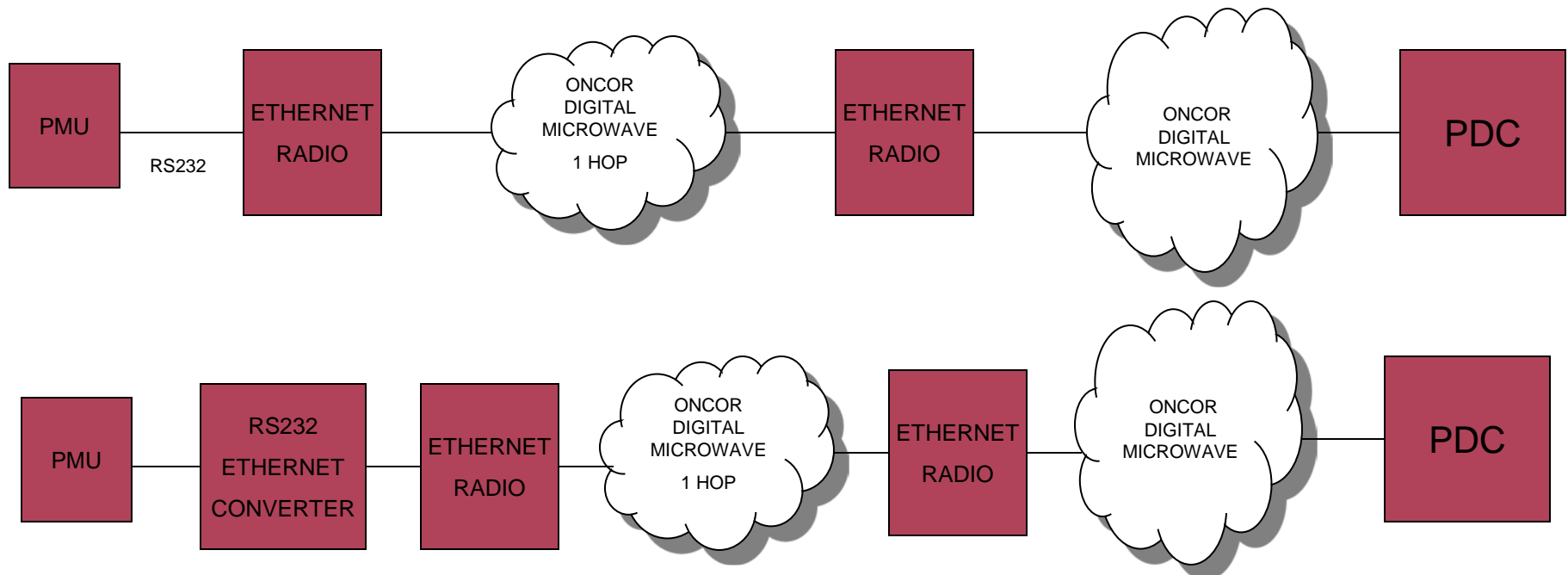


Oncor's Actions to Resolve Data Loss Issue

- 2-28-2011 – It was determined two PMU locations data were being buffered by the microwave radio at each site and this was causing data from these two sites to be dropped (instead of streaming the data packet by packet, the radio waits until it has 12-14 packets before sending the data). This buffering of data was having an affect on the timing of the data being sent to ERCOT. We began working with our IT people to find a solution to the buffering of data.
- 3-9-2011, SEL released a new version of PDC software that supports data that comes in bursts caused by buffering and this solved the missing data problem with ERCOT. We will continue to work with our IT department to solve the buffering of data by the radios, as this increases the latency from the PMU to the PDC. We may have to replace the radios.

Resolving the Data buffering Issue

- 4-8-2011 - Determined that going serial from the PMU to the radio was causing the buffering of data. Added a serial to Ethernet converter on the output of the PMU and connected to the radio Ethernet and this stopped the buffering problem.



Remaining Issue

- All PMUs, with the exception of Broadband Power Line (BPL) and Multiprotocol Label Switching (MPLS) connected PMUs (these are the three locations connected directly into the Oncor Corporate network), periodically drop off. We are working with our IT department to improve this connectivity. We believe the remaining issues are associated with the Microwave and radio systems that Oncor uses.