# Homework 1

## Defect Cost Analysis and Prevention Plan

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This article addresses the 911 emergency lines failure due to a software glitch in the year 2014, which affected over 11 million people across seven states (“Top 10 software fails of 2014,” 2014).

## **Introduction**

911 is the emergency telephone number used by millions of residents across the United States and Canada (“9-1-1,” 2016). In order to understand the software bug that caused emergency lines failure, we should know the working of 911 and the transition of 911 to next generation services NG911.

In early days, 911 calls were voice calls using land lines. The incoming calls were received by the central office and routed them to the nearest Public Safety Access Points(PSAP). In order to enhance the way of communication which included images, text messages and video data, internet protocol communication links started replacing these land lines. This new 911 service using IP communication links was called as Next Generation 911 - NG911 (“Next Generation 9-1-1,” 2016). This NG911 has a centralized site to which the central office routes the incoming calls, unlike the 911 service. These centralized sites then route the calls to local PSAP. In NG911, central computers handle the incoming calls and a failure to one of these central sites will have a major impact on the 911 services. Since there were thousands of lines which needed replacement by IP communication links, NG911 implementation was under development when a software bug in the centralized site stopped 911 service for six hours affecting millions of residents across the USA (“April 2014 Multistate 911 Outage Cause and Impact,” 2014).

The reason for this software bug was the transition of 911 to NG911 without considering the future impacts and poor monitoring.

## **Details of Bug**

Intrado Inc. a major 911 service provider handles over half of all nationwide 911 calls and has control over 3000 of nations 6000 PSAPs. It has two call centers known as Emergency Call Management Centers (ECMCs) which reroutes the calls to nearest PSAP based on the databases maintained in Englewood, Colorado and Miami, Florida.

Intrado ECMC assigns a unique identification key to each incoming call to facilitate further processing of the calls and the system was designed to have a maximum of forty million keys. These keys were periodically purged to ensure there were a sufficient number of keys to handle incoming calls. The last purge at Colorado ECMC was in September 2013(“Washington 911 failure Retrieved from,”2015). Since there was no monitoring on the next purge, on April 9, 2014, Colorado system ran out of keys and was not able to handle the incoming calls. All the calls were timed out and callers were replied with a busy signal. There were many service providers involved including CenturyLink, Verizon, AT&T, Comcast, TCS, Frontier. Its considered that the poor communication between these providers prolonged the outage.

## **Consequences/Impact**

This software bug affected over 11 million residents of USA within six hours. As per the report “April 2014 Multistate 911 Outage Cause and Impact”, seven states were affected and out of 6410 calls, 5618 calls failed. No deaths during this outage.



Even though none of the articles explicitly mentioned any of the losses that occurred during this outage, I would like to put my perspective on the losses that would have occurred.

1. These failed emergency calls can be anything such as Vehicle, Commercial or Residential Burglary, missing or found child etc. (“911 services,” 2016).
2. Even though there were no deaths, people would have been injured badly and would have lost their hand or leg making them physically disabled. Many people would have lost their children (missing child reports), money or anything that is really precious to them.
3. This affected the reputation of service providers involved such as Intrado, Verizon, CenturyLink.
4. People would have gone through emotional, physical or mental issues during this outage.
5. The financial loss to service providers as Verizon was fined $3.4 million, Intrado $1.4 million and CenturyLink with $16 million (“Service providers fine,” 2015).

These are only a few but, there can be many such incidents that affected the people across these seven states.

## **Cost modelling calculation**

Considering the cost of the defect as 100 million dollars

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| --- | --- | --- |
|  | Bottom-up Cost Factors | Total Software Cost Factors |
| Requirement | 10x | 10x |
| Design | 15x | 15x-18x |
| Build | 20x | 22x-28x |
| Test | 55x | 33x-50x |
| Operations | 60x | 70x-100x |

## **Reason for the Issue**

It took nearly 6 hours to fix this bug due to following reasons.

1. Low-level alarms were generated in Englewood, Colorado ECMS when the key threshold reached its limit. Since it was low-level alarm this was ignored.
2. At the same time, there was a network outage in Oregon and Intrado thought even this outage has the same issue but it was unrelated.
3. Intrado had the option to reroute the traffic to its redundant hub in Miami and this would have restored the service immediately. Since glitch was not noticed straightaway and improvement actions were not well developed, Intrado did not execute either an automatic or manual switchover of the traffic.
4. Poor communication between the Intrado and other contractors was the biggest hindrance.

## **Quality assurance and testing techniques**

1. Boundary value testing can be carried out to check the maximum limit of keys assigned and generate an alarm with high priority to take immediate action.
2. Functional testing to check whether the re-routing of traffic is working in case of such failure.

## **Process in which testing could have been applied to detect and correct the error**

I think if most of the things were taken care and planned well in the requirement stage then the cost of such defects will be low.

In the testing phase, if the test cases were defined properly then the issues which were not addressed in the requirement phase could have been captured. Even though the expense of capturing these issues at testing phase would have been the cost and time, but would have prevented this outage which affected millions of people across the country.

## **Prevention Plan**

1. Capture all the requirements in the requirement phase keeping future enhancements in mind.
2. Write proper test cases to capture all the test scenarios and provide proper feedback.
3. Increase the maximum limit of the keys that can be generated.
4. Hire a person to monitor the key allocation and to check the maximum limit.
5. Generate a notification on a weekly basis on the number of keys remaining and purge date.
6. Generate a high priority alarm in case of key reaching its maximum limit and enable automatic rerouting option for the smooth working of 911 services.
7. Since there are many service providers working on a single project, coordination between these teams is key for fixing any such issues. Hence I will make sure that the teams are working close together in an agile environment attending daily standup meetings and know how to tackle such situations as a single team instead of individual service providers.

## **Reference**:

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