ILLINOIS INSTITUTE OF TECHNOLOGY

ASSURE911

NG 9-1-1: Reliability after Design

Design and Reliability Solutions for Emergency Services Networks

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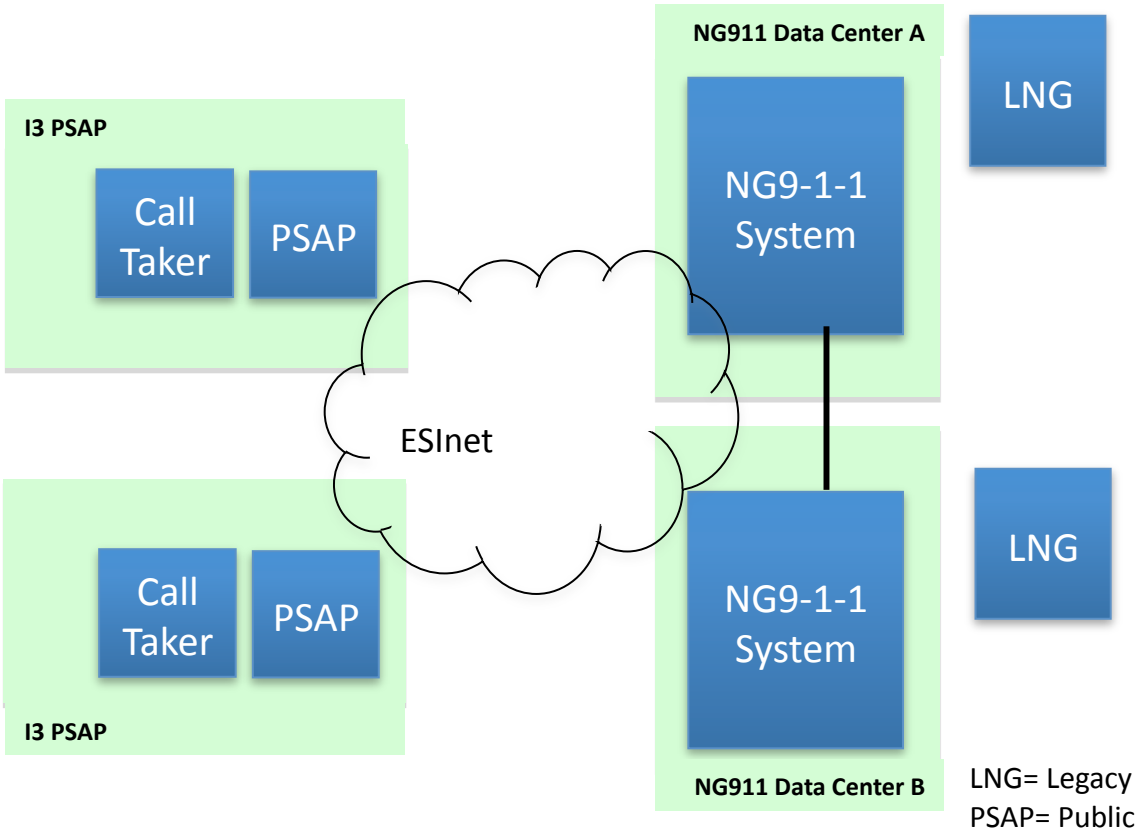
Contracted to design ESInet for Counties of Southern Illinois

- Presented Design to Illinois Commerce Commission
- Presented Design to FCC
- Funding and managing design validation testing at IIT
- End-to-End monitoring system to be deployed

Next Generation 9-1-1 Network Architecture



LNG= Legacy Network Gateway
PSAP= Public Safety Answering Point

Reliability, Defined …

NENA Emergency Services IP Network Design for NG9-1-1

[08-XXX, Version 1, August 16, 2011] quotes IEEE:

"Reliability is the ability of a system or component to perform its required functions under stated conditions for a specified period of time [IEEE 90]."

(See [NENA] for a discussion of Reliability vs. Availability.)

IEEE 90 – Institute of Electrical and Electronics Engineers, IEEE Standard Computer Dictionary: A Compilation of IEEE Standard Computer Glossaries. New York, NY: 1990

Reliability, Defined …

[NENA] further defines reliability as an measure of how close can you get to operating 100% of the time before a failure :

$$R = e^{-\left(\frac{Time}{MTBF}\right)}$$

where *e* = the mathematical constant *e* or 2.718281828459045…
and Time = time of the mission in hours

Reliability	Time (hrs)	Required MTBF (hrs)
0.9	8760	83,143
0.99	8760	871,613
0.999	8760	8,755,619
0.9999	8760	87,595,620
0.99999	8760	875,995,620
0.999999	8760	8,759,995,620

Using 8760 (hours in a year), typical routers have MTBF 240k to 340k, Ending up between .9 and .99 reliable

[NENA] Emergency Services IP Network Design for NG9-1-1 [08-XXX, Version 1, August 16, 2011]

Planning Reliability

In the ESInet Design

- Select components with high MTBF (mean time between failures)
- Physical broadband network passes Data Centers and PSAPs with diverse facilities
- Carriers may choose SIP with many paths over which traffic can be delivered to either Data Center
- Sectored routing gives legacy traffic diverse paths to LNGs

Availability, on the other hand …

[NENA]:

$$A = \frac{UpTime}{(UpTime + DownTime)}$$

Availability	Downtime
90% (1-nine)	36.5 days/year
99% (2-nines)	3.65 days/year
99.9% (3-nines)	8.76 hours/year
99.99% (4-nines)	52 minutes/year
99.999% (5-nines)	5 minutes/year
99.9999% (6-nines)	31 seconds/year

Less than 5 minutes of Down Time per year is Five-Nines

(Performance after design)

[NENA] Emergency Services IP Network Design for NG9-1-1 [08-XXX, Version 1, August 16, 2011]

Reliability, another definition …

"In my village the perception of reliability of our 9-1-1 service is that if someone sees another person bleeding, they'll call 9-1-1 first."

- heard at a prior IIT RTCL Conference

Reliability, one more definition

$$R_a = \frac{Successes}{Attempts}$$

where attempts = successes + failures [NENA]

Attempt = Caller originates communications (Call, Text, etc)
Success = Caller and Telecommunicator at PSAP connect

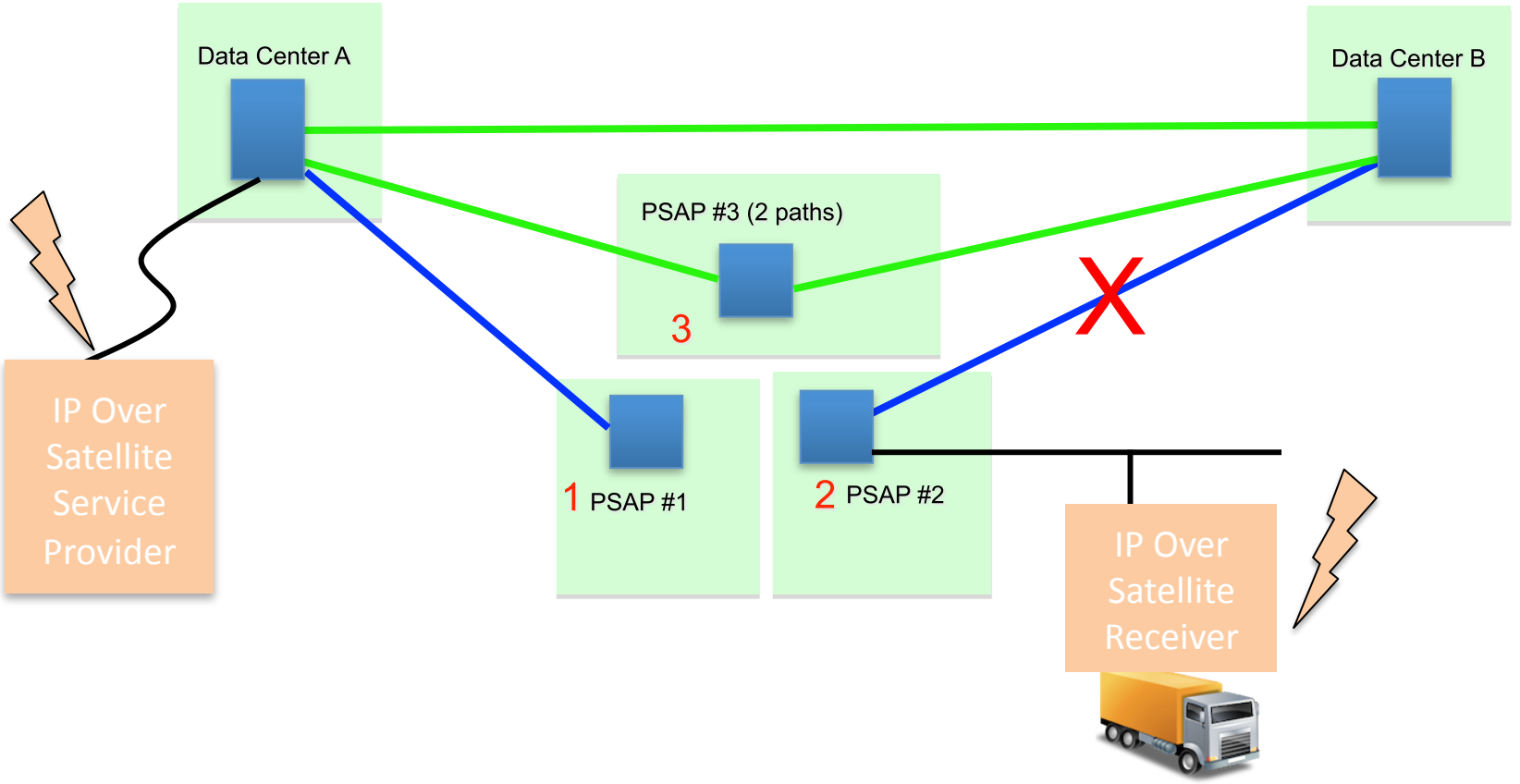
[NENA] Emergency Services IP Network Design for NG9-1-1 [08-XXX, Version 1, August 16, 2011]

Reliability After Design

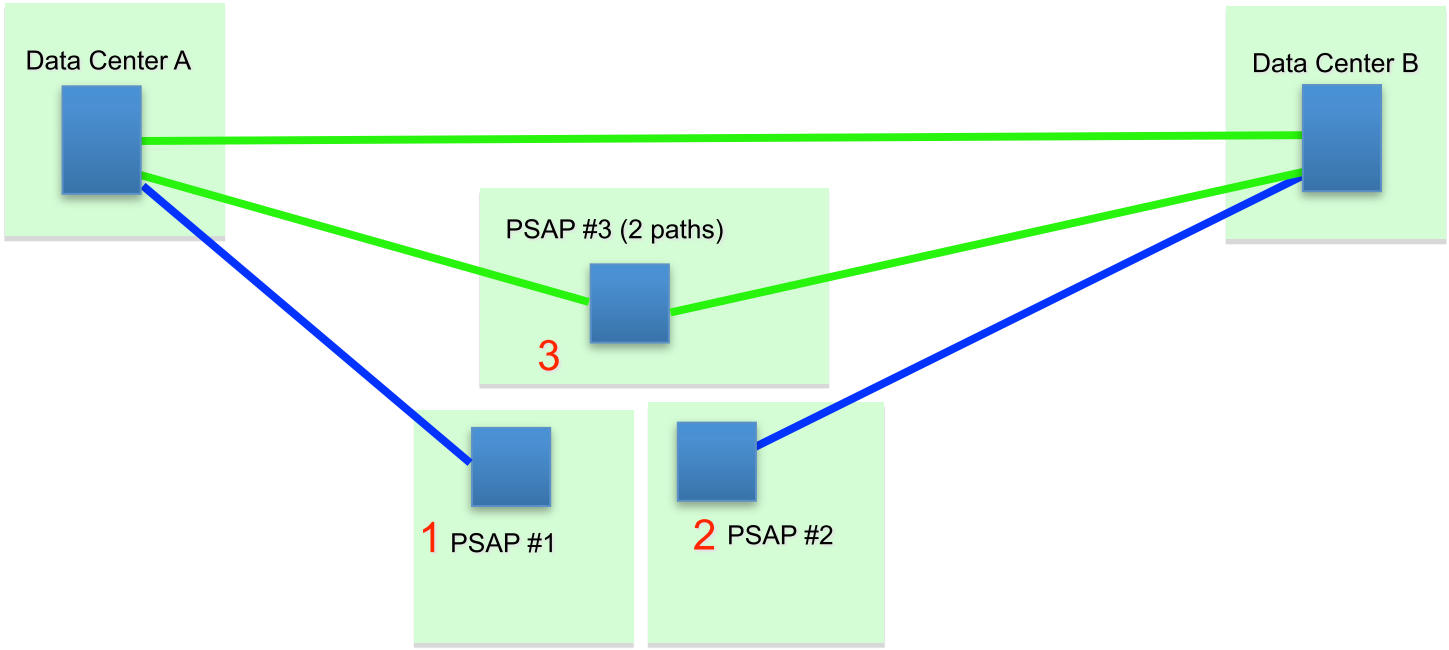
After the ESInet Design

- IP Over Satellite facility for recovery of isolated PSAP
- Intergovernmental agreements allow agencies to serve as alternate answering points for isolated PSAPs
- End-to-End Real-time monitoring and system log analysis to discover processing anomalies

Mobile Satellite connection may be able to put a PSAP back on the air

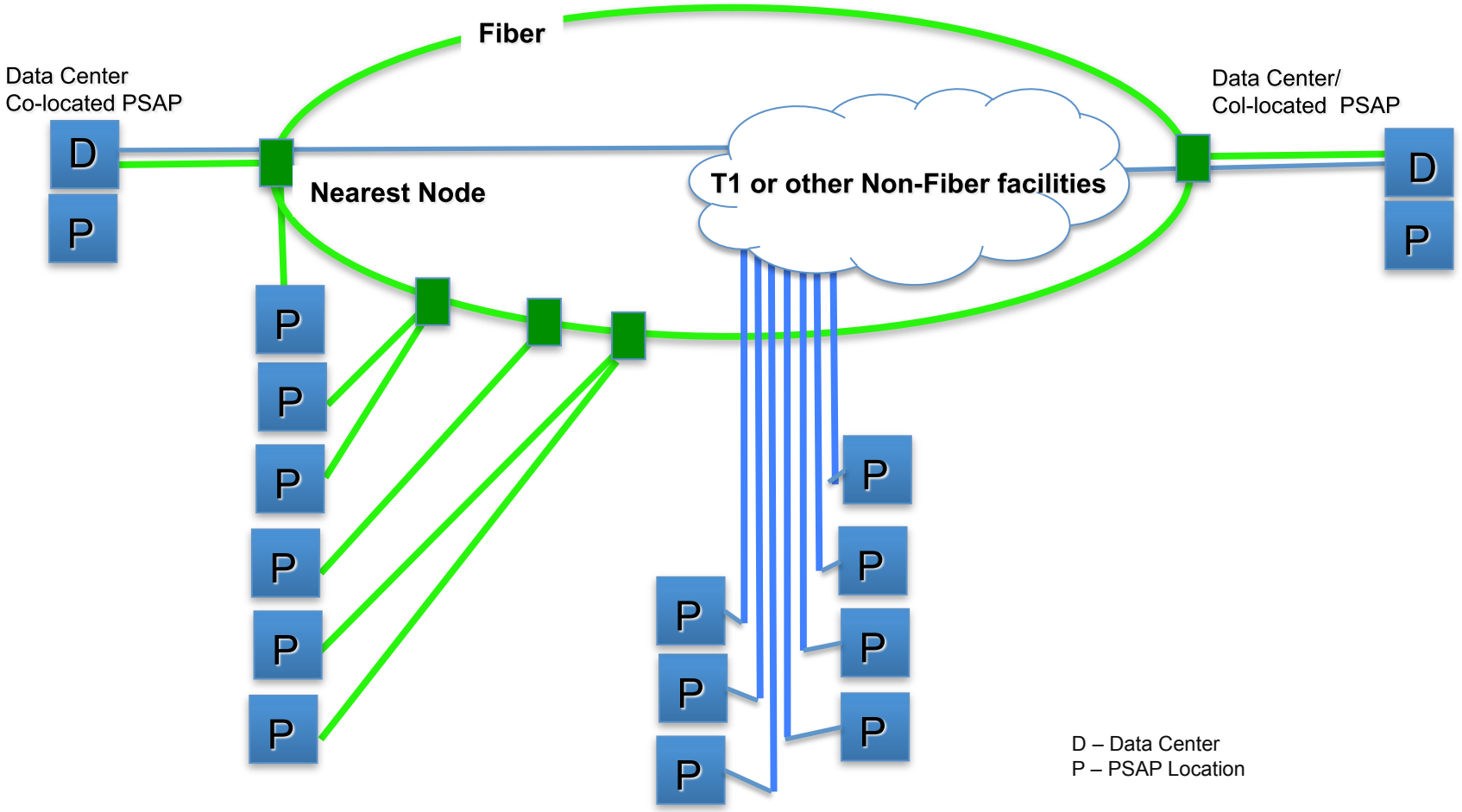


Physical broadband network may not pass all PSAPs with diverse facilities

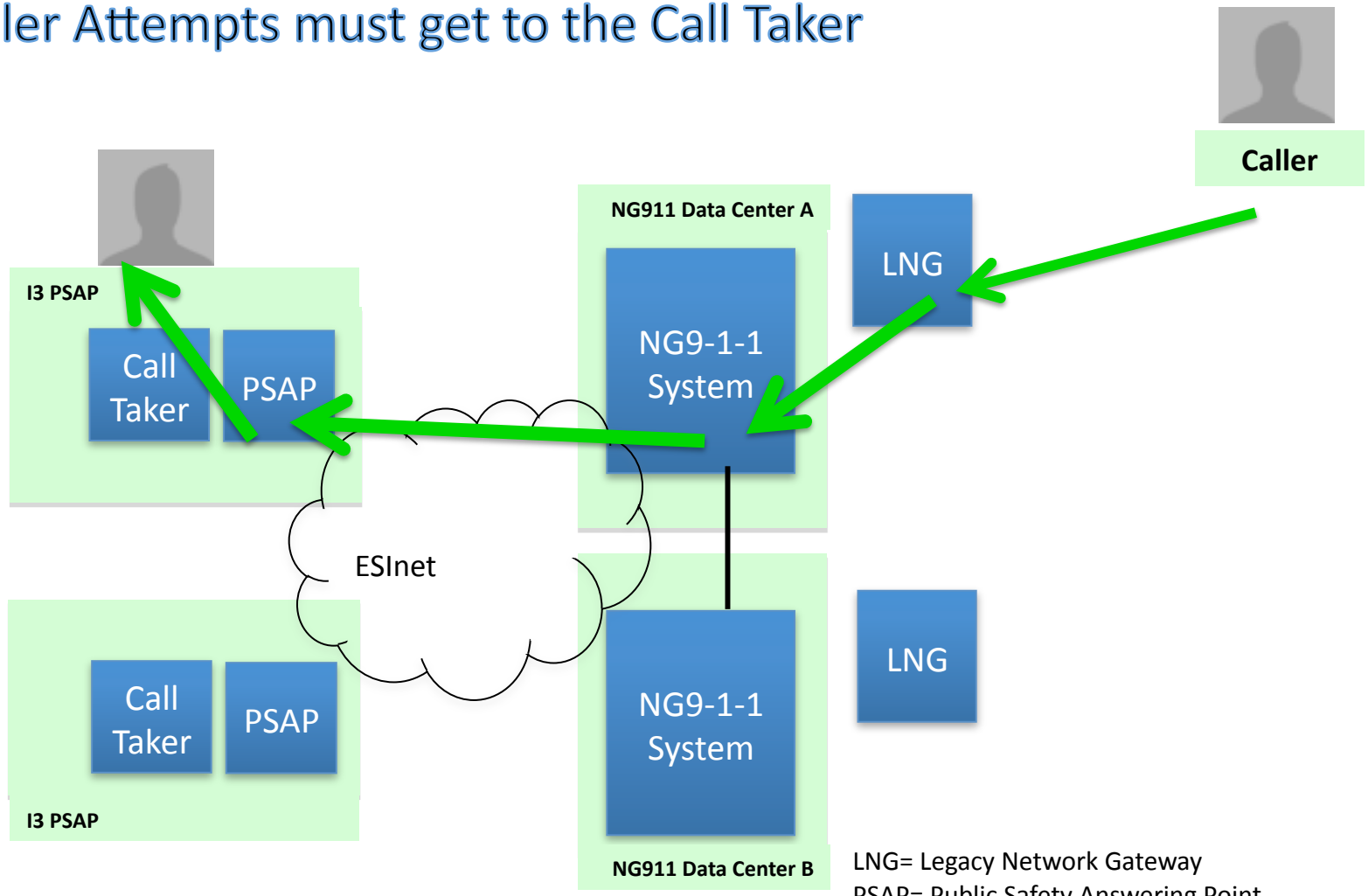


Intergovernmental agreements allow PSAP #3 to serve as an alternate answering point for PSAP #1 and/or #2

Every PSAP can take Any Call



Caller Attempts must get to the Call Taker



LNG= Legacy Network Gateway
PSAP= Public Safety Answering Point

I3 = Current version of NENA NG 9-1-1 Specification

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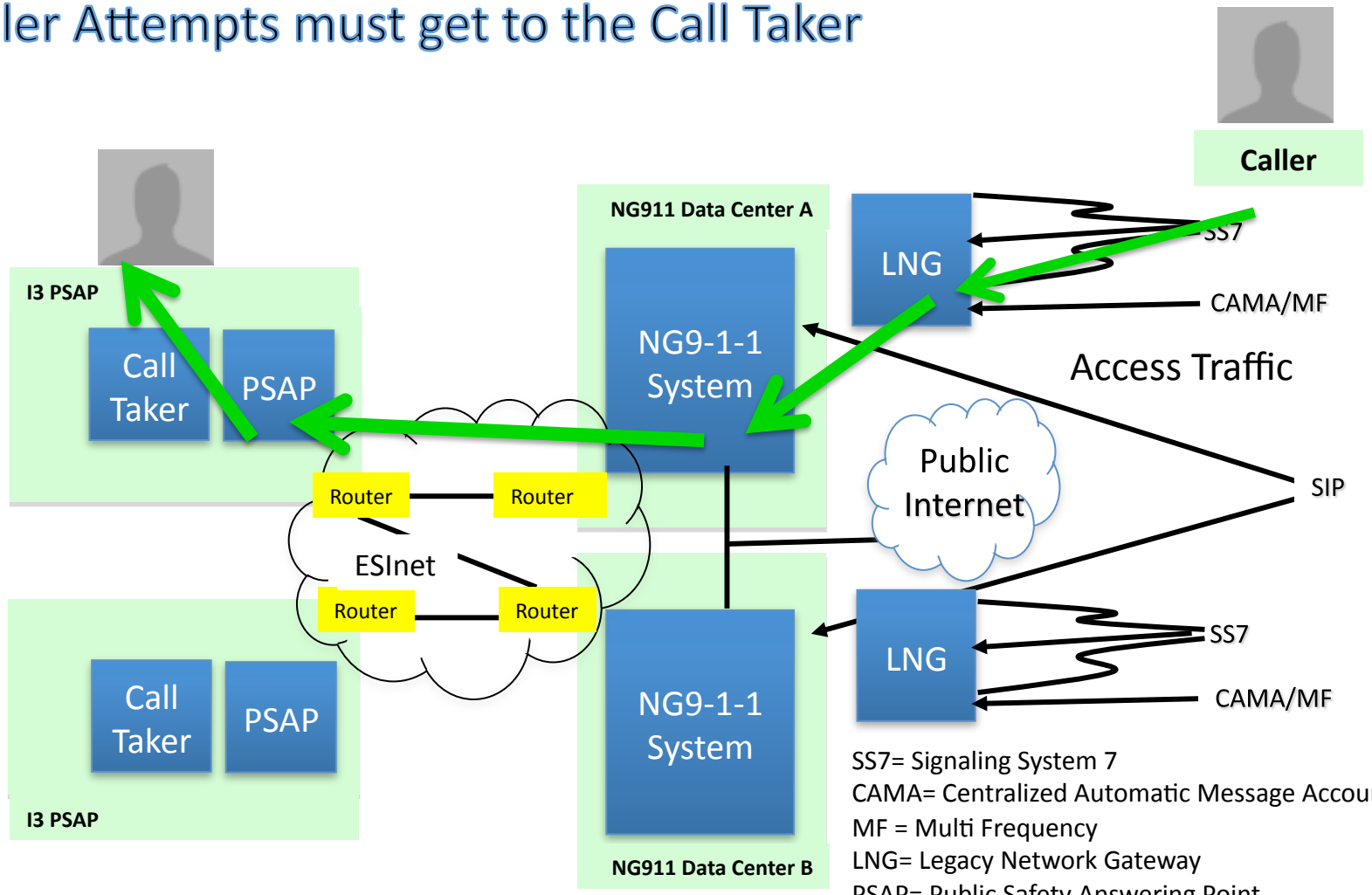

SS7= Signaling System 7
CAMA= Centralized Automatic Message Accounting
MF = Multi Frequency
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SIP = Session Initiation Protocol

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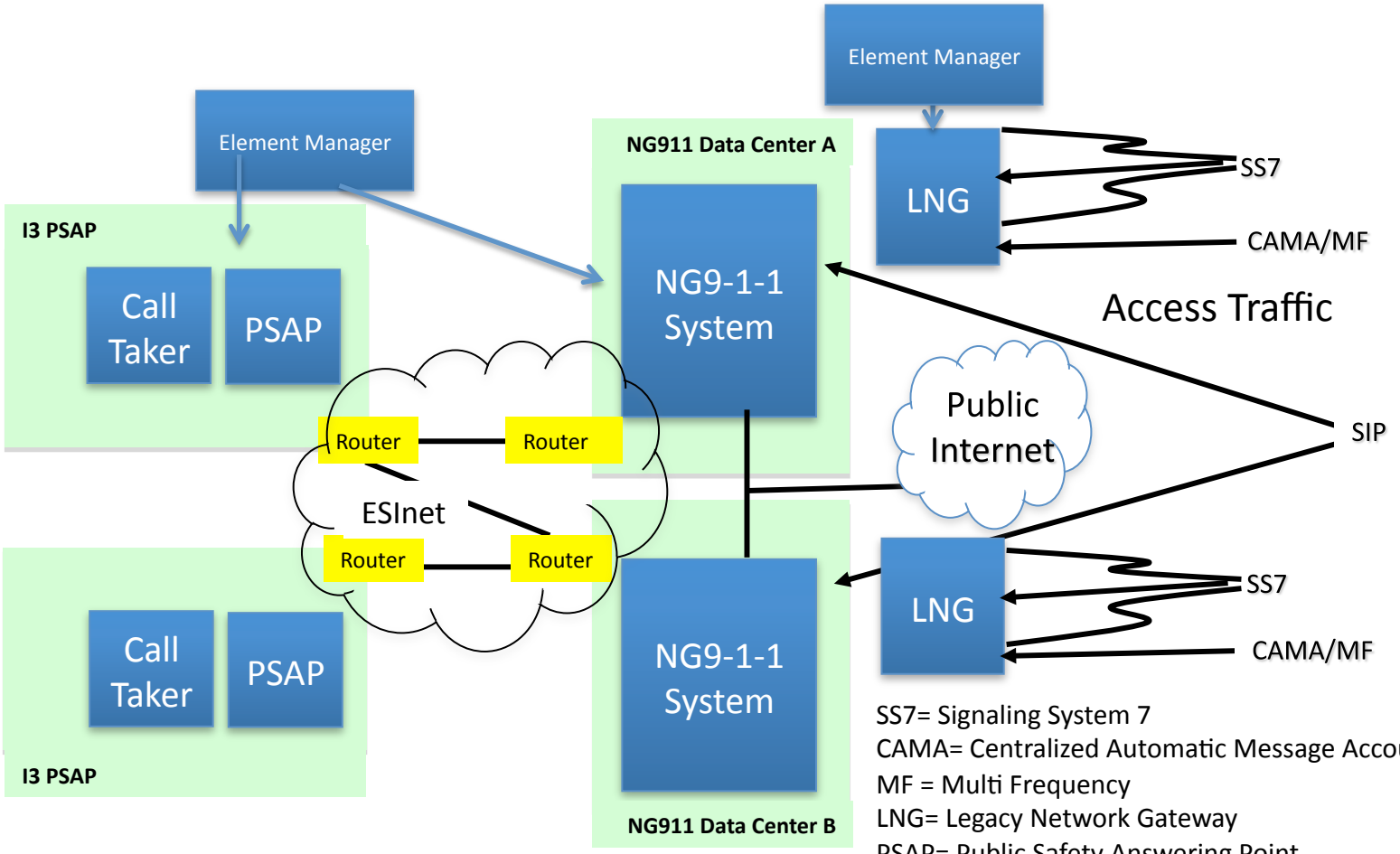
Vendor Element Management Systems have a partial view,



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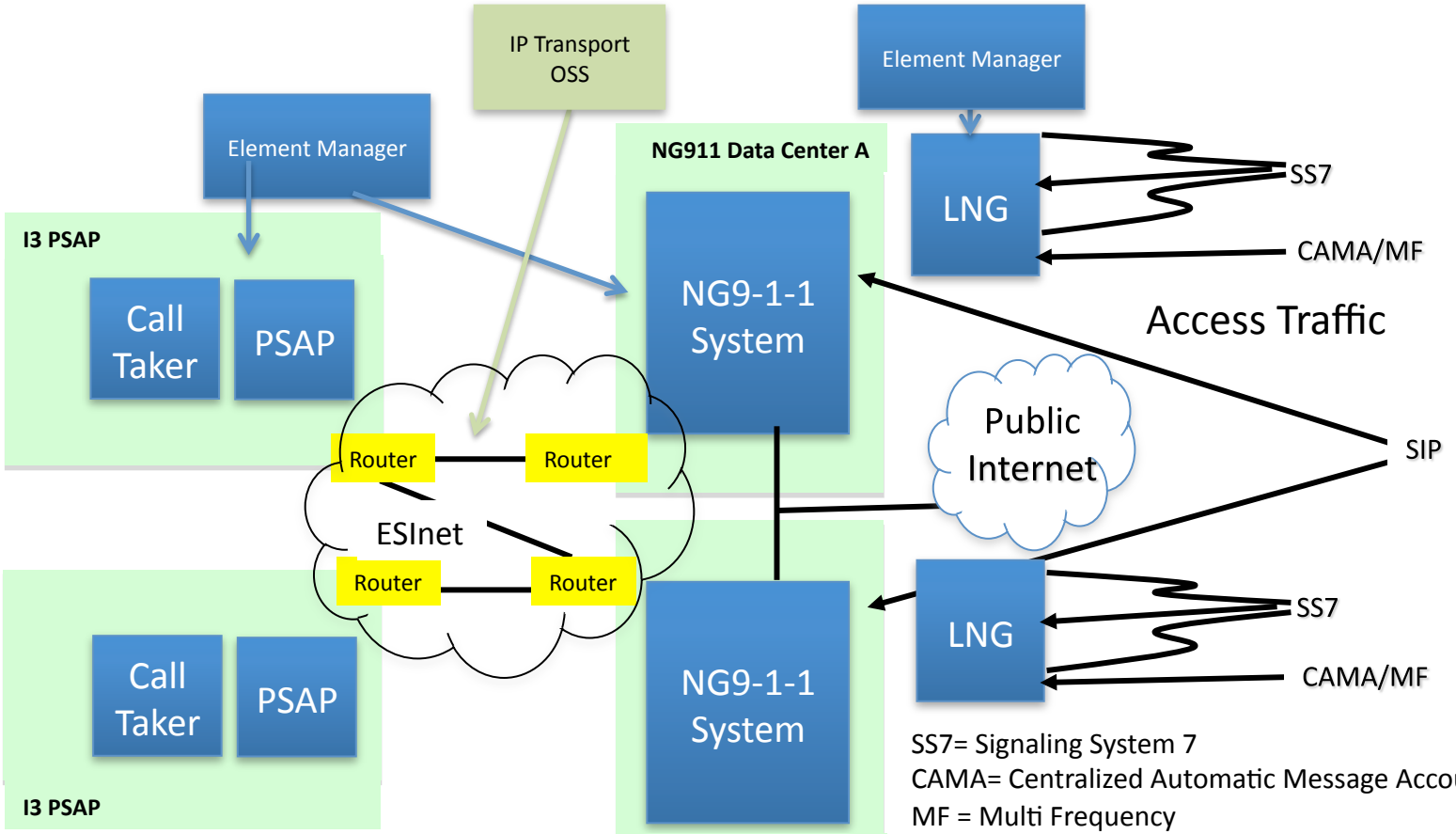
Vendor EMS, Facility Provider Operational Support Systems,



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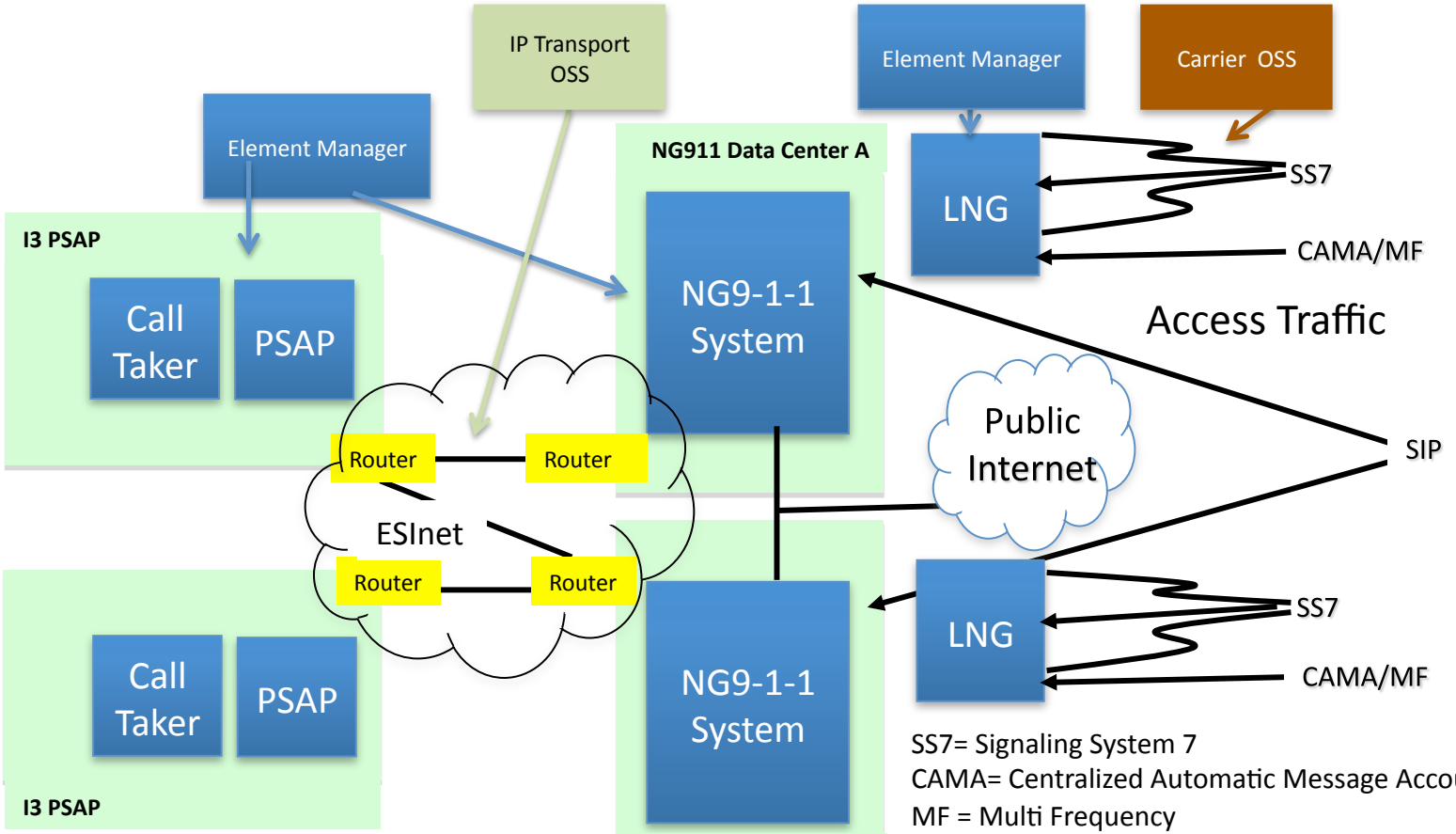
Vendor EMS, Facility Provider OSS, Access Carriers OSS



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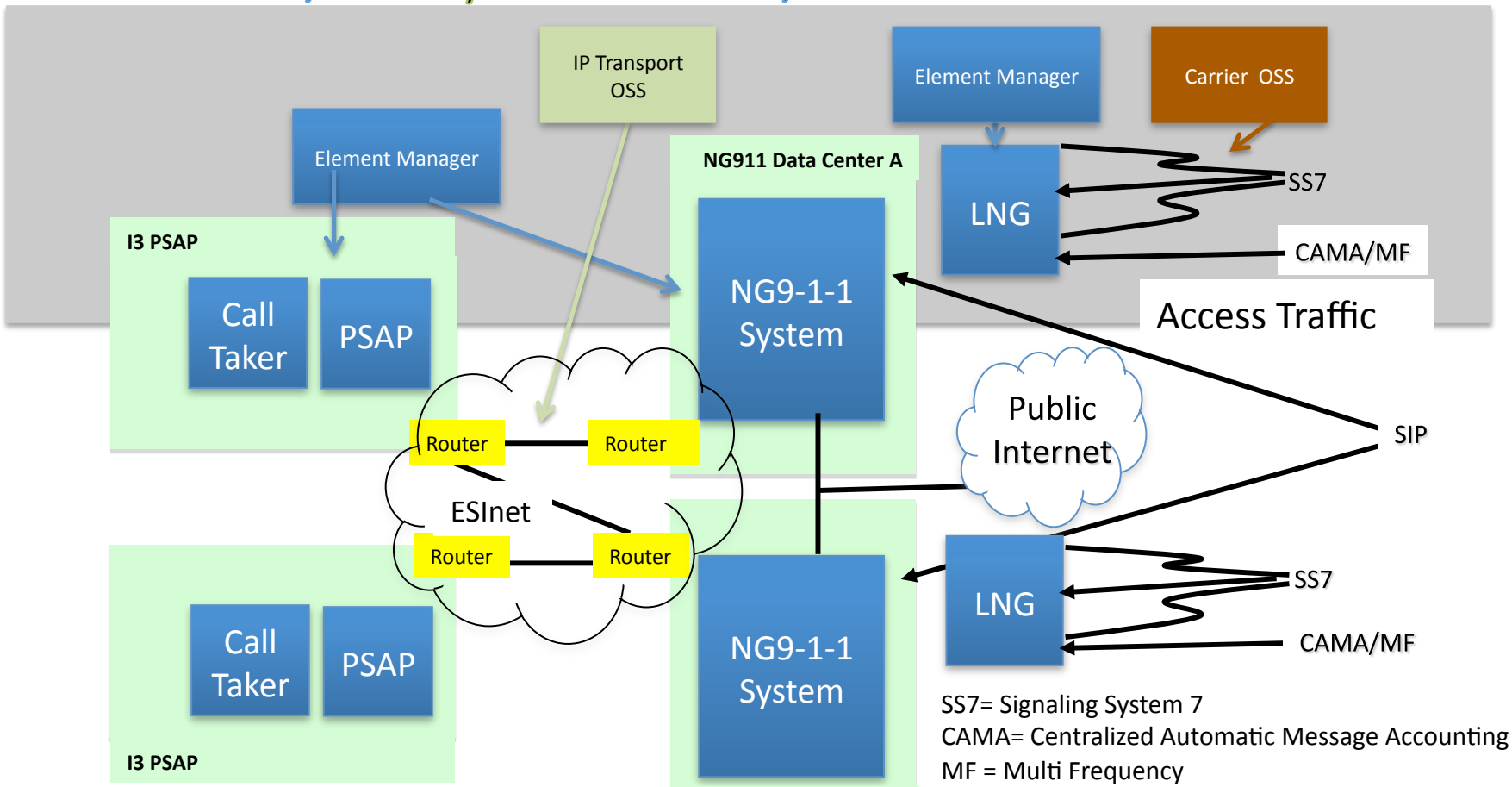

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Higher Reliability achieved by monitoring the End-to-End service

Failed SS7 Origination

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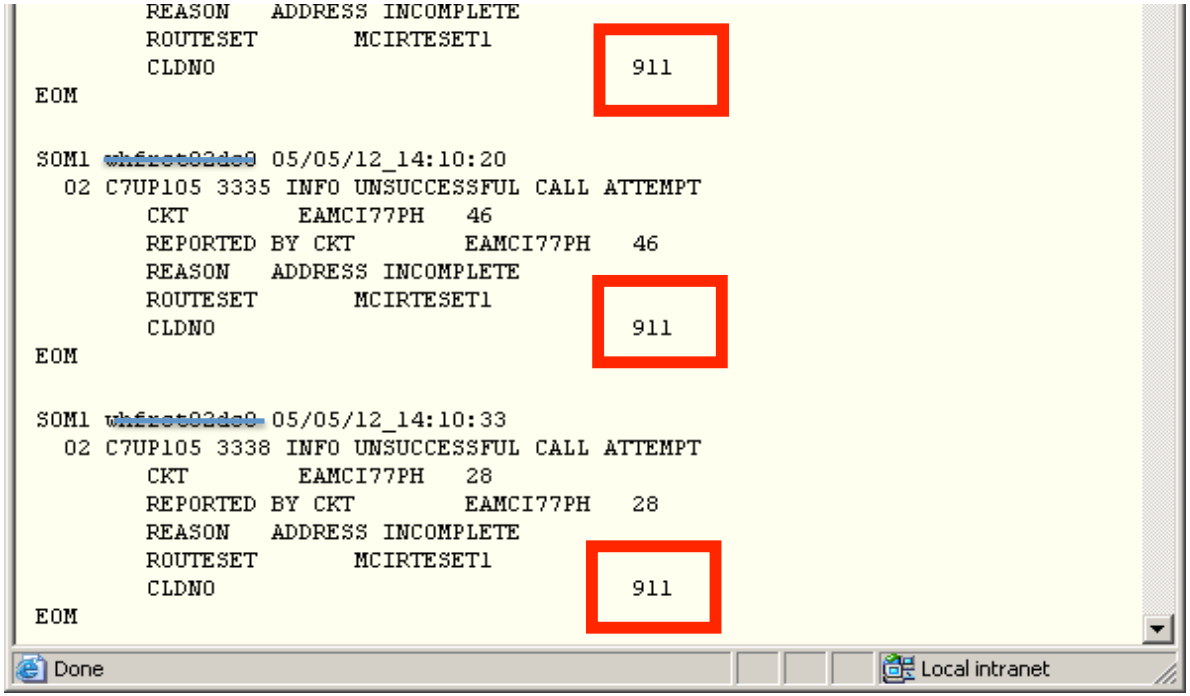
14:14:25 PM - “UNSUCCESSFUL CALL ATTEMPT”, to “911”

14:14:42 PM - User acknowledged alarm (within 17 seconds)

The same person made 15 attempts in 22 minutes.



SIP INVITE Failures

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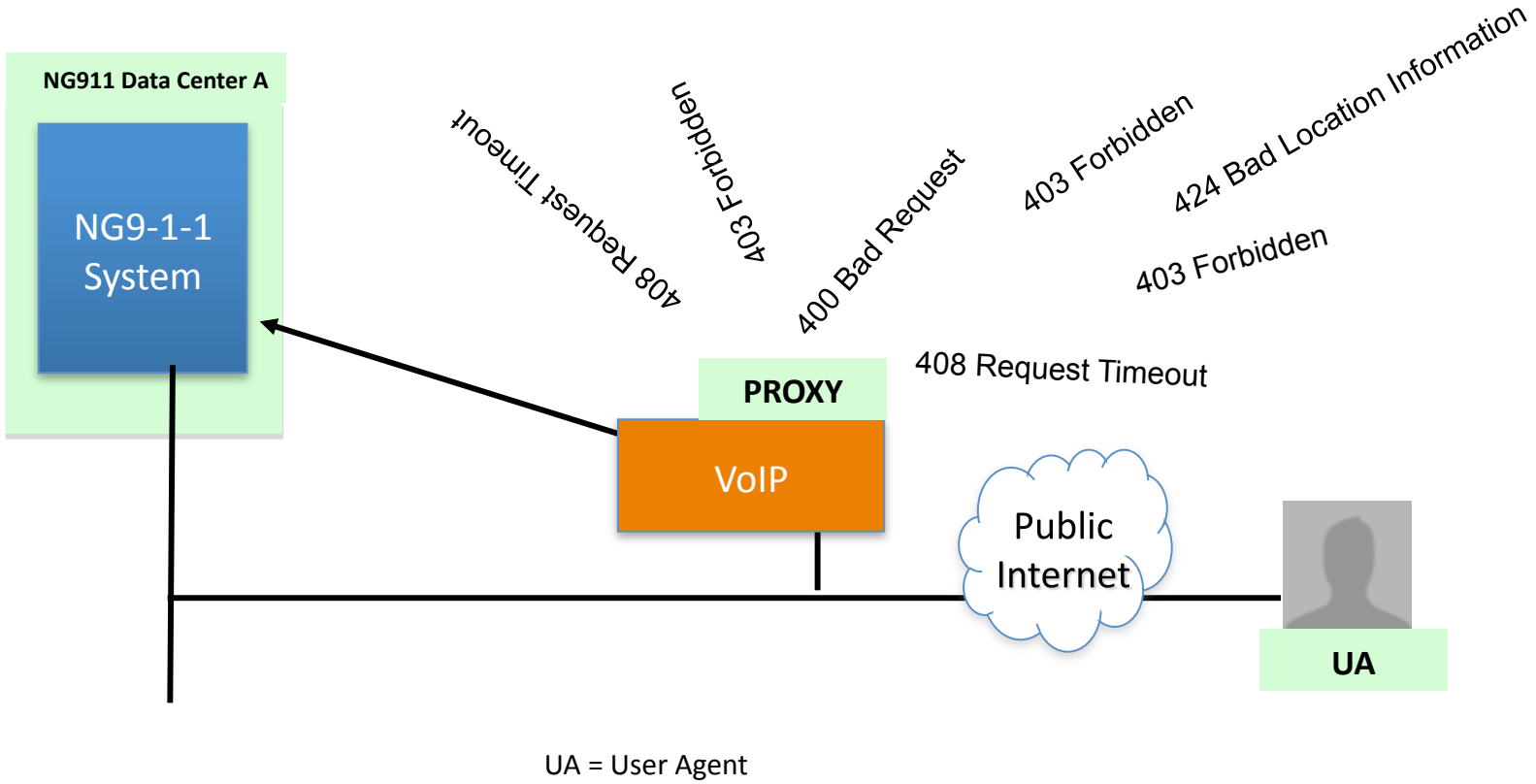

UA = User Agent

Reliability After Design

$$R_a = \frac{Successes}{Attempts}$$

To increase reliability after design:
Make it a priority to keep attempts successful

- Let the NG911 System route to backup PSAPs
- Add cost effective technology to add routes on the fly
- Act on origination failures

Thank You!

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Assure911™

Patented, End-to-End 9-1-1 Status System