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The Invisible Performance Indicator - A Case Study on Busy / Reorder

By implementing a full-time Communications Network Monitoring and Analysis System, the PSAP manager benefits from simplified identification of potential call handling problems, *comprehensive* Call Taker performance analysis and timely network trouble notification.

CASE STUDY

Profiled Organization	• *Medium Size PSAP with 40 Lifeline trunks split up between four trunk groups and 58 call takers working in three shifts. See Figure 1*
Challenge	• *Eliminate PSAP Equipment Busy / Reorder and reduce Network Busy / Reorder conditions*
Solution	• *Rearrange trunk groups to spread out the load more evenly.*
Benefits	• *Reduce the chance of PSAP liability for missed calls due to equipment congestion.*

Profiled Organization

The study PSAP chosen was the Suffolk County Police E9-1-1 center in New York. The Suffolk County Police PSAP handles approximately 18,000 Wireline and Wireless calls per week. There is an average of 2.67% more Wireline calls than Wireless calls. Two E9-1-1 Network Tandem switches handle the Wireline and Wireless calls. There are a total of 24 Wireline Trunks and 16 Wireless Trunks. Both Wireline and Wireless Trunk Groups will overflow calls to the other like trunk group if there are no trunks available from the primary serving tandem switch. Figure 1 shows the basic network configuration for the study PSAP.

External Monitoring equipment was connected to all the PSAP trunks and the CTI and ALI data links were also monitored.

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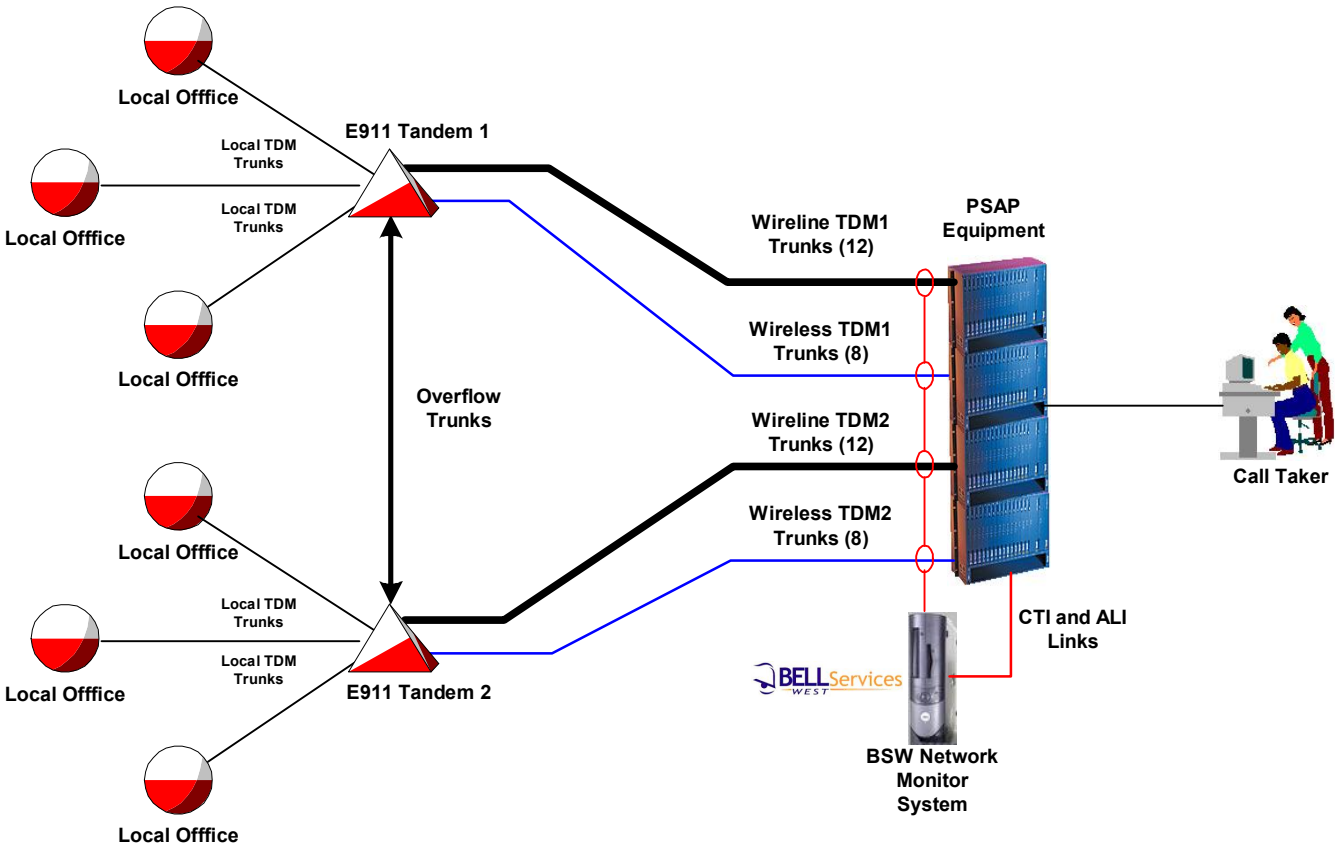

Figure 1 - Suffolk County Police PSAP Network Configuration

Challenge

After a few months of monitoring, it became clear that the Wireless Trunk Groups were not efficiently handling traffic. Referring to Tables 1 and 2, the Wireless TDM 2 Trunk Group is under trunked and Wireless TDM 1 is barely holding its own. The Wireline Trunk Groups are over trunked. Because the Wireless Trunk Groups are under trunked, they are Blocking Calls from the Network and the PSAP even though these trunks will overflow to another Trunk Group if all trunks are busy.

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Table 1 – Wireline Trunk Group Statistics

	Wireline TDM 1						Wireline TDM 2					
	Call Volume	Blocked Calls	Busy / Reorder	Required Trunks	Available Trunks	% Overflow	Call Volume	Blocked Calls	Busy / Reorder	Required Trunks	Available Trunks	% Overflow
Aug[1]	11373	0	2	5	12	7.94	41354	2	1	10	12	2.98
Sept	8605	0	0	6	12	8.24	33365	1	1	10	12	2.98
Oct	8629	0	1	6	12	9.12	33548	2	2	13	12	3.07
Nov[1]	9631	0	1	6	12/10	8.69	39875	1	2	10	12/10	2.56
Dec	8176	0	0	6	10	10.19	34071	1	0	11	10	2.64
Jan	7601	0	0	5	10	11.2	32299	1	0	11	10	2.80

Wireline TDM 1 overflows to Wireline TDM 2 even if there are trunks available in the Wireline TDM 1 Trunk Group. It is not known at this time why this occurs, but it is why the overflow percentages are so high. Because Wireline TDM 1 is severely over trunked, there should be very few overflow calls.

Table 2 – Wireless Trunk Group Statistics

	Wireless TDM 1						Wireless TDM 2						
	Call Volume	Blocked Calls	Busy / Reorder	Required Trunks	Available Trunks	% Overflow	Call Volume	Blocked Calls	Busy / Reorder	Required Trunks	Available Trunks	% Overflow	
Aug[1]	20240	0	5	8	8	0.64	33676	1	5	11	8	0.36	
Sept	15273	0	3	7	8	0.63	25428	1	5	10	8	0.31	
Oct	15221	1	5	8	8	0.68	25081	2	5	11	8	0.3	
Nov[1]	22175	0	7	7	8/10	0.56	29154	0	5	8	8/10	**10.1***	**0.28***
Dec	13946	**0**	**0**	7	10	0.65	23823	**1**	**1**	9	10	**0.12**	
Jan	12112	**0**	**0**	7	10	0.69	28369	**1**	**0**	9	10	**0.08**	

**** Corrected for Wireless Provider Translation Error, which temporarily forced calls onto the wrong Tandem.***
1 – Five Week Month

The Invisible Performance Indicator

Blocked calls (Network Busy / Reorder) are virtually impossible to detect and track. They are invisible to the PSAP since the PSAP never sees the call. Network Busy / Reorder (Fast Busy) is usually returned to the caller if the network switch cannot connect to a PSAP trunk either because there are no available trunks from the local office to the E9-1-1 Tandem or there are no available trunks from the E9-1-1 Tandem to the PSAP (See Figure 1).

Traditional network management techniques are used to determine the possibility of Blocked Calls based on call volume, call duration and call frequency. Erlang B tables are used to determine the required trunks and the number of Blocked calls for a given Grade of Service. This information can then be used to determine how many trunks are needed to reduce the number of Network Blocked Calls.

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Busy / Reorder signals originate from the PSAP equipment. These signals can also be invisible to the PSAP unless they are monitored externally at the trunk. If the trunking and PSAP equipment are properly configured, PSAP Busy / Reorders should be few and far between. Like Network Busy / Reorders, these calls never made it to a Call Taker. They are often dismissed because, from the caller's point of view, they sound just like Network Busy / Reorders. The Network gets blamed, so what else is new? Callers just hang up and try again, that is, if they can!

PSAP Busy / Reorders are a very temporary trouble condition. They are caused when the PSAP equipment does not have enough spare resources (Digit Receiver, voice channel, Queue access, etc.) to process the call. Once a resource is freed up, a new call can be handled. PSAP Busy / Reorder almost always happens during Busy Hour since a temporary equipment congestion scenario causes it. The problem is, the damage has been done and a call was lost.

Though some PSAP equipment may provide alarms or equipment log messages indicating that the equipment could not process the call, they are often not understood. Since they do not happen very often, if they are detected, Busy / Reorders are usually ignored. Fortunately, unlike Network Busy / Reorders, PSAP Busy / Reorders can usually be resolved at the PSAP.

Solution

There were a couple of options available to Mathew:

1. Add two trunks to the Wireless TDM 2 Trunk Group and delete four trunks from the Wireline TDM 1 Trunk Group.
2. Rearrange some of the Wireline Trunks and move them to the Wireless Trunk Groups.
   e.g. Move two Wireline TDM 1 trunks to Wireless TDM 1 and move two Wireline TDM 2 trunks to Wireless TDM 2. This would give each Trunk Group 10 trunks.

Option 1 would require installing new trunks, testing them and then cutting them over. Option 2 only required rearranging the translations at the Tandems. All existing trunk facilities could be reused and there would be less testing.

Option 2 was implemented. There was no noticeable interruption of service except for a few test calls. Call Takers didn't even know anything had changed.

"The cutover was no more than a redefining of the trunk lines within our CPE equipment. Coordination with the CPE vendor and with the Telco Vendor amounted to no more than a few hours of modifications, testing and into production. The overall cost was minimal, a few hours of our CPE Engineer's time."- Matthew Jones

Though the rearrangement was transparent to the user, it did have a significant impact on call flow.

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Benefits

Referring again to Tables 1 and 2, it can be seen that after November, the following traffic flow changes had occurred:

1. Call Volume did not change very much over all the Trunk Groups. There was a slight reduction in November and December due to the holidays.
2. Blocked calls (Network Busy / Reorders) did not drastically change even though two trunks were taken away from the Wireline groups. Network Busy / Reorder was never really a problem.
3. PSAP Busy / Reorders did not drastically change for the Wireline group; however, they were dramatically reduced for the Wireless group.
4. The number of required trunks also stayed relatively the same. Big difference is that the Wireless groups now have the number of trunks they require. There was a slight drop in the number of required trunks in November and December due to the holidays.
5. Overflows in the Wireline groups increased slightly due to the reduction in trunks. Wireless TDM 2 drastically reduced the number of overflows since this trunk group can now handle its own traffic.

The major benefit to the Suffolk County Police PSAP was that more calls could get to the Call Takers than before. Callers are not getting Busy / Reorders as often. These steps were taken to make sure as many calls as possible are reaching Call Takers. Although there were never any complaints for “Can’t reach 911”, these modifications ensure that the potential for these complaints is neutralized.

With the increased usage of cell phones, it was apparent that the modifications were necessary to continue to deliver the greatest level of service to those people calling 911.

Conclusion

Network management tools are more than fancy reports, charts and graphs. When utilized correctly, they can help PSAP managers anticipate future network requirements, identify routing problems, assist in trouble resolution, verify wireless Phase 2 and Phase 3 compliance, discover ALI database errors and validate PSAP equipment upgrades by providing before and after views of the PSAP operations.

With the advent of PS-ALI and VOIP services, it is important to know how these services are affecting the PSAP’s performance. Studies can be initiated that will automatically track the impact of these new services. Alarms can be generated to alert PSAP managers if there are problems now. Trend reports can be used to justify the need for more Trunks, Admin Lines or Call Takers.

The ability to analyze and interpret traffic and network performance information is key to any successful call center operation. The BSW monitoring service can help ensure that you are realizing the full potential of your E9-1-1 PSAP system before committing to costly and unnecessary expansion expenditures, while it also provides a recorded trail to prevent any due diligence performance liabilities.

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Glossary

Table Definitions:

% Overflow	Percentage of total calls presented to the PSAP that used the alternate trunk group to handle the call instead of the primary trunk group designated to handle the call i.e. a call presented to the Wireless TDM 1 used a Wireless TDM 2 Trunk instead of a Wireless TDM 1 trunk. This should only happen if all trunks in the primary trunk group are busy.
Blocked Calls	Or Network Busy / Reorder originates from the local Central Office when the network does not have a trunk to connect to E9-1-1 caller
Busy / Reorder	Or PSAP equipment Busy / Reorder originated from the PSAP equipment when there are no available resources to process the call
Call Volume	Number of calls sent over a trunk group a month
Required Trunks	The average number trunks needed to handle the amount of traffic during Busy Hour. Erlang B tables are used to determine this value

Erlang: A unit of measurement of traffic density in a telecommunications system. The erlang describes the total traffic volume of one hour, or 3600 seconds.

For example, 60 calls in one hour, each lasting 5 minutes, results in the following number of erlangs:
minutes of traffic in the hour = number of calls x duration
minutes of traffic in the hour = 60 x 5
minutes if traffic in the hour = 300
hours of traffic in the hour = 300/60
hours of traffic in the hour = 5
traffic figure = 5 erlangs

Network designers use the erlang to understand traffic patterns within a voice network and use the figures to determine how many lines are required between a telephone system and a central office or between network locations.

References

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