



Intelligent Transportation Systems
U.S. Department of Transportation



Next Generation 9-1-1 (NG9-1-1) System Initiative

Preliminary Analysis of Cost, Value, and Risk

Washington, D.C.

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V1.0	December, 2007	Draft
V2.0	February, 2008	Final

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USDOT has taken a leadership position in assessing Next Generation 9-1-1 technologies and the development of a framework for national deployment

- ▶ The U.S. Department of Transportation (USDOT) understands that access to emergency services provided by 9-1-1 in today's world of evolving technology will ultimately occur within a broader array of interconnected networks comprehensively supporting emergency services - From public access to those services, to the facilitation of the services, to the delivery of emergency information to dispatchers and first responders
- ▶ USDOT's intent is to:
 - Promote the vision for the Next Generation 9-1-1 (NG9-1-1) system
 - Provide leadership, guidance, and resources to work with public and private 9-1-1 stakeholders
 - Develop a path forward with the goal of migrating to a nationally interoperable* emergency services network over a phased approach

**The emergency services internetwork will be "interoperable" in that the networks and systems that comprise the NG9-1-1 architecture system of systems will have the ability to work together using standard formats and protocols*

Access to emergency services provided by 9-1-1 will ultimately occur within a broader array of interconnected networks

- ▶ *“The objective of the NG9-1-1 Initiative, as a USDOT-sponsored research and development project, is to define the system architecture; develop a transition plan that considers responsibilities, costs, schedule, and benefits for deploying IP-based emergency services across the Nation; and implement a working proof-of-concept demonstration system”**
- ▶ USDOT views the NG9-1-1 System as an evolutionary transition to enable the general public to make a 9-1-1 “call” from any wired, wireless, or Internet Protocol (IP) based device, and allow the emergency services community to take advantage of enhanced 9-1-1 (E9-1-1) call delivery and other functions through new internetworking technologies based on open standards
- ▶ **The purpose of this preliminary analysis is to examine the costs, value, and risk associated with moving to a next generation environment**

**As defined in the NG9-1-1 Concept of Operations, March, 2007*

This analysis aims to provide insights on migrating to a national framework for Next Generation 9-1-1 based on an assessment of value, cost, and risk

▶ **The Preliminary Analysis aims to:**

- Define a common vision and approach for Next Generation 9-1-1
- Assess the current 9-1-1 operating environment
- Develop scenarios for NG9-1-1 deployment
- Analyze and compare the current 9-1-1 environment to NG9-1-1
- Provide a summary of value, costs, and risks across the current and NG9-1-1 scenarios

▶ **This Preliminary Analysis does not consider:**

- **Detailed Design.** This analysis is not based on NG9-1-1 detailed design requirements and technical specifications nor the requisite planning and development details
- **Governance Model.** Our analysis does not consider an overall governance model at this point in time. May serve as a key consideration for Task 4
- **Funding considerations.** A key assumption inherent to our national deployment model is that funding is readily available pursuant to our notional rollout schedule
- **Government Regulations and Mandates.** We assume that requisite regulations and legislation will be created to support a uniform approach to NG9-1-1
- **Local jurisdiction organization / PSAP structure.** The optimization of PSAPs and other operations support entities is not a key component of this analysis

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The objective of this preliminary analysis is to gain a high level understanding of the environmental drivers for NG9-1-1; the final analysis will provide further detail based on lessons learned from the Proof of Concept

Preliminary Analysis of Value, Cost, and Risk

- ▶ Develop assumption-based analysis
- ▶ Leverage secondary research
- ▶ BAH and subcontractors with guidance from DOT represent all key stakeholders for working sessions
- ▶ Focus on Decision Framework development
- ▶ Provide Rough Order of Magnitude (ROM) cost estimates, ranges based on the application of uncertainty and sensitivity analyses
- ▶ Provide high level value and risk analysis

Final Analysis of Value, Cost, and Risk

- ▶ Engage key stakeholders; potential interviews and working sessions
- ▶ Incorporate additional transition issues and resultant costs and risks identified in the *Transition Issues Report* into deployment scenarios
- ▶ Refresh cost assumptions and lifecycle costs based on stakeholder feedback, vendor community discussions, and Proof of Concept lessons learned
- ▶ Develop benefit scenarios based on values defined

The approach for this Preliminary Analysis is based upon the Value Measuring Methodology (VMM)

- ▶ The objective of VMM is to try to capture the full range of cost and value provided by a particular alternative, while considering project risks that might decrease value or increase cost
- ▶ VMM provides a scalable and flexible approach for estimating and analyzing cost, value, and risk and evaluating the relationships among them
- ▶ VMM allows the calculation of non-financial value that might be unaccounted for in traditional financial metric calculations, allowing for a more rigorous comparison of alternatives
- ▶ VMM has been cited as a best practice by the CIO Council and is available at:

http://www.cio.gov/documents/ValueMeasuring_Methodology_HowToGuide_Oct_2002.pdf, last accessed date: 01/15/2008

Benefits of the Methodology

- ▶ Qualitatively and quantitatively measures direct and indirect benefits and subjective variables
- ▶ Provides the approach required to conduct risk assessments and reasonably predict outcomes
- ▶ Focuses on certainty, rather than specificity, providing probability and distribution ranges of outcomes
- ▶ Considers multiple perspectives in quantifiable terms

VMM was developed in response to the changing definition of value brought on by the advent of the Internet and advanced software technology. This methodology incorporates aspects of numerous traditional business analysis theories and methodologies, as well as newer hybrid approaches

The key to VMM is clearly define a decision methodology to ensure a consistent evaluation of value, risk, and cost

Decision Framework Components

- 1 Value Structure**
 - ▶ Facilitates the development and prioritization of a detailed quantitative benefits (performance measurement) analysis
- 2 Cost Structure**
 - ▶ Allows for a high level view and rough order of magnitude (ROM) of the lifecycle costs to develop and deploy NG9-1-1
- 3 Risk Structure**
 - ▶ Identifies known factors that may impede the ability of an initiative to achieve its goals, degrading projected levels of performance and escalating estimated cost



Analysis Outputs

- ▶ Clearly communicates intended benefits of the chosen management approach for specific stakeholders
- ▶ Give visibility into the relevant needs and priorities of stakeholders and users
- ▶ Provides transparency into executive level management decision making process
- ▶ Establishes understanding of DOT's key success factors that will require management attention
- ▶ Comprehensively identifies risks to help develop appropriate mitigation strategies early in the development process

The Value Measuring Methodology provides holistic and structured approach evaluating cost, value, and risk

VMM Framework Approach

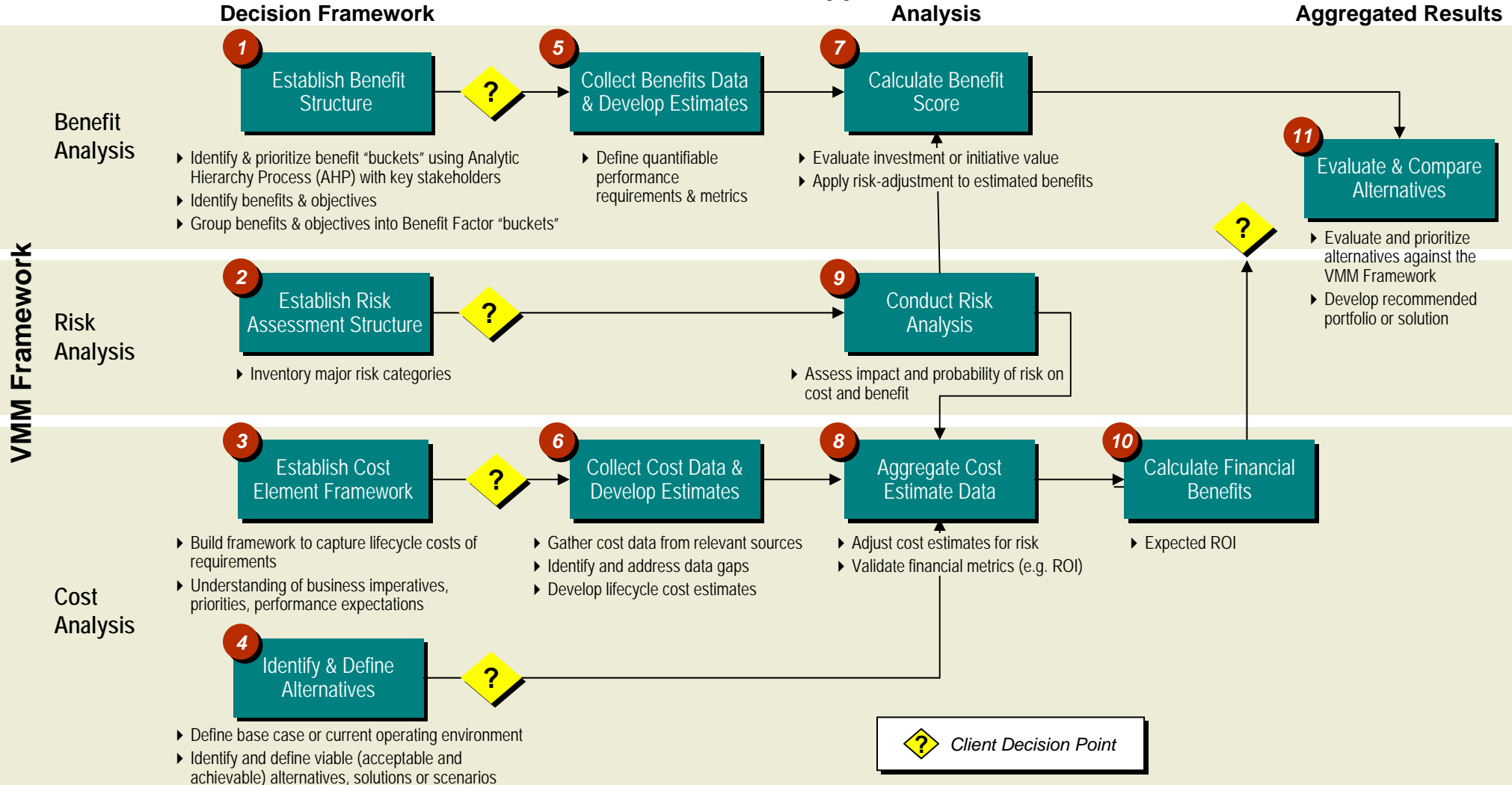


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This analysis centers upon two primary alternatives: Current 9-1-1 Environment and Next Generation 9-1-1

1
**Baseline
Current 9-1-1 Environment**



Status Quo of current PSAP and 9-1-1 Authority operations. Operations are based on varying levels of technology, from Remote Call Forwarding (RCF) to Wireless Phase II and some degree of VoIP solution.*

2
**Next Generation 9-1-1
(NG9-1-1)**



The NG9-1-1 System will enable the general public to make a 9-1-1 call** from any wired, wireless, or Internet Protocol (IP) – based device, and allow the emergency services community to take advantage of enhanced call delivery and advanced functional and operational capabilities through new internetworking*** technologies based on open standards****

* Recognizing that today's VoIP solutions are similar to Wireless Phase II, and have limited financial impact on the PSAP community (as apposed to the VoIP provider community).

**The term "call" is used to indicate any real-time communications – voice, text, or video – between a person needing assistance and a PSAP call taker

*** "Internetwork" – to go between one network and another ; a large network made up of a number of smaller networks

****Source: NG9-1-1 Architecture Analysis Report, November, 2007

The 9-1-1 Baseline environment was defined by identifying key levels of technology and the population served on a county basis

- ▶ In order to provide an assessment of cost, value, and risk for the current and next generation environments on a national basis, the team defined segment profiles for counties based on population served and current technologies employed. The five levels of 9-1-1 technology are defined as:

Remote Call Forwarding	➔	As utilized within Interim Number Portability, a permanent call forwarding feature that allows a call to one Directory Number to be automatically advanced to a Directory Number of another Local Exchange Carrier
Basic	➔	An emergency telephone system which automatically connects 9-1-1 callers to a designated answering point. Call routing is determined by an originating central office only. Basic 9-1-1 may or may not support ANI and/or ALI
E9-1-1	➔	An emergency telephone system which includes network switching, data base and CPE elements capable of providing Selective Routing, Selective Transfer, Fixed Transfer, caller routing and location information, and ALI
Wireless Phase I	➔	Required by FCC Report and Order 96-264 pursuant to Notice of Rulemaking (NPRM) 94-102. The delivery of a wireless 9-1-1 call callback number and identification of the cell-tower from which originated. Call routing is usually determined by cell-sector
Wireless Phase II	➔	Required by FCC Report and Order 96-264 pursuant to Notice of Proposed Rulemaking (NPRM) 94-102. The delivery of a wireless 9-1-1 call with Phase I requirements plus location of the caller within 125 meters 67% of the time and Selective routing based upon those coordinates. Subsequent FCC rulings have redefined the accuracy requirements

Source: http://www.nena.org/media/files/NENA00-001_V1020070605.pdf, Last Date Accessed: 01/15/2008

The 9-1-1 Baseline environment was defined by identifying key levels of technology and the population served on a county basis (cont)

- ▶ For purposes of this analysis, a logical segmentation of counties based on population served was developed. A population of 50,000 was chosen as a measure to differentiate rural from urban counties
 - **Nearly 70% of all counties in the U.S. have population of 50,000 or less**
 - All of the counties with 9-1-1 calls routed via remote call forwarding and nearly all of the counties with Basic 9-1-1 level of service are characterized as rural in nature – that is, having population of 50,000 or less
- ▶ Other segmentations reflect various sizes of urbanized counties. The project team chose segments based on population size of counties with:
 - **50,000 – 250,000 population** to represent urbanized areas of medium size
 - **250,000 – 1,000,000 population** to represent urbanized areas with large sized cities, and
 - **1,000,000 or more population** to represent large metropolitan areas
- ▶ As population size increases, the extent of Enhanced 9-1-1 availability and wireless Phase I and Phase II availability of services also increases. This is to be expected, given the propensity of larger areas to have more well-developed 9-1-1 systems, and the ability to fund them through various funding alternatives

Applying these factors yields eight primary county segments to base our current and NG environments upon

- ▶ Segment profiles will provide a basis from which to estimate the costs, value, and risk of moving to the defined alternatives
- ▶ Our segmentation will also consider the seven states that have state-wide systems. These states (or counties within) are not included within the county segmentation presented below
- ▶ **More than 80 percent of counties have some level of wireless 9-1-1 service, with 3 percent of counties served only by remote call forwarding**

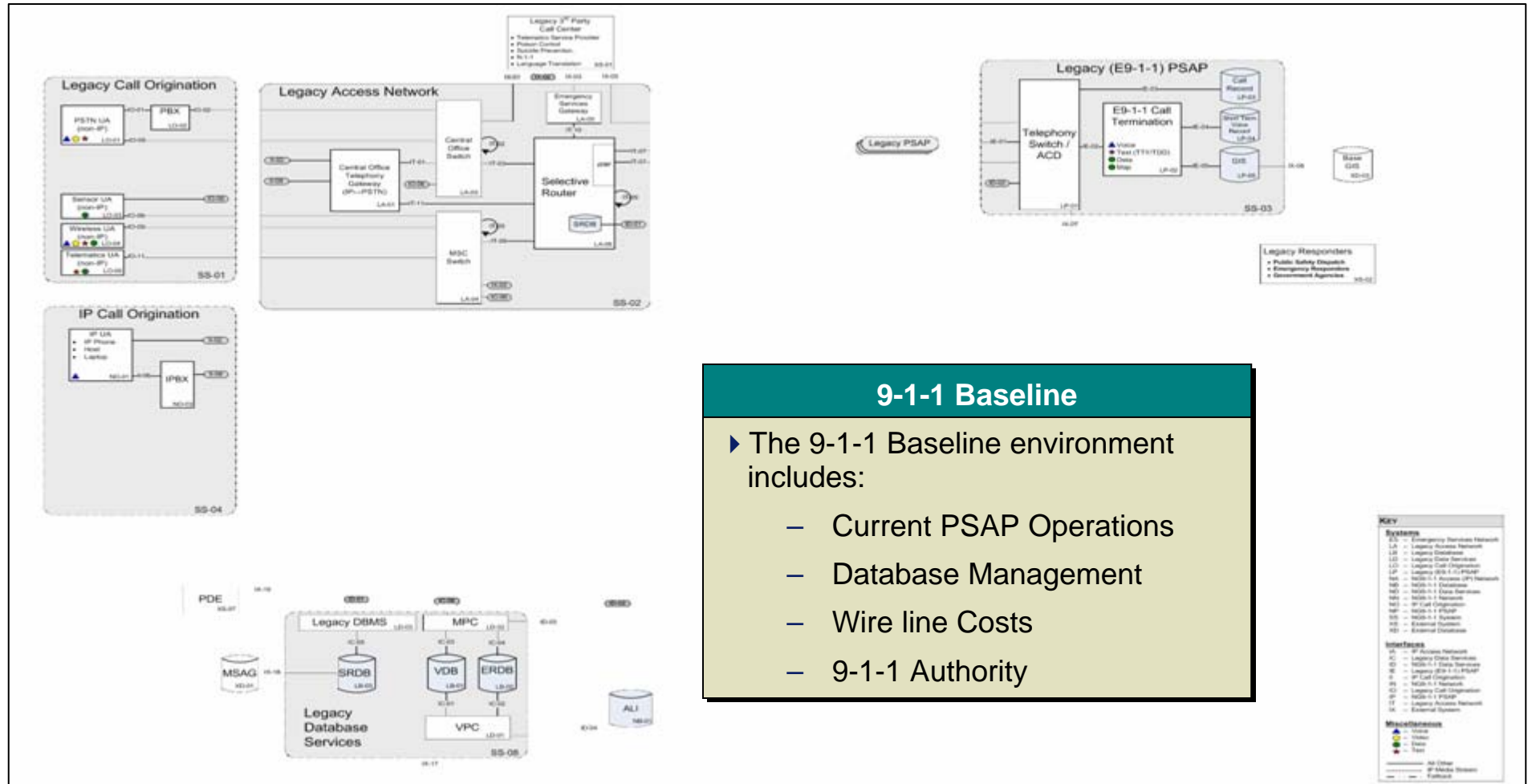
County Segmentation for Cost Profile Development*
(Seven state systems are not included in this table***)

	1 RCF	2 Basic	3 E-9-1-1	5 Wireless**	Total
Less than 50,000	98	114	304	1684	2200
50,001 to 250,000	0	2	62	588	650
250,001 to 1,000,000	0	0	4	175	175
More than 1,000,000	0	0	2	25	25
Total	98	116	366	2472	3052

*For the purpose of this analysis, it is assumed that a county is equivalent to a 9-1-1 Authority
 **Includes Phase I and Phase II as well as counties that have started wireless deployments as of 7/7/07
 *** A complete breakout of the total population of counties is provided in the appendix

Source: *Wireless Deployment Profile* maintained and updated by the National Emergency Number Association (NENA). Available on NENA's web site

The 9-1-1 Baseline environment architecture provides a high level description of current operations



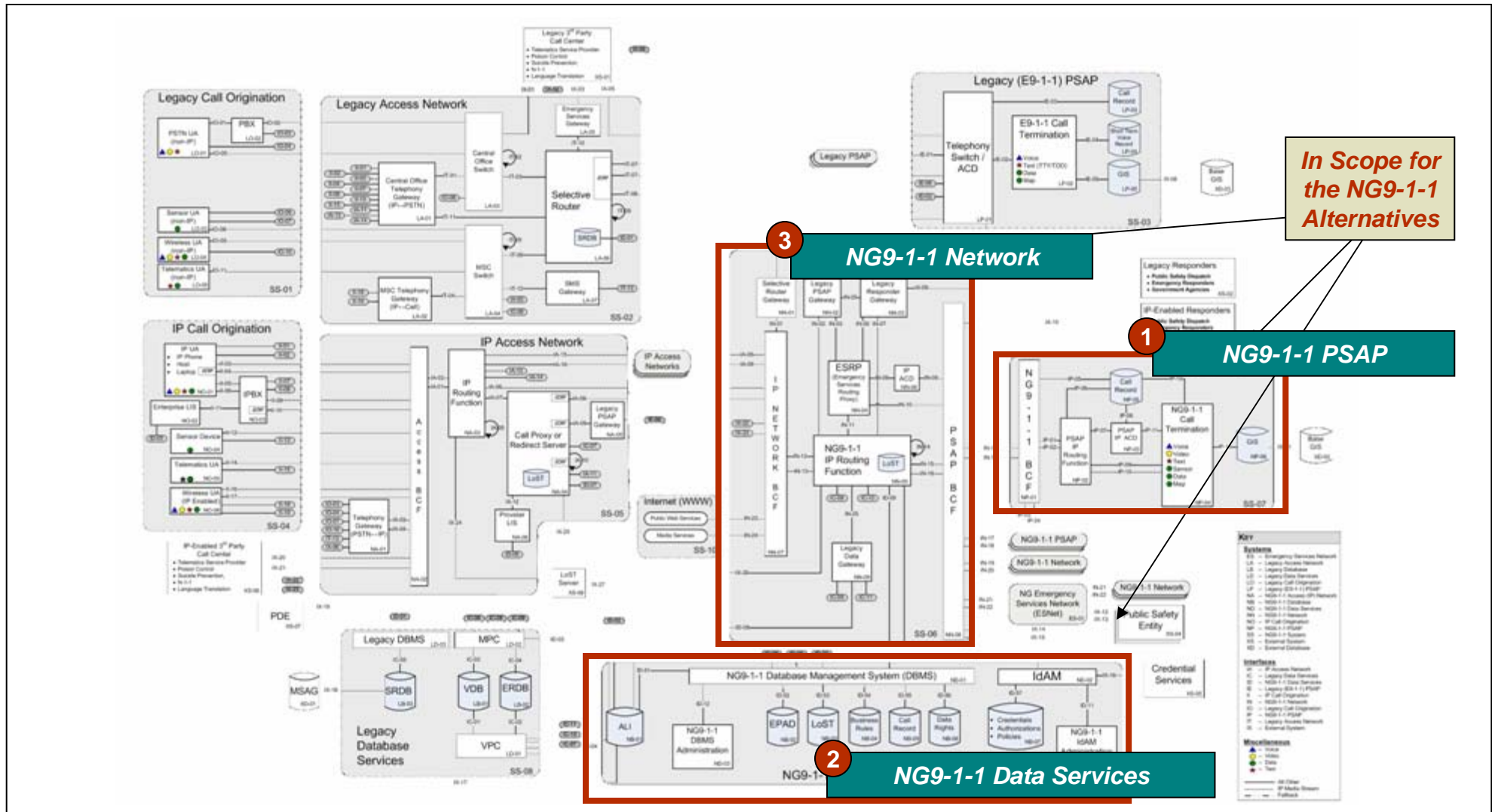
9-1-1 Baseline

- ▶ The 9-1-1 Baseline environment includes:
 - Current PSAP Operations
 - Database Management
 - Wire line Costs
 - 9-1-1 Authority

The vision for Next Generation 9-1-1 is to provide a foundation for public emergency services in an increasingly mobile and technologically diverse society

- ▶ The transformation and integration of IP technology with NG9-1-1 is a major change from traditional E9-1-1. The impetus for the use of IP is its widespread and increasing standardization as the communication protocol for wired and wireless networks
- ▶ The NG9-1-1 System must be able to interface with multiple systems and to transport traffic using a common protocol (IP) to achieve end-to-end interoperability
- ▶ As a next generation system, NG9-1-1 will use the IP and routing capabilities to transform and link existing public safety systems
- ▶ Three primary components combine to form the NG 9-1-1 architecture:
 - **PSAP:** first point of reception of a 9-1-1 call (recognizing some telematics calls are relayed through third party service providers)
 - **NG9-1-1 Network:** telecommunications system that will transmit 9-1-1 media from end users to call takers and from call takers to dispatchers (and databases)
 - **NG9-1-1 Data Services:** data centers that will house servers where storage of address, GIS and other 9-1-1 relevant information will occur
- ▶ It is also important to note that telecommunications service providers will continue to be responsible for providing access to emergency communications, and delivering 9-1-1 calls to the appropriate Emergency Services network as well as providing services and applications to help support NG9-1-1

The NG9-1-1 architecture for this analysis comprises three key areas: PSAPs, Network and Data Services components



For the NG9-1-1 alternative, Booz Allen considered a number of possible options for scaling the solution to a repeatable, sensible size that would match its current level of complexity

- ▶ A basic assumption of this analysis is that the cost of upgrading the defined segments to NG is uniform across all segments*
- ▶ The Booz Allen Team considered deploying the NG alternative by state, by region, and on a national basis:
 - **By State.** State varies widely in size and there is no guarantee that all NG networks will be implemented state-wide
 - **By Region.** A regional network was also considered but would be difficult to assess typical / average regional considerations and to assess regional disparities from one jurisdiction to the next for a national deployment
 - **National Basis.** A national network was considered, but ultimately rejected because it would require a large federal investment to stand up and would remove 9-1-1 authority from the states control and transfer it to the federal government
- ▶ ***The Booz Allen team adopted the concept of a “unit” based on a population size that could be used as a building block for national deployment. This allowed us to assess cost, value, and risk in a modular way and scale the unit to fit a national framework that would coincide with our baseline segments***

*Assumption validated based on Subject Matter Expert Input from the National Emergency Number Association and L.R. Kimball and Associates

The “Unit” strategy was based on two primary sources of existing data

- ▶ In its recent implementation of an IP-based 9-1-1 network, Vermont (Population 623,908) determined that the maintenance of 32 call taker positions was appropriate for a population of its size
 - Vermont’s staffing requirements are based on an average traffic estimate of 1.47 erlangs (unit that measures total call traffic volume in one hour) per position*
- ▶ Based on the number of call taker positions currently in operation in the U.S. (Population 299 million), the average ratio of call taker position per person *under a non-IP based system* is approximately 40 call taker positions for a population of 625,000.
 - National figures are based on an estimated average of 1.45 erlangs per position**
- ▶ Given the increased call handling and queuing efficiencies inherent in switching to an IP-based system, the lower value of 32 call taker positions per 625,000 population was selected for the purposes of calculating alternative costs
- ▶ For data and network purposes, it was assumed that each state would maintain jurisdiction over its own 9-1-1 system
 - The U.S. contains approximately 500 populations of 625,000, meaning that each redundant data center and network would correspond to exactly 10 PSAP units (the equates to 50 paired data centers and networks total)

*Source: Vermont Dept. of Public Safety and Vermont Communications Study Group, *Dispatch Services Executive Summary*, September, 2005

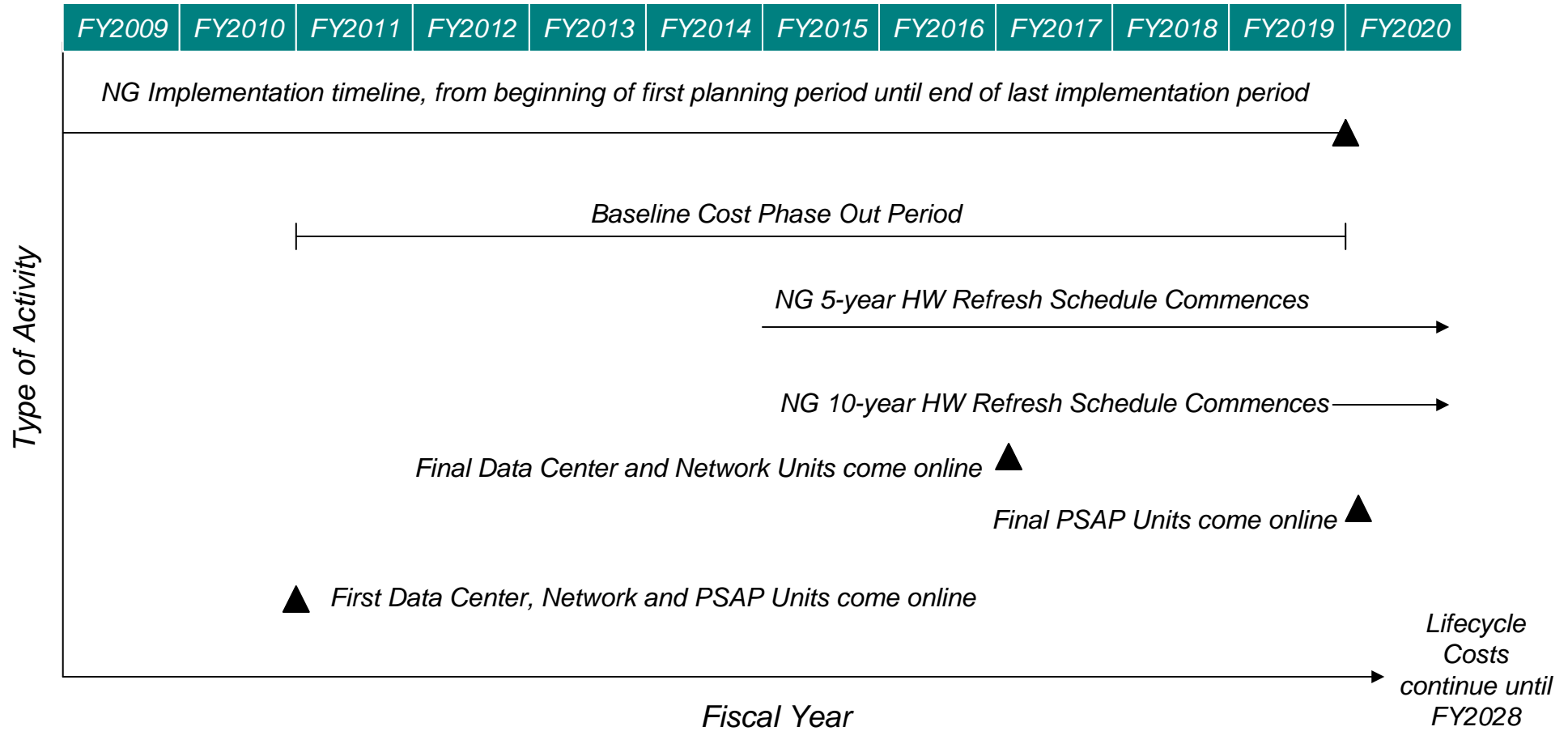
** Source: L. Robert Kimball and Associates, *PSAP Staffing Guidelines Report*, as Commissioned by NENA SWAT Operations Team, 2003

The “Unit” strategy has many advantages, including flexibility and scalability across local entities, regions, and states

- ▶ The median population settled on for our unit: 625,000 people (based on existing data)
- ▶ 625,000 people = 32 call taker positions to serve them on average (based on existing data/national average of population/position)
- ▶ Redundant data centers and the network will host on average 320 call taker positions (10 PSAP “units” per Data/Network “unit”)
- ▶ Overall, the U.S. contains **508 PSAP Units** and **50.8 Data/Network Units**. This equates to approximately 50 data centers and networks
- ▶ This approach fits correlates to a state deployment scenario for NG9-1-1, while allowing flexibility to cost based on local data and at a national scale

NG9-1-1 Cost Calculation Methodology	
1.	Define the median population served by a single IP backbone, using existing state network data.
2.	Use average national profile to estimate number of call taker positions required for a system of our “unit” population size
3.	Determine the number of these “units” that would be optimally supported by a paired set of data centers and an accompanying network.
5.	Divide this “unit” population into the national population to determine the number of PSAP, Data, and Network units we will need to deploy overall
6.	Scale the cost of each unit (PSAP & Data/Network) based on the relative population served by each. Multiply the cost of each unit by the number of units calculated in step 5
7.	Aggregate unit totals to determine what a national implementation would cost

For this analysis, a notional rollout of the NG system and concurrent phase out of the baseline system spans a 10 year implementation period



Random sequencing guides the national deployment across the defined baseline segments

Deployment Strategy	Pros	Cons
<i>Largest Segments Adopt First</i>	<ul style="list-style-type: none"> ▶ Realistic to assume that urban areas could better afford the up front costs of NG system. ▶ Large and medium sized cities would likely plan on being among the first adopters due to their heavier call volumes 	<ul style="list-style-type: none"> ▶ Any pilot studies would likely take place in smaller cities, making them more likely to be early adopters ▶ Might be politically inexpedient to allow an urban-rural divide right from the start
<i>Smallest Segments Adopt First</i>	<ul style="list-style-type: none"> ▶ Politically expedient ▶ Allows for the creation of rural-oriented pilot studies 	<ul style="list-style-type: none"> ▶ Smaller segments will likely not be able to afford system without significant help from the state, potentially causing short term budgetary problems for adopting states
<i>Middle Segments Adopt First</i>	<ul style="list-style-type: none"> ▶ Matches pattern of feasibility studies currently underway ▶ Middle size cities could probably afford up-front costs 	<ul style="list-style-type: none"> ▶ Assumes that no large cities would implement until later, which is possibly not a realistic assumption ▶ Raises similar equity concerns to assuming largest segments would adopt first
<i>Random Sequencing – Leveraged for this analysis</i>	<ul style="list-style-type: none"> ▶ Allows for middle sized cities being early adopters, while allowing possibility of Largest segments following close behind ▶ Solves equity of implementation concerns 	<ul style="list-style-type: none"> ▶ Unclear that this is the pattern that will track with actual implementation ▶ More difficult to fit in logistically ▶ Segment numbers may not fit with optimal implementation sequence

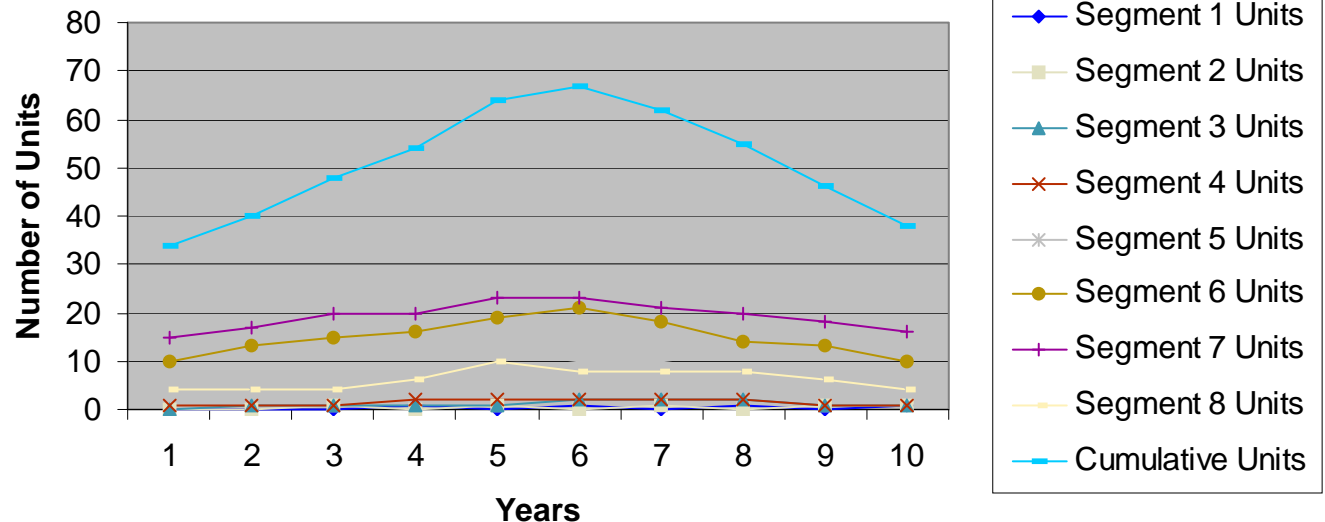
National rollout will occur over a 10 year period, with the majority of units deploying in years 5 and 6

- ▶ PSAP units are deployed over the course of a 10 year span, with a few early and late adopters at the beginning and end, respectively, and the majority of units rolling out in the middle
- ▶ Units are deployed based on baseline segments corresponding to the 625,000 population level of the unit

Assumptions

- ▶ Total Number of Units Deployed: 508
- ▶ Each unit rollout is implemented over a 2 year time period
- ▶ Operations and Maintenance Costs will commence in year 3

Proposed Implementation Rollout (PSAP)



Data Center and Network unit deployment will drive the deployment of PSAP units

- ▶ As each pair of redundant data centers and network will support 10 PSAP units and random unit deployment is likely, all data centers will roll out in the first few years in order to allow PSAPs to come online
- ▶ This is the equivalent of each state building a data center and network, then letting counties upgrade their PSAPs at their own pace

Assumptions

- ▶ Total Number of Data Center/Networks Units Deployed: 50
- ▶ Equivalent to 1 Data Center/ Network per state
- ▶ Each Data Center / Network supports a population of 6,250,000, or the equivalent of 10 PSAP units

Data Center Unit Rollout

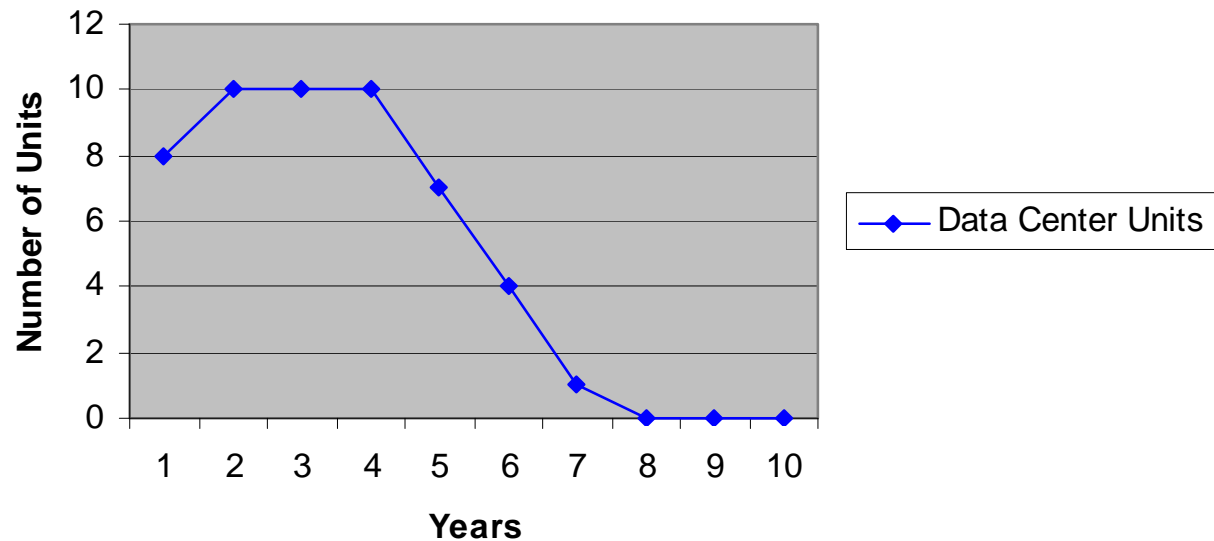


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The Value Structure provides the roadmap for predicting the value outcomes for the alternatives under study

- ▶ The Value Structure (comprised of the five Value Factors) provides the framework by which to assess and compare the defined alternatives
- ▶ Benefit measures and performance metrics were developed over the course of several working sessions with technical, functional, and business representation from the National Emergency Number Association (NENA), L.R. Kimball & Associates (Kimball), and Booz Allen Hamilton (Booz Allen)
 - NENA and Kimball representatives are the Subject Matter Experts (SMEs) referred to throughout this document
- ▶ During an Expert Choice* Session on June 25, 2007, representatives from DOT, NENA, Kimball, and Booz Allen assigned scores to each Value Factor and Benefit
 - The group session utilized Expert Choice, a tool widely used in the private sector to enhance group decision-making
 - The goal of the sessions was not necessarily to achieve consensus, but to ensure that all points of view were heard and understood by all participants

*Expert Choice is a software program based on the Analytic Hierarchy Process. See: Saaty, T.L., The Analytic Hierarchy Process, McGraw Hill, New York, 1980

In assessing the 9-1-1 environment, multiple stakeholder perspectives were incorporated into the value framework

9-1-1 Stakeholder Segmentation

Stakeholder Segment	Definition	Represented by	
Primary (Direct) Users	Users of the network will be any and all organizations that improve the safety of the public by being able to exchange information in emergencies	<ul style="list-style-type: none"> ▪ General Public ▪ Special Needs Communities (e.g. hearing impaired) ▪ PSAP/911 Authority System Management 	<ul style="list-style-type: none"> ▪ PSAP Call Takers ▪ Public Safety Dispatchers ▪ First Responders ▪ Support Responders
Government Agencies	Responsible for establishing policy, funding, and overseeing the operation of PSAPs and emergency response services	<ul style="list-style-type: none"> ▪ Local, state, regional, and federal policy, regulation, and funding agencies 	<ul style="list-style-type: none"> ▪ Local and state emergency communications agencies ▪ Local, state, regional, and federal emergency response agencies
Industry Associations and SDOs	Responsible for overseeing the development of key ubiquitous components of next generation system, and for representing the interests and needs of impacted stakeholder communities in that development	<ul style="list-style-type: none"> ▪ Professional and industry associations ▪ Standards Development Organizations ▪ Research and Academia 	<ul style="list-style-type: none"> ▪ Private emergency response and recovery organizations ▪ Citizen and special interest advocacy organizations
Service Providers	<p>Responsible for functional services essential to the operation of next generation systems and the access to those systems by the public, emergency communications personnel, and responders</p> <p>Represent specific public communities or consumer groups responsible for providing access to emergency services and/or data</p>	<ul style="list-style-type: none"> ▪ “Traditional” telecommunications service providers ▪ “Public safety/emergency” service providers ▪ “Other” IT/telecommunication ASPs ▪ IP-network access infrastructure/service providers 	<ul style="list-style-type: none"> ▪ Service and Applications Providers ▪ Third-Party Service Providers ▪ Telematics ▪ Poison Control ▪ Medical Alert ▪ Central Alarm Monitoring ▪ Relay Services ▪ N-1-1 services

The Value Structure is comprised of five key value factors that aim to represent viewpoints across key stakeholders


Value Factors Defined

Value Factor	Definitions
Direct User	Direct Users of the network include any and all people and organizations that use 9-1-1 systems and processes to improve the safety of the public by being able to exchange information in emergencies
Operational / Foundational	Benefits associated current Federal, State, and Local Government 9-1-1 operations, the order of magnitude improvements realized in current 9-1-1 operations and processes and in laying the groundwork for future initiatives
Strategic / Political	Contributions to achieving both Public (Federal, State, and Local governments) and Private sector strategic goals and priorities
Social	Benefits related to non-direct users (ie. those not immediately involved in specific 9-1-1 incident), communities of stakeholders, the larger economy and society as a whole
Financial	Financial benefits (e.g., cost savings, cost avoidance) realized in the Federal, State, or Local entities or by identified constituent groups

The Direct User Value Factor resulted in the highest priority for realizing value from the 9-1-1 system

- ▶ Although each of the five factors represents important stakeholder value, delivering value in one factor may be more important than delivering value in another. In other words, the factors are not necessarily equal in importance and therefore should not carry equal “weight” in the decision making process
- ▶ Similarly, it is important to consider all of the value measures identified within the value factors, however the relative importance of these value measures may not be equivalent
- ▶ In order to better model the relative importance of the value factors and measures, each of the values factors and measures was assigned a weight or level of importance. The weighting was accomplished in facilitated sessions Expert Choice Sessions

Expert Choice Value Factor Outcome



VALUE STRUCTURE	Weight*
Direct User	51.8%
Operational / Foundational	20.2%
Strategic / Political	7.9%
Social	13.6%
Financial	6.6%
TOTAL	100%

Within each Value Factor, the Value Measures were also prioritized during our Expert Choice session

Direct User Value Measure Outcome

VALUE MEASURES	WEIGHT
Direct User	51.8%
Accessibility	38%
Timeliness	20.2%
Ease of use	9.9%
Reliability of service	26.3%
User satisfaction	5.5%
Total	100.0%

Operational / Foundational Value Measure Outcome

VALUE MEASURES	WEIGHT
Operational / Foundational	20.2%
Scalability and adaptability of system functionality and usage	15.7%
Information accuracy	19.1%
Data management	20.3%
Operational efficiency	9.9%
Data sharing	11.4%
Security and Privacy	23.6%
Total	100%

Within each Value Factor, the Value Measures were also prioritized during our Expert Choice session (cont)

Strategic / Political Value Measure Outcome

VALUE MEASURES	WEIGHT
Strategic / Political	7.9%
Public trust	6.3%
Coordination between 9-1-1 and other Public Services	17.5%
Alignment of Strategic Goals	6.7%
Technology standards	18.0%
Consistency and standardization of laws and regulations	7.9%
Coordination between domestic PSAPs, both within and across state borders	16.0%
Coordination between U.S. PSAPs on an international basis	3.9%
Strategic use of resources and data	16.1%
Value to Industry	7.7%
Total	100%

Social and Financial Value Measure Outcome

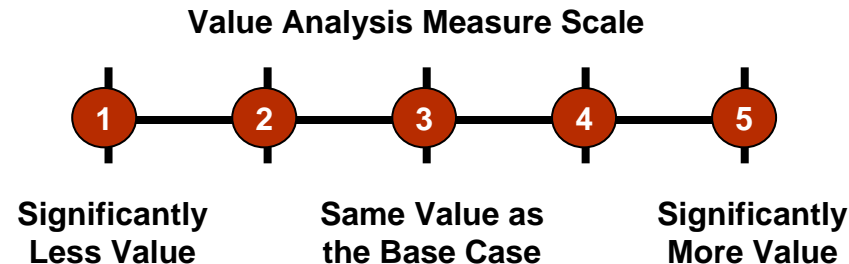
VALUE MEASURES	WEIGHT
Social	13.6%
Public Safety	50.9%
Efficient Use of Funding Source Dollars	18.6%
Safety to Responder	20.4%
Energy and Environment	10.1%
Total	100%
Financial	6.6%
Cost Savings	57.0%
Cost Avoidance	43.0%
Total	100%

The top 10 benefits identified came from a range of categories, with Direct User and Operational benefits comprising the majority

- ▶ The greatest benefits identified through our “Expert Choice” sessions were largely direct user-related
 - **Accessibility totaled almost 20% of the total value identified**
 - Reliability of service was second with 13.6% of the overall value
 - Timeliness was third with 10.6%
 - Ease of Use came in fifth with 6.1% of the total value
- ▶ Of the top ten benefits, four related to Operational and Foundational issues
 - Security topped this list with 4.8% of the total value (sixth overall)
 - Data Management and Accuracy came in seventh and eighth with 4.1% and 3.9% of total value respectively
 - Scalability and Adaptability came in tenth with 3.1% of total value
- ▶ Of the social benefits, only Public Safety appeared in the top ten, coming in fourth with 6.9% of the overall value
- ▶ Cost avoidance came in ninth with 3.8% of the overall benefit and was the only financial benefit in the top ten

To analyze the expected value between Base Case 9-1-1 and NG9-1-1, the team scored each against the value measures defined

- ▶ To arrive at a score for each measure, the team evaluated whether NG9-1-1 would be expected to provide more or less value than the Base Case
- ▶ Each measure was scored on a scale of one to five
 - The Base Case was assumed to be at the midpoint of the scale (3).
 - Using a combination of 9-1-1 data and SME input for each measure, the team estimated whether NG9-1-1 would provide:



- ▶ The previously determined weights were then applied to the score for each measure, and factor weights were applied to the scores for the measures within each factor

Based on our value analysis, NG9-1-1 is expected to deliver significantly more value than the current environment

- ▶ The value analysis considered multiple stakeholder perspectives in an attempt to leverage expectations in identifying the key objectives of 9-1-1 and the potential migration to NG environment
- ▶ Value Analysis Results (on a scale of 5)
 - **Current Environment: 50**
 - **NG9-1-1: 80.1**
- ▶ Based on our value analysis, NG9-1-1 is expected to deliver more than **60 percent** additional value over the current operating environment to the 9-1-1 community

Value Analysis Results

Value Factors & Benefits	Current Environment		NG9-1-1
	Weight	Score	Score
Direct User Benefits	52%	25.90	44.17
Accessibility	38%	9.87	19.74
Timeliness	20%	5.23	6.10
User Satisfaction	6%	1.42	2.14
Reliability of Service	26%	6.81	11.92
Ease of Use	10%	2.56	4.27
Social Value	14%	6.80	10.14
Public Safety	51%	3.46	5.19
Safety to Responder	20%	1.39	1.39
Efficient Use of Taxpayer Dollars	19%	1.26	2.53
Energy & Environment	10%	0.69	1.03
Foundational/Operational Value	20%	10.10	12.62
Scalability & Adaptability of System	16%	1.59	2.77
Information Accuracy	19%	1.93	2.89
Data Management	20%	2.05	2.05
Operational Efficiency	10%	1.00	2.00
Data Sharing	11%	1.15	2.30
Security and Privacy	24%	2.38	0.60
Strategic / Political Value	8%	3.90	6.57
Public Trust	6%	0.25	0.37
Coordination between 9-1-1 & Other	17%	0.68	1.36
Alignment of Strategic Goals	7%	0.26	0.39
Technology Standards	18%	0.70	1.05
Consistency and standardization of Laws	8%	0.31	0.46
Coordination Between Domestic PSAPs	16%	0.62	1.25
Coordination Between US PSAPs on an	4%	0.15	0.30
Strategic Use of Resources & Data	16%	0.63	0.78
Coordination with Industry	8%	0.30	0.60
Government Financial Benefits	7%	3.30	6.60
Cost Savings	43%	1.42	2.84
Cost Avoidance	57%	1.88	3.76
Total	100%	50.00	80.10

A discussion of non-system financial benefits is provided in the appendix and will be the focus of additional analysis

The largest differentials in value between the Current Environment and NG9-1-1 are mostly positive

- ▶ Accessibility (+9.87 value points, 100% increase over the current environment): This large increase is expected due to the large number of IP-based devices that will be capable of using the system under NG that currently cannot in the present system
- ▶ Reliability of Service (+5.11 value points, 75% increase over the current environment): This significant increase is expected due to the increased linkages between PSAPs under an NG scenario that allows for complete redundancy in the event of natural disasters or individual PSAP failure
- ▶ Public Safety - Indirect Users (+1.73 value points, 50% increase over the current environment): This boost is expected due to improved “reverse 9-1-1” capacity that would allow the public safety system to more effectively reach the public in the case of large scale incidents
- ▶ Security (-1.79 value points, 75% decrease from the current environment): This decrease in value is due to the increased vulnerability of an IP-based (NG) system to access by unauthorized individuals (e.g. hackers). The current environment, which is mostly analog-based, is not as vulnerable to high level computer-based sabotage as an IP system would be

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Baseline segmentation was derived based on population served and the current operating environment at the county level

- ▶ Segments are created by grouping counties based on population and their current level of 9-1-1 service. These profiles will provide a basis from which to estimate the costs, value, and risk of moving to the defined alternatives
- ▶ Our segmentation will also consider the seven states that have state-wide systems and state administration components that are not included in table below
 - State systems are assumed to be Wireless Phase 1 or 2

County Segmentation for Cost Profile Development*

	1 RCF	2 Basic	3 E-9-1-1	4	5 Wireless**	6	7	8 Total
Less than 50,000	98	114	304		1684			2200
50,001 to 250,000	0	2	62		588			650
250,001 to 1,000,000	0	0	4		175			175
More than 1,000,000	0	0	2		25			25
Total	98	116	366		2472			3052***

*For the purpose of this analysis, it is assumed that a county is equivalent to a 9-1-1 Authority

**Includes Phase I and Phase II as well as counties that have started wireless deployments as of 7/7/07

***Does not include counties participating in state-wide systems

Source: Wireless Deployment Profile, www.nena.org

For each county and state segment, a profile was developed to define the current environment and operating costs

Baseline Segmentation Cost Profile Template*

Segment 1		System Costs	PSAP	Database (GIS)	Total
Hard	Segment n	System Costs	PSAP	Database (GIS)	Total
Soft					
O&M	Hardware				
Netw	Software				
Secu	O&M Personnel				
Rec	Network Operations				
Faci	Security				
Othe	Recurring Training				
Tota	Facilities				
	Other Direct Costs				
	Total Operating Costs				

**Completed county segment and state profiles are included in Appendix B: Cost Analysis*

- ▶ **System Costs.** Voice/Data network, Selective Routing, ALI Database Equipment, ALI data links by PSAP, dynamic update DLs (by MPC/VPC vendor and ALI server), central system DBMS, security costs
- ▶ **PSAP Costs.** Hardware and Software used by the PSAP to receive and transfer incoming data. Includes CPE costs and interfaces, but not public safety dispatch/responder systems or related expenses
- ▶ **Data Services (with GIS).** Data management equipment, local DBMS software, cost of GIS Database, mapping system, base layer data, any provider costs for TN subscriber extraction records, security costs, application software costs

Personnel:

In Scope: PSAP staff and management, System Administrators, System Operators, DBA, 9-1-1 Authority

Out of Scope: Dispatchers/Responders

Applying benchmarks* to arrive at a capital cost estimate, the total 9-1-1 baseline is estimated at an annual cost of \$2.2B

9-1-1 Baseline Operating Environment Total Annual Cost Estimate

Segment	Individual Segment Cost	Number of Segments	Annual Capital Costs	Annual Recurring Costs	Total Annual Cost
1	\$1850	98	\$36,260.00	\$181,300	\$217,560
2	\$143,690	114	\$3,276,132.00	\$16,380,660	\$19,656,792
3	\$351,840	304	\$21,391,872.00	\$106,959,360	\$128,351,232
4	\$683,610	62	\$8,476,764.00	\$42,383,820	\$50,860,584
5	\$370,790	1684	\$124,882,072.00	\$624,410,360	\$749,292,432
6	\$723,460	588	\$85,078,896.00	\$425,394,480	\$510,473,376
7	\$1,662,250	175	\$58,178,750.00	\$290,893,750	\$349,072,500
8	\$4,430,900	25	\$22,154,500.00	\$110,772,500	\$132,927,000
Total	\$529,975	3052	\$323,475,246.00	\$1,617,376,230	\$1,940,851,476
State 1	\$14,636,239	1	\$2,927,247.80	\$14,636,239	\$17,563,487
State 2	\$20,589,018	1	\$4,117,803.60	\$20,589,018	\$24,706,822
State 3	\$29,220,219	1	\$5,844,043.80	\$29,220,219	\$35,064,263
State 4	\$144,428,405	1	\$28,885,681.00	\$144,428,405	\$173,314,086
State 5	\$20,484,965	1	\$4,096,992.95	\$20,484,965	\$24,581,958
State 6	\$6,723,790	1	\$1,344,758.00	\$6,723,790	\$8,068,548
State 7	\$4,750,946	1	\$950,189.11	\$4,750,946	\$5,701,135
Total	\$240,833,581	7	\$48,166,716.27	\$240,833,581	\$289,000,298
State Program*	\$199,068	31	\$1,049,089.44	\$6,171,114	\$7,220,204
Grand Total:					\$2,237,257,111

*Booz Allen benchmarks and research indicate that recurring costs account for 80% of total annual costs. Capital costs, which comprise the other 20%, are one time investments treated as annual costs spaced out over time due to the large size of the environment we are evaluating. See Appendix B for details

As a conservative measure, the baseline 9-1-1 environment is estimated to cost between \$11.18 and \$15.86 per call

- ▶ Annual recurring costs were developed based on SME* input for each county and state profile and data queries
- ▶ Annualized capital costs were estimated leveraging industry benchmarks and SME input
 - A benchmark of 20 percent of total cost was applied to estimate capital costs for each baseline segment**
- ▶ **Approximately 200,000,000 calls are received by 9-1-1 PSAPs annually**
 - Total annual operating costs of \$2.2B yield an average cost per call of **\$11.18**
 - Two (2004) Industry studies estimated that average cost per calls are in the range of **\$15.86*** to \$36.85****** (values in \$2007)
 - Leveraging the large call center cost per call cited by Industry experts as a conservative measure, a range is established to represent our current operating environment

9-1-1 Baseline Total Annual Costs
Based on an estimated 200,000,000 annual call volume

	Baseline Profile	Industry Estimates
Average Cost per Call	\$11.18	\$15.86
Annual Estimate (\$M)	\$2,200	\$2,892

*See slide 27 for full SME reference

**Source: Booz Allen Hamilton IC

***<http://www.nena.org/medira/files/NENASWATStaffingReport-5Jan04revpart3.pdf>, (last accessed, Jan. 15, 2008) in \$2004, inflated to \$2007 for the purposes of our analysis. See appendix B for details

*****National Benefit/Cost Analysis of Three Digit-Accessed Telephone Information and Referral Services*, University of Texas, 2004, inflated to \$2007 for the purposes of our analysis

Based on our baseline segmentation analysis, the current 9-1-1 environment lifecycle costs are estimated at \$55.6B in nominal dollar terms

9-1-1 Baseline, Current Environment (Low)

Cost Elements (\$M, Inflated)	FY2009	FY2010	FY2011	FY2012	FY2013	FY2014 – 2028*	Total
1.0 Program Planning and Research and Development	\$-	\$-	\$-	\$-	\$-	\$-	\$-
2.0 Acquisition and Implementation	\$373	\$381	\$390	\$398	\$407	\$7,324	\$9,273
3.0 Operations and Maintenance	\$1,864	\$1,907	\$1,949	\$1,993	\$2,038	\$36,648	\$46,399
Total Lifecycle Cost	\$2,237	\$2,288	\$2,339	\$2,391	\$2,445	\$43,972	\$55,672
Total Lifecycle Cost (Discounted)	\$2,237	\$2,177	\$2,117	\$2,060	\$2,004	\$24,269	\$34,863

*FY2014-2028 represents the sum of the 15 year period for presentation purposes

Based on our estimated baseline upper bound, the 9-1-1 lifecycle costs increase to \$78.9B in nominal dollar terms

9-1-1 Baseline, Current Environment (High)

Cost Elements (\$M, Inflated)	FY2009	FY2010	FY2011	FY2012	FY2013	FY2014 – 2028	Total
1.0 Program Planning and Research and Development	\$-	\$-	\$-	\$-	\$-	\$-	\$-
2.0 Acquisition and Implementation	\$529	\$540	\$553	\$565	\$578	\$10,388	\$13,152
3.0 Operations and Maintenance	\$2,644	\$2,704	\$2,765	\$2,827	\$2,890	\$51,983	\$65,814
Total Lifecycle Cost (Nominal)	\$3,173	\$3,245	\$3,318	\$3,392	\$3,468	\$62,371	\$78,966
Total Lifecycle Cost (Discounted)	\$3,173	\$3,087	\$3,003	\$2,922	\$2,842	\$34,423	\$49,451

Two scenarios for NG9-1-1 were evaluated for this analysis

▶ Scenario 1: NG9-1-1 Total Cost

- Assumes deployment from a total cost basis for PSAP, Data Services, and Network implementation and operations costs

▶ Scenario 2: NG9-1-1 Cost Share

- Assumes that the broader responder and public safety community (e.g. police, fire, emergency medical services, dispatch) will contribute to the development of the network
- Cost sharing is estimated at 50 percent of network implementation, acquisition and recurring costs over the lifecycle, and 20 percent of Data Services implementation acquisition and recurring costs over the lifecycle

▶ In both NG9-1-1 scenarios, PSAP labor and facilities are held constant

- Labor costs alone represent approximately 70% of the baseline environment costs (\$37B to \$53B over the lifecycle)
- Facility costs comprise \$1.8B to \$2.6B of the baseline environment costs

▶ As a conservative measure, a key assumption in our investment profile for NG9-1-1 is that contractor labor is leveraged for all implementation activities

The NG9-1-1 alternative is comprised of a repeatable, scalable architecture to be deployed across the defined segments based on population served

- ▶ Preliminary estimates show for our each call taker position, approximately \$150k is required for planning, acquisition, and installation / implementation to upgrade to NG9-1-1
- ▶ Data Services and Network costs have been scaled to support 120 PSAPs*
 - Initial Data Services initial costs are estimated between \$6.5M, with acquisition estimated at approximately \$3.2M
 - Network initial costs are estimated initially at approximately \$7.8 and \$8M, with acquisition estimated at approximately \$3.8M

NG9-1-1 Investment Profile, Unit Point Estimate

(\$CY07)	PSAP Total Cost Per Call Taker	Total Cost Per PSAP Unit	Data Services (10 PSAP Units)	Network (10 PSAP Units)
Total	\$150k	\$4.8 M	\$6.5 M	\$7.8 M

**See slides 19-21 for supporting documentation on unit sizing*

Total initial investment required for full deployment of NG9-1-1 across all segments is estimated at \$3.1B in current year dollars

NG9-1-1 National Deployment Initial Investment Point Estimate (CY07\$)*

1 Network Unit (\$000)	10 PSAP Units	Data Services	Network	Total
1.0 Planning	\$ 2,331	\$ 320	\$ 383	\$ 3,034
2.0 Acquisition	\$ 23,312	\$ 3,200	\$ 3,827	\$ 30,339
3.0 Implementation	\$ 22,236	\$ 3,052	\$ 3,651	\$ 28,939
Total	\$ 47,880	\$ 6,572	\$ 7,861	\$ 62,313

National Deployment (\$000)	PSAP Units	Data Services	Network	Total
1.0 Planning	\$ 117	\$ 16,000	\$ 19,137	\$ 151,697
2.0 Acquisition	\$ 1,166	\$ 160,000	\$ 191,367	\$ 1,516,971
3.0 Implementation	\$ 1,112	\$ 152,616	\$ 182,535	\$ 1,446,962
Total	\$ 2,394	\$ 328,616	\$ 393,038	\$ 3,115,629

*See Appendix B for the Basis of Estimate

NG9-1-1 Total Costs are estimated at \$63.7B over the 20-year lifecycle in nominal dollar terms

NG9-1-1 Total Cost*

Cost Elements (\$M, Inflated)	FY2009	FY2010	FY2011	FY2012	FY2013	FY2014 – 2028	Total
1.0 Program Planning and Research and Development	\$33	\$40	\$49	\$56	\$68	\$302	\$547
2.0 Acquisition and Implementation	\$262	\$337	\$405	\$470	\$524	\$8,336	\$10,335
3.0 Operations and Maintenance	\$1,972	\$2,016	\$2,104	\$2,205	\$2,303	\$42,252	\$52,852
Total Lifecycle Cost (Nominal)	\$2,267	\$2,393	\$2,559	\$2,731	\$2,895	\$50,889	\$63,734
Total Lifecycle Cost (Discounted)	\$2,267	\$2,277	\$2,316	\$2,352	\$2,372	\$28,287	\$39,872

*Costs based on deployment/rollout strategy, slides 24-25. Total cost = unit cost (see slide 46 for details) x number of units deployed per year

NG9-1-1 lifecycle costs decrease to \$57.9B over the 20-year lifecycle in nominal dollar terms based on network and data cost sharing estimates

NG9-1-1 Cost Share

Cost Elements (\$M, Inflated)	FY2009	FY2010	FY2011	FY2012	FY2013	FY2014 – 2028	Total
1.0 Program Planning and Research and Development	\$21	\$25	\$31	\$36	\$43	\$192	\$349
2.0 Acquisition and Implementation	\$222	\$279	\$336	\$387	\$437	\$5,748	\$7,410
3.0 Operations and Maintenance	\$1,353	\$1,384	\$2,126	\$2,253	\$2,352	\$40,713	\$50,181
Total Lifecycle Cost (Nominal)	\$1,597	\$1,688	\$2,492	\$2,676	\$2,833	\$46,654	\$57,940
Total Lifecycle Cost (Discounted)	\$1,597	\$1,606	\$2,256	\$2,305	\$2,321	\$26,128	\$36,213

Note: “Shared Costs” are for Network (assumed split evenly with other key stakeholders such as emergency response) and Data Service (assumed 20% shared with other key stakeholders) costs only. PSAP costs are fully accounted for here.

Lifecycle costs results indicate the NG9-1-1 Cost Share scenario at \$57.94B over the 20-year lifecycle

- ▶ The current 9-1-1 environment is estimated to range between **\$55B and \$79B** over a 20-year lifecycle
- ▶ NG9-1-1 is estimated to range between **\$57B and \$64B** over the 20-year lifecycle
- ▶ If the Baseline 9-1-1 (High) scenario is considered in comparison to both NG9-1-1 scenarios, potential for system savings exists in the range of **\$15-21B** over the lifecycle

Cost Analysis Point Estimate Results
(Then Year \$B)

Values in Then Year \$B	Baseline 9-1-1 (Low)	Baseline 9-1-1 (High)	NG9-1-1 Total Cost	NG9-1-1 Cost Share
1.0 Planning	-	-	\$0.55	\$0.35
2.0 Acquisition and Implementation	\$9.27	\$13.15	\$10.33	\$7.41
3.0 Operations and Maintenance	\$46.39	\$65.81	\$52.85	\$50.18
Total Lifecycle Costs (Point Estimate)	\$55.67	\$78.97	\$63.73	\$57.94

Note: for the purposes of this report, we have NOT considered any scenario in which PSAPs are consolidated in moving from the current environment to a Next Generation one. The cost estimates above reflect a maintenance of the status-quo in this regard. Baseline Labor use is assumed constant in the NG environment

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Eight key risk categories were identified for the 9-1-1 environment that served as a basis to develop the risk inventory

- ▶ Risks may degrade performance, impede implementations, and/or increase costs. Risk that is not identified cannot be mitigated or managed, and may cause new (NG9-1-1) or existing (current 9-1-1) organizations to miss performance targets, or to fail either in the pursuit of funding, or during implementation. The greater attention paid to mitigating and managing risk, the greater the probability of success
- ▶ Based on working sessions with team SMEs*, eight key risk categories were developed to serve as the underpinnings to the risk structure
- ▶ The risk inventory was developed in conjunction with the eight defined risk categories. The risk categories and inventory were designed to capture the full spectrum of risks that may be realized in the 9-1-1 environment and industry in order to estimate the likelihood of occurrence and the impact of those identified risks on value and costs



Risk Categories	
1	Project Resources/Acquisition
2	Technology
3	Security and Privacy
4	Political / Strategic
5	Organizational and Change Management
6	Business / Industry
7	Funding
8	Public

NOTE: risk measured and stated in this document is specific to this document and will vary when applied to any specific 9-1-1 system

**SME input acquired from same sources that provided input during the expert choice session, see slide 27 for full reference*

The team identified eight key risk categories applicable to the 9-1-1 environment to serve as a basis to develop the risk inventory (cont.)

Risk Category	Definition
1 Project Resources/Acquisition	Risk associated with mis-estimation of investment and lifecycle costs, reliance on a small number of vendors without cost controls and (poor) acquisition planning. Risks associated with the program / project management, monitoring and evaluation, and timeliness of implementation(s)
2 Technology	Risk associated with immaturity/obsolescence of commercially available technology; risk of technical problems/failures with applications and their ability to provide planned and evolving technical functionality and meet service level requirements. Risk that personal communications or other related services/tech will continue to outpace 9-1-1 technologies
3 Security	Risk associated with security/vulnerability of the systems, websites, information, and networks; risks of intrusions and connectivity to other (vulnerable) systems; risk associated with the misuse (criminal/fraudulent) of information
4 Political / Strategic	Risk associated with strategic/government-wide goals (at the Federal, State, and Local Jurisdiction levels) including the risk that the alternative fails to result in the achievement of those goals or in making contributions to them; risks associated with regulatory changes, impact to society, and legal implications; risks associated with lack of coordination across Government entities; risks associated with the lack of adherence to voluntary technology standards

The team identified eight key risk categories applicable to the 9-1-1 environment to serve as a basis to develop the risk inventory (cont.)

Risk Category	Definition
5 Organizational and Change Management	Risk associated with organizational, agency or government-wide cultural resistance to change and standardization; risk associated with the bypassing of, lack of use of, improper use of or improper adherence to new systems and processes due to organizational structure and culture
6 Business / Industry	Risk associated with dependencies on key stakeholder communities within the private sector; risk that the private sector will not support the alternative vision resulting in the alternative's failure to achieve process efficiencies and streamlining; risk that service levels between the private sector and alternative will not be met; risk that the program effectiveness targeted by the project will not be achieved
7 Funding	Risk of funding not meeting anticipated levels, regardless of mechanism (mechanisms include grants, taxes, market funding, surcharges); risk of funding being used for non-optimal or non-911 related purposes; risk that funding burdens are not allocated appropriately, leading to funding disputes, thus hurting implementation efforts; Market funding risks associated with fluctuation of interest rates or inflation over time
8 Public	Risk of degradation of public confidence in system leading to compromised long term viability of system; risk that public perception of privacy of system becomes compromised

Program Resources/Acquisition is the first of the major risk categories to consider in our analysis

RISK STRUCTURE		
Risk Category	Risk	Risk Description
1 Program Resources / Acquisition	Monopolies in the supply chain due to natural supply shortages or mergers and acquisitions lead to increasing costs, incomplete/untimely design & standards and keep new competitors out of markets	Key areas of the supply chain are dominated by firms with monopolistic characteristics, thus driving up project costs significantly
	Ineffective Program Controls/Project Management	Lack of planning & monitoring and evaluation of projects within the program portfolio leads to incomplete implementation or projects extending beyond expected timelines
	Budget mis-estimation (both over and under)	Not relying on shared resource pool that could supplement funding/reduce cost, or pooling resources but not receiving adequate funding/cost mitigation in return
	Procurement and maintenance processes for 9-1-1 IT services and equipment transferred to a central IT procurement authority, multiple parties share the use of the items procured, new approval processes delay or discourage optimal procurement practices at local levels	Central IT procurement authority unaware of the unique needs of 9-1-1; incremental costs for shared items not clearly identified and allocated among the sharers

A number of risks can be identified surrounding the increasing use of and implementation of new technologies and security

RISK STRUCTURE		
Risk Category	Risk	Risk Description
2 Technology	Inability of system to meet functional requirements	Mis-estimation of technology capabilities leads to failure to meet functional requirements
	Interoperability roadblocks with legacy systems (both interface and data exchange) continue to exist	System does not connect smoothly with analog/legacy infrastructure, reducing functionality of service
	Use of proprietary standards (open standards not developed)	9-1-1 authorities set up their own systems that may not interface correctly with other 9-1-1 systems
	Vendors systems do not keep pace with required system goals	Risk that vendor design does not meet acceptable 9-1-1 service levels
	Continued practice of vendor workarounds prevents system development and evolution	These temporary fixes perpetuate an outdated system that doesn't meet modern public safety communication requirements
3 Security and privacy	Inadequate internal controls	Authorized personnel use confidential data inappropriately
	Unauthorized access of confidential information	People outside of system gain access to confidential information
	Degradation of security performance - security controls to do not keep up with security threats	System degrades over time, allowing unauthorized users access

Political and Strategic risks comprise a major piece of the overall risk to the operations of any 9-1-1 system

RISK STRUCTURE		
Risk Category	Risk	Risk Description
<div style="display: flex; align-items: center;"> <div style="border: 2px solid red; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin-right: 10px;">4</div> <div style="background-color: #e6e6e6; padding: 10px; border: 1px solid black;"> Political / Strategic </div> </div>	Inadequate Federal, State, and Local legislative support.	Regulations and mandates are not sufficient to facilitate adoption across all jurisdictions
	Strategic/political alliances for the purposes of facilitating interoperability between jurisdictions do not occur	Data sharing agreements and data-handling regulations are not codified, leading to limited cooperation between jurisdictions
	Regulations do not foster development and evolution of 9-1-1 system	Restrictions on types of allowable computer equipment acquisitions do not adjust to new systems. Too many restrictions on purchasing for 9-1-1 equipment and services.
	Lack of regulatory knowledge of what is required from the private sector for appropriate 9-1-1 system functionality	Regulations do not mandate business acceptance of its role in 9-1-1 system, regulators do not have enough information (lack of understanding in the public sector) to determine if service providers are providing the appropriate services to support the 9-1-1 system
	Lack of compliance with technology and operational standards leads to less than optimal system performance	Voluntary nature of tech and ops standards leads to the adoption of proprietary standards instead of best practices/open standards

As organizations continue to evolve, a new set of risks may be realized around adapting to change

RISK STRUCTURE		
Risk Category	Risk	Risk Description
5 Organizational and Change Management	Minimal stakeholder adoption of new technologies processes	Established processes and regulations will not be fully embraced / adopted by all local jurisdictions and employees
	Volume and complexity of incoming data increases call processing time	Mismanagement of data leads to inability of call takers to identify the key issue, process the call and initiate a timely response
	Loss of Human Capital	The efficiencies brought about by new processes, procedures, training requirements, systems, and configuration (governance, location, etc.) results in voluntary employee attrition, a reduction in force (RIF) of experienced employees (including those at the local, state and federal levels), and/or complicates organized labor negotiations
	Unwillingness of jurisdictions to set aside traditional/historical parochial interests and collaborate with one another	Jurisdictional turf issues limit data sharing, interfaces, resource sharing (etc.)

Due to the heavy reliance of 9-1-1 telecommunications infrastructure on the private sector, risk related to business and industry must be accounted for as well

RISK STRUCTURE		
Risk Category	Risk	Risk Description
<div style="display: flex; align-items: center;"> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; margin-right: 10px;">6</div> <div style="background-color: #e6e6e6; padding: 10px; border: 1px solid black;"> Business / Industry </div> </div>	Private industry may choose differing solutions than the 9-1-1 community for technology or operation of system	Inability of private industry to meet 9-1-1 capacity requirements and service levels ultimately resulting in inadequacy of the 9-1-1 system
	Private industry may not provide resources to the 9-1-1 system	Private service providers refuse to fund or implement key pieces of infrastructure necessary for optimal 9-1-1 system functionality due to cost or lack of marketability considerations
	Necessary goods and services are not provided by private sector	Goods and services shortfall results in less than optimal 9-1-1 system functionality
	Changeover of service providers causes loss of 9-1-1 specific expertise in market	New vendors enter community that have incomplete understanding of the 9-1-1 environment
	Private sector communications services do not ensure consumer access to 9-1-1	Access to 9-1-1 is reduced commensurate with the consumer adoption of alternative communications media

Risk of funding shortfalls, funding misuse, and mismatch of funding to the appropriate cost schedules is of key concern

Risk Structure		
Risk Category	Risk	Risk Description
7 Funding	Unclear demarcation of funding for shared expenses (e.g. backbone, interfaces)	Service providers v. 9-1-1, county v. county, state v. state, private v. public, 911 v. public safety at large
	Funding Misuse	States/Jurisdictions will use funds earmarked for 911 for unrelated or non-optimal purposes
	Funding models cannot meet project needs	Funding does not keep pace with technology upgrade or operations costs due to decline or obsolescence of funding sources
	Urban-rural funding disparities result in inequity in service	Surcharge, tariff or other revenues may differ from one area to another, leading to zones of funding shortfalls inadequacy of service therein
	Lack of technological equity in surcharge assessment and remittance	Emerging service providers do not contribute significantly to alleviating the funding burden, leading to lack of buy in by all necessary parties and funding shortages as a result
	Fluctuation of market rates	Insufficient funding resulting from interest rate fluctuations on interest bearing securities or excessive inflation rates over the lifecycle (e.g. - state/municipal bond issuances lose value due to rising interest rates)

Risk of public backlash against the system should service or privacy protections not live up to expectations is the final risk category to be considered in our analysis

Risk Structure		
Risk Category	Risk	Risk Description
8 Public	Public concern over amount of private information available through system and public's perception of its security and privacy	Public confidence in system falls due to concern over willingness to share personal data (e.g. location data) with emergency responders
	Degradation in 9-1-1 customer service levels	Transfer of technologies (implementation) or change of technologies may cause service disruptions
	Lack of public knowledge and awareness of 9-1-1 system capabilities and functionality	Outreach efforts do not adequately inform the general public on how to use the full range of 9-1-1 services

Risk Probability and Impact are measured based on a notional scale of “High”, “Medium” and “Low”

- ▶ The probability and impact of identified risks were determined on a notional scale with SME* input, and then mapped to the identified values and costs for both the current 9-1-1 and NG9-1-1 environments
 - Once the risk structure was defined, the next step was to assess the probability that the risks would materialize during the lifecycle for the current and NG environments
 - Assessing the impact of risk on value and cost is a two step process. First, the impact was measured; second, the impact was applied to a value. Not every value or cost was impacted by every risk factor. Employing the defined scale, the team assigned high, medium, low, or no impact to each risk factor. Then, the impact was applied to the affected value and cost factors
- ▶ The likelihood of a risk occurring is weighed, and then the magnitude of its effect on the identified value or cost is assigned based on the table below

Probability and Cost and Value Impact

	Probability	Cost Impact	Value Impact
High	50%	10%	-10%
Medium	30%	5%	-5%
Low	10%	2%	-2%
None	0%	0%	0%

**SME input acquired from same sources that provided input during the expert choice session, see slide 27 for full reference*

The Booz Allen team assessed the probability that the risks would materialize during the lifecycle of each alternative

Risk Inventory	Probability	
	Current Environment	NG9-1-1
1.0 Program Resources / Acquisition		
1.1 Monopolies in the supply chain due to natural supply shortages or mergers and acquisitions lead to increasing costs, incomplete/untimely design & standards and keep new competitors out of markets	High	Low
1.2 Ineffective Program Controls/Project Management	Low	High
1.3 Budget mis-estimation (both over and under)	Low	High
1.4 Procurement and maintenance processes for 9-1-1 IT services and equipment transferred to a central IT procurement authority, multiple parties share the use of the items procured, new approval processes delay or discourage optimal procurement practices at local levels	Low	High
2.0 Technology		
2.1 Inability of system to meet functional requirements	High	Low
2.2 Interoperability roadblocks with legacy systems (both interface and data exchange) continue to exist	High	Low
2.3 Use of proprietary standards (open standards not developed)	High	Medium
2.4 Vendors systems do not keep pace with required system goals	High	Medium
2.5 Continued practice of vendor workarounds prevents system development and evolution	High	Low

The Booz Allen team assessed the probability that the risks would materialize during the lifecycle of each alternative (cont)

Risk Inventory	Probability	
	Current Environment	NG9-1-1
3.0 Security and privacy		
3.1 Inadequate internal controls	Low	High
3.2 Unauthorized access of confidential information	Low	High
3.3 Degradation of security performance over time - security controls to do not keep up with security threats	Low	High
4.0 Political / strategic		
4.1 Inadequate Federal, State, and Local legislative support.	Medium	High
4.2 Strategic/political alliances for the purposes of facilitating interoperability between jurisdictions do not occur	Medium	High
4.3 Regulations do not foster development and evolution of 9-1-1 system	High	High
4.4 Lack of regulatory knowledge of what is required from the private sector for appropriate 9-1-1 system functionality	Medium	High
4.5 Lack of compliance with technology and operational standards leads to less than optimal system performance	Medium	Low
5.0 Organizational and change management		
5.1 Minimal stakeholder adoption of new technologies and processes	Low	Medium
5.2 Volume and complexity of incoming data increases call processing time	Low	Medium
5.3 Loss of Human Capital	Medium	High
5.4 Unwillingness of jurisdictions to set aside traditional/historical parochial interests and collaborate with one another	Medium	High

The Booz Allen team assessed the probability that the risks would materialize during the lifecycle of each alternative (cont)

Risk Inventory	Probability	
	Current Environment	NG9-1-1
6.0 Business / industry		
6.1 Private industry may choose differing solutions than the 9-1-1 community for technology or operation of system	Low	Medium
6.2 Private industry may not share resources with the 9-1-1 system	High	Medium
6.3 Necessary goods and services are not provided by private sector	Low	Low
6.4 Changeover of service providers causes loss of 9-1-1 specific expertise in market	Medium	High
6.5 Private sector communications services do not ensure consumer access to 9-1-1	Medium	Low
7.0 Funding		
7.1 Unclear demarcation of funding for shared expenses (e.g. backbone, interfaces)	Low	High
7.2 Funding Misuse	High	High
7.3 Funding models cannot meet project needs	High	High
7.4 Urban-rural funding disparities result in inequity in service	High	Medium
7.5 Lack of technological equity in surcharge assessment and remittance	Medium	Low
7.6 Fluctuation of market rates	Medium	Medium
8.0 Public risk		
8.1 Public concern over amount of private information available through system and public's perception of its security	Low	Medium
8.2 Lack of public knowledge and awareness of 9-1-1 system capabilities and functionality	Low	Medium
8.3 Degradation in 9-1-1 customer service levels	Medium	Low

Risk Impact

Risk Description	Value Impact		Cost Impact	
	Current Environment	NG9-1-1	Current Environment	NG9-1-1
1.0 Program Resources / Acquisition				
1.1 Monopolies in the supply chain due to natural supply shortages or mergers and acquisitions lead to increasing costs, incomplete/untimely design & standards and keep new competitors out of markets	Medium	Medium	Low	Low
1.2 Ineffective Program Controls/Project Management	Low	Medium	Low	High
1.3 Budget mis-estimation (both over and under)	Low	Medium	Low	Medium
1.4 Procurement and maintenance processes for 9-1-1 IT services and equipment transferred to a central IT procurement authority, multiple parties share the use of the items procured, new approval processes delay or discourage optimal procurement practices at local levels	Low	Medium	Medium	Medium
2.0 Technology				
2.1 Inability of system to meet functional requirements	High	High	Medium	Medium
2.2 Interoperability roadblocks with legacy systems (both interface and data exchange) continue to exist	High	High	Medium	Low
2.3 Use of proprietary standards (open standards not developed)	Low	High	Low	Medium
2.4 Vendors systems do not keep pace with required system goals	High	High	Medium	High
2.5 Continued practice of vendor workarounds prevents system development and evolution	High	High	Medium	Low

Risk Impact (continued)

Risk Description	Value Impact		Cost Impact	
	Current Environment	NG9-1-1	Current Environment	NG9-1-1
3.0 Security and privacy				
3.1 Inadequate internal controls	Medium	High	Low	Medium
3.2 Unauthorized access of confidential information	Medium	High	Low	Medium
3.3 Degradation of security performance over time	Medium	High	Low	High
4.0 Political / strategic				
4.1 Inadequate Federal, State, and Local legislative support.	High	High	None	None
4.2 Strategic/political alliances for the purposes of facilitating interoperability between jurisdictions do not occur	Low	High	Medium	Medium
4.3 Regulations do not foster development and evolution of 9-1-1	Medium	High	Low	High
4.4 Lack of regulatory knowledge of what is required from the private sector for appropriate 9-1-1 system functionality	Medium	Medium	Low	High
4.5 Lack of compliance with technology and operational standards leads to less than optimal system performance	Medium	Medium	Low	Medium
5.0 Organizational and change management				
5.1 Minimal stakeholder adoption of new technologies and processes	High	High	Low	Medium
5.2 Volume /complexity of incoming data increases call processing time	Medium	High	Low	Medium
5.3 Loss of Human Capital	Medium	High	Medium	High
5.4 Unwillingness of jurisdictions to set aside traditional/historical parochial interests and collaborate with one another	Low	High	Medium	Medium

Risk Impact (continued)

Risk Description	Value Impact		Cost Impact	
	Current Environment	NG9-1-1	Current Environment	NG9-1-1
6.0 Business / industry				
6.1 Private industry may choose differing solutions than the 9-1-1 community for technology or operation of system	Medium	Medium	High	High
6.2 Private industry may not share resources with the 9-1-1 system	Low	Low	Medium	High
6.3 Necessary goods and services are not provided by private sector	Medium	High	High	High
6.4 Changeover of service providers causes loss of 9-1-1 specific expertise in market	Low	Medium	Medium	Medium
6.5 Private sector communications services do not ensure consumer access to 9-1-1	High	High	None	None
7.0 Funding				
7.1 Unclear demarcation of funding for shared expenses (e.g. backbone, interfaces)	Medium	Medium	None	None
7.2 Funding Misuse	High	High	None	None
7.3 Funding models cannot meet project needs	High	High	None	None
7.4 Urban-rural funding disparities result in inequity in service	High	High	None	None
7.5 Lack of technological equity in surcharge assessment and remittance	Medium	Low	None	None
7.6 Fluctuation of market rates	Low	Low	Low	Low

Risk Impact (continued)

Risk Description	Value Impact		Cost Impact	
	Current Environment	NG9-1-1	Current Environment	NG9-1-1
8.0 Public risk				
8.1 Public concern over amount of private information available through system and public's perception of its security	Medium	Medium	None	None
8.2 Lack of public knowledge and awareness of 9-1-1 system capabilities and functionality	Low	Medium	None	None
8.3 Degradation in 9-1-1 customer service levels	High	High	Low	Low

The final phase of the risk analysis involves conducting uncertainty analysis and applying the risk factors to the appropriate individual cost elements and values

- ▶ Based on AACE* International Cost Estimating Guidance
- ▶ Order of Magnitude estimates where project is defined as the *Concept Screening* phase
 - Low end range of -15% to -30%
 - High end range of +2% to +50%
- ▶ For uncertainty analysis, a **-25% to +50%** range was applied to the following factors
 - Personnel Salaries (Current and NG environments)
 - NG9-1-1 Hardware
 - NG9-1-1 Software
- ▶ 1000 trials / iterations were run to arrive at the defined resultant ranges
- ▶ The calculations were used to adjust lifecycle costs (after uncertainty analysis) and value scores for risk are presented below

Risk Calculation Approach

Risk Adjustment Type	Calculation
Risk Impact on Total Value (Benefits) for a Given Alternative	The risk-adjusted benefit score is the sum of the following calculation for all benefits across all risks: $Benefit^n Score - (Benefit^n Score \times Risk^n Probability \times Risk^n Impact)$
Risk Impact on Total Lifecycle Cost for a Given Alternative	The risk-adjusted cost is the sum of the following calculations for all 3 top-level CES categories across all applicable risks: $Cost Element^n + (Cost Element^n \times Risk^n Probability \times Risk^n Impact)$

*Association for the Advancement of Cost Engineering standardized guidance for uncertainty analysis ranges

Results of the uncertainty analysis and risk adjustment yield a varying increase in lifecycle costs and decrease in value for all scenarios

Risk Adjusted Value Scores

	Current 9-1-1 Environment (Low and High)	NG9-1-1 Total Cost And Cost Share
Estimated Value Score	50	80.10
Total Risk Adjusted Value Score	32.82	43.06

Risk Adjusted Lifecycle Costs (Then Year \$B)

Costs in Then Year \$B	Baseline 9-1-1 (Low)	Baseline 9-1-1 (High)	NG9-1-1 Total Cost	NG9-1-1 Cost Share
Risk Adjustment	28%		56%	
Low-End Lifecycle Cost	\$53.07	\$75.28	\$61.74	\$55.89
Mid-point Lifecycle Cost Estimate	\$55.67	\$78.97	\$63.73	\$57.94
Risk Adjusted Expected Lifecycle Cost (Mid-point)	\$71.25	\$101.05	\$98.82	\$90.19
Risk Adjusted High-End Lifecycle Cost	\$79.39	\$112.60	\$110.69	\$101.42

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- ▶ Methodology
- ▶ Alternatives Defined
- ▶ Value Analysis
- ▶ Cost Analysis
- ▶ Risk Analysis
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A summary of our lifecycle cost and values indicates that the NG9-1-1 Cost Share scenario provides the best risk adjusted value to cost ratio

Lifecycle Cost and Value Summary (\$TYB)

Analysis Summary	Base Case (low)	Base Case (high)	NG9-1-1 Total Cost	NG9-1-1 Cost Share
Lifecycle Cost Summary (Risk Adjusted Expected TY\$)				
Total Lifecycle Costs	\$71.25	\$101.05	\$98.82	\$90.19
Lifecycle Cost Break down (Risk Adjusted TY\$)				
1.0 – Planning			\$0.73	\$0.47
2.0 – Acquisition and Implementation	\$11.1	\$15.74	\$14.83	\$10.63
3.0 – Operations and Maintenance	\$60.15	\$85.31	\$83.26	\$79.09
Value Summary				
Value Risk Scores	50		80.10	
Risk Adjusted Value Scores	32.82		43.06	

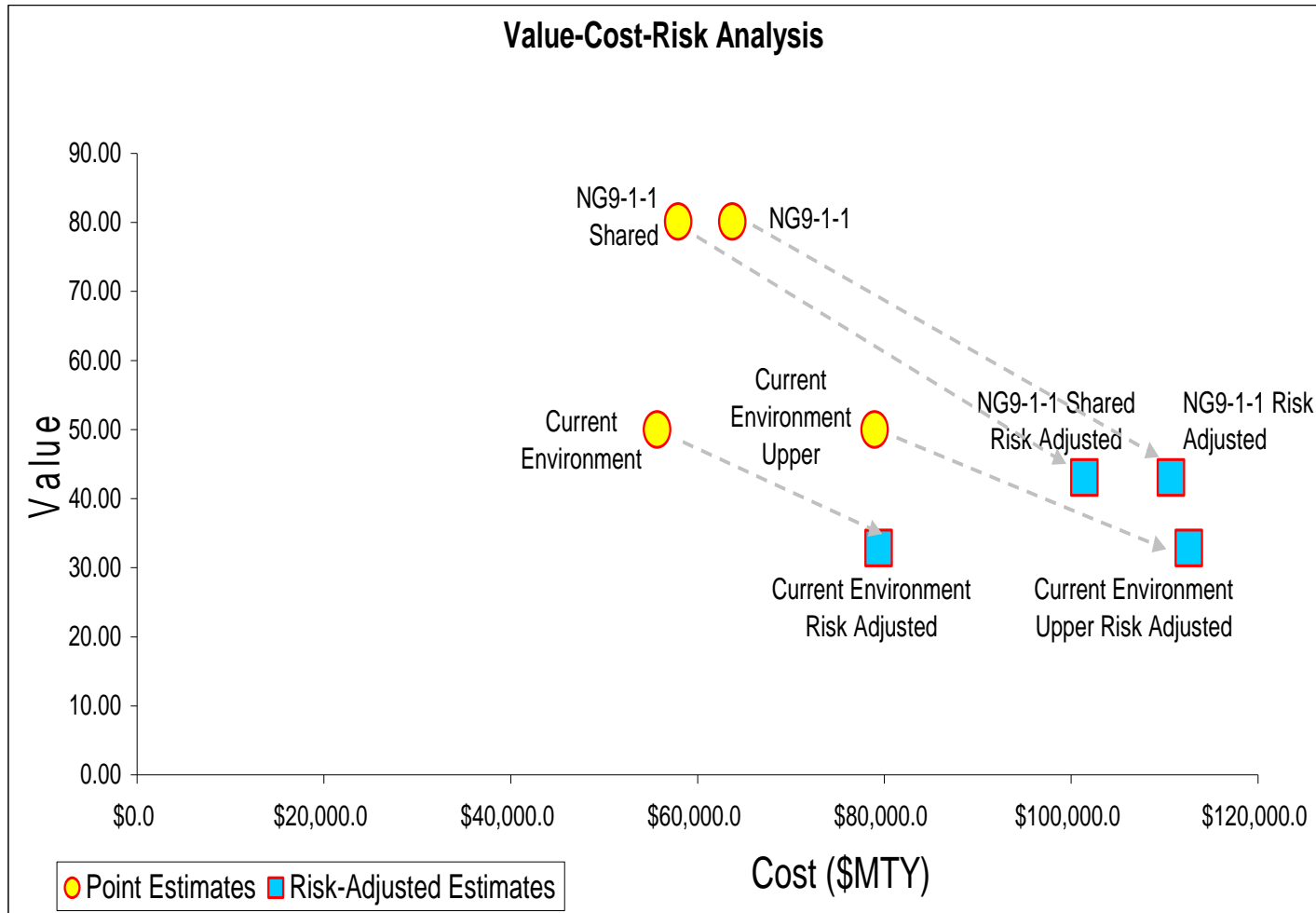
There exist many areas for cost savings opportunities to be achieved within the NG environment not accounted for in this analysis

- ▶ Labor in the current 9-1-1 environment accounts for approximately 70% of the total costs, and was held constant in the NG-9-1-1 scenarios
- ▶ Through PSAP optimization and the creation of “Virtual” PSAP locations, the overall number of call operators and facilities maintained may be reduced. Additionally, the consolidation of data centers into larger, more centralized units may generate economies of scale and, concordantly, monetary savings
- ▶ Considering only labor, according to a recent study *IP Telephony and the Contact Center**, by upgrading systems and reducing facilities in operation additional savings may be obtained in the scale of:
 - Total staffing – 3 to 8%;
 - Staff efficiencies – 3 to 9%

By implementing these staffing changes consecutively (first reduction, then efficiency), potential savings range up to \$378M per year based on our 9-1-1 current environment labor estimates

**White Paper: Dave Bengston, Global Strategic Solutions Team, Avaya, Inc., September 2004, Issue 2
A discussion of additional “Indirect” benefits is provided in the appendix*

Plotting value, cost, and risk together, key relationships across the alternatives can be identified



- ▶ It is clear that NG9-1-1 offers significantly higher value for comparative costs in the point estimates
- ▶ NG9-1-1 continues to deliver significantly greater value when risk adjusted in comparison to the current environment, however, if risks are realized fully lifecycle costs increase significantly and the full range of NG9-1-1 lifecycle costs surpasses the current environment

In conclusion, the increased value of NG9-1-1 in contrast to the current environment outweighs the risks

- ▶ After adjusting for the risks inherent in the upgrade to an NG9-1-1 scenario, both the NG9-1-1 Total Cost and Cost Share scenarios have total lifecycle costs that are within the range of the current 9-1-1 environment's lifecycle costs.
 - This makes choosing between the NG9-1-1 and Current Environment alternatives primarily a function of the value provided by each;
- ▶ NG9-1-1 has the potential to provide significantly greater value than current 9-1-1 technology during the next 20 years. This conclusion is based on several trends identified over the course of the value analysis:
 - NG9-1-1 provides greater opportunities for cost savings, cost avoidance and increased operational efficiencies than the current 9-1-1 environment;
 - NG9-1-1 has greater potential to meet the public's expectations for accessibility than the current 9-1-1 environment;
 - NG9-1-1 has greater scalability and flexibility than the current 9-1-1 environment; and
 - NG9-1-1 has greater potential to increase public and responder safety through interconnectivity and interoperability than the current 9-1-1 environment

Appendices

▶ Appendix A: Value Details

▶ Appendix B: Cost Details

▶ Appendix C: Risk Details

▶ Appendix D: Acronym List

Direct Users of the network include any and all people and organizations that use 9-1-1 systems and processes

VALUE STRUCTURE	Measure Definition	Metrics
Direct User Value	Direct Users include callers, special needs communities, PSAP / 9-1-1 Authority Management, PSAP call takers, public safety dispatchers, and first and support responders	
Accessibility	9-1-1 System is equally accessible to all members of the general public. The system is also equally accessible to all PSAP call takers	▶ Overall percent of population with 9-1-1 service
		▶ Number of types of communications devices or services that enable the general public to make a 9-1-1 call (including event devices)
		▶ Number of PSAPs where call takers can receive, process, and transfer 9-1-1 calls to PSAPs (Primary and Secondary) beyond their local system to facilitate correct 9-1-1 call delivery and dispatch.
Timeliness	9-1-1 calls are received and processed by PSAP call takers and handed off to emergency responders in a timely manner	▶ Call set up times (from gateway to (NG) network to PSAP) for call delivery and associated data
		▶ Time to process data at PSAP (ACN, queuing)
		▶ Call taker processing (receive, process, and release call to dispatch)
User satisfaction	9-1-1 callers and call takers are generally satisfied with the overall functionality of the system	▶ Number of complaints with regards to the system in urban (read: measurable) areas, both by callers and by PSAP operators

Direct User Value (continued)

VALUE STRUCTURE	Measure Definition	Metrics
Direct User	Direct Users include callers, special needs communities, PSAP / 9-1-1 Authority Management, PSAP call takers, public safety dispatchers, and first and support responders	
Reliability of service	9-1-1 System has no single point of failure and has established redundancy to minimize service disruptions and limit susceptibility to failure and / or natural disaster	▶ Percentage of calls identified by system, but not processed
		▶ Capability of system to route calls appropriately (regardless of path) in times of PSAP evacuation and overload
		▶ Peak workload accommodated by system
		▶ Frequency (or number) of PSAP failures
Ease of use	Information can be effectively obtained, organized, and delivered in a format to the PSAP that supports proper and effective call processing	▶ All calls are documented and reported appropriately (Y/N?)
		▶ Percent of calls received/distributed with data/information in a standard data format
		▶ Number of discrepancies documented and reported by call takers

* Possible issue surrounding scope

Operational / Foundational Value includes benefits and efficiencies associated Federal, State, and Local Government 9-1-1 operations

VALUE STRUCTURE	Measure Definition	Metrics
Operational / Foundational: Federal, State, and Local Jurisdiction 9-1-1 end to end operations		
Scalability and adaptability of system functionality and usage	Ability to expand system functionality to accommodate new types of users, complementary functionality, and volume of usage without affecting system performance	▶ Level of hardware and software scalability and adaptability in software and additional hardware to address future requirements and demands.
		▶ Carrying capacity (ability of the system to manage increasing margin of calls)
Information accuracy	Information / services / systems validate, process and utilize the incoming data (e.g. location, call type, service provider identification, etc.)	▶ Ability to validate accuracy of location data received
		▶ Percent of calls misrouted
Data management	Data archiving, management services / systems can monitor, restore, assign access or distribution privileges, and perform database recovery for all 9-1-1 databases	▶ Process time from the point when customer information changes in outside world to the full update of the information in the system

Operational / Foundational Value (continued)

VALUE STRUCTURE	Measure Definition	Metrics
Operational / Foundational: Federal, State, and Local Jurisdiction 9-1-1 end to end operations		
Operational efficiency	Services / Resources / Equipment that are part of the 9-1-1 System are maintained and operated in a streamlined and unified manner. Staff resources across the 9-1-1 system are appropriately trained, hours appropriately distributed, and located optimally	▶ Workforce is optimized across the system to ensure that 100% of 9-1-1 calls are answered
		▶ Ability of the call taker to notify and transfer necessary emergency incident information and calls to appropriate emergency responders regardless of which PSAP may initially receive the call.
		▶ System resources are sufficient to receive and forward supplemental data from third party service providers
Data sharing	Information / services / equipment can fully interoperate with multiple PSAPs and to external key stakeholders/databases	▶ Number of jurisdictions that can share multiple forms of data with others and interface with internal and external databases
Security and privacy	Security adequately sets up, manages, authenticates, and maintains a secure environment; provides adequate data and service protection to mitigate unauthorized access, service exploitation, and leakage of confidential or sensitive information; and provides audit capabilities for activity traceability and accountability across all 9-1-1 systems	▶ Impermeability of system to unlawful access
		▶ Are there end to end security processes and systems between the 9-1-1 Authorities?

Strategic / Political Value includes captures the benefits toward Government (Federal, State, or Local) strategic goals and perception by the public

VALUE STRUCTURE	Measure Definition	Metrics
Strategic / Political: Contributions to achieving both Public (Federal, State, and Local governments) and Private sector strategic goals and priorities		
Public trust	Public and congress have confidence and trust in the 9-1-1 community. Public outreach and education on 9-1-1 emergency services are emphasized	▶ Level of public support for Emergency Relief Services
Coordination between 9-1-1 and other public services	System enables Interoperability and sharing of information and databases and infrastructure as well as the level of institutional relationships established with Public Service entities such as N-1-1 Call Centers, Poison Control Centers, Traffic Management Centers, and Emergency Operations Centers	▶ Number of public service agencies with which system interacts
Alignment of strategic goals	Strategic goals for 9-1-1 are aligned across Federal and State entities	▶ Level of shared vision in the implementation of strategic plans moving forward
Technology standards	Technology standards facilitate standardized 9-1-1 system and service operations across federal, state, and local authorities	▶ Number of systems that are based on open and defined standards

Strategic / Political Value (continued)

VALUE STRUCTURE	Measure Definition	Metrics
Strategic / Political: Contributions to achieving both Public (Federal, State, and Local governments) and Private sector strategic goals and priorities		
Consistency and standardization of laws and regulations	System enables coordination between federal, state, and local authorities and leads to codification and simplification of relevant 9-1-1 laws and regulations	<ul style="list-style-type: none"> ▶ Number of states planning or implementing revised 9-1-1 laws, policies and regulations that support or promote interconnected institutional arrangements and architecture
Coordination between PSAPs across states	Strategic partnerships, cooperation, and goodwill between PSAPs across state borders	<ul style="list-style-type: none"> ▶ Number of PSAPs able to send and receive 9-1-1 calls, share data, and provide services to another state
Coordination between domestic PSAPs, both within and across state borders	System enables strategic partnerships, cooperation, and goodwill between PSAPs across state borders. Governance structure of 9-1-1 system is facilitated by coordination of PSAPs	<ul style="list-style-type: none"> ▶ Number of PSAPs able to send and receive 9-1-1 calls, share data, and provide services to another state
		<ul style="list-style-type: none"> ▶ Number of data-sharing/cooperation agreements between PSAPs within each state
		<ul style="list-style-type: none"> ▶ Number of Governance agreements between PSAPs across states

Strategic / Political Value (continued)

VALUE STRUCTURE	Measure Definition	Metrics
Strategic / Political: Contributions to achieving both Public (Federal, State, and Local governments) and Private sector strategic goals and priorities		
Strategic use of resources and data	Ability to leverage existing and new/emerging emergency information, data, and resources across PSAPs and related communications centers outside of PSAPs (i.e. for disaster planning purposes (etc.))	▶ Number of agreements for data and resource sharing between states/counties and Federal/not-for-profit agencies
		▶ Amount of new useful public safety-related data created through sharing of resources
Value to industry	System enables strategic partnerships, cooperation and goodwill between the system operators and the private sector	▶ Number of contracts for data and resources between states/counties and private companies
Coordination between U.S. PSAPs on an international basis	System enables strategic partnerships, cooperation, and goodwill across borders between PSAPs (foreign governments, international travelers to the US, and military deployments)	▶ Number of inter-jurisdiction / counties / state agreements for data and resource sharing

Social Value captures the greater benefit of 9-1-1 by defining value in terms of the impact of the initiative on indirect stakeholders

VALUE STRUCTURE	Measure Definition	Metrics
Social: Benefits related to non-direct users (ie. those not immediately involved in specific 9-1-1 incident), communities of stakeholders, the larger economy and society as a whole		
Public safety	The system provides for the general safety of the public (e.g. reduced congestion, increased communications in the case of public emergencies, (etc.))	▶ Number of outreach initiatives to educate the general public on the 9-1-1 system and operations
		▶ Average traffic delay time per incident (incident management capabilities / average time to respond to highway related incidents) - impact will be linked to downstream effects such as secondary incidents, diversion of police resources
		▶ Percent of affected-public that can be reached in case of large-scale public emergency
Efficient use of taxpayer dollars	Federal, state, and local government aims to maximize use of operational funds / taxpayer dollars through seeking operational improvements and efficiencies while providing the greatest good for the public	▶ Operational efficiencies minimize the funds necessary while for 9-1-1 infrastructure investment and maintenance while delivering maximum value

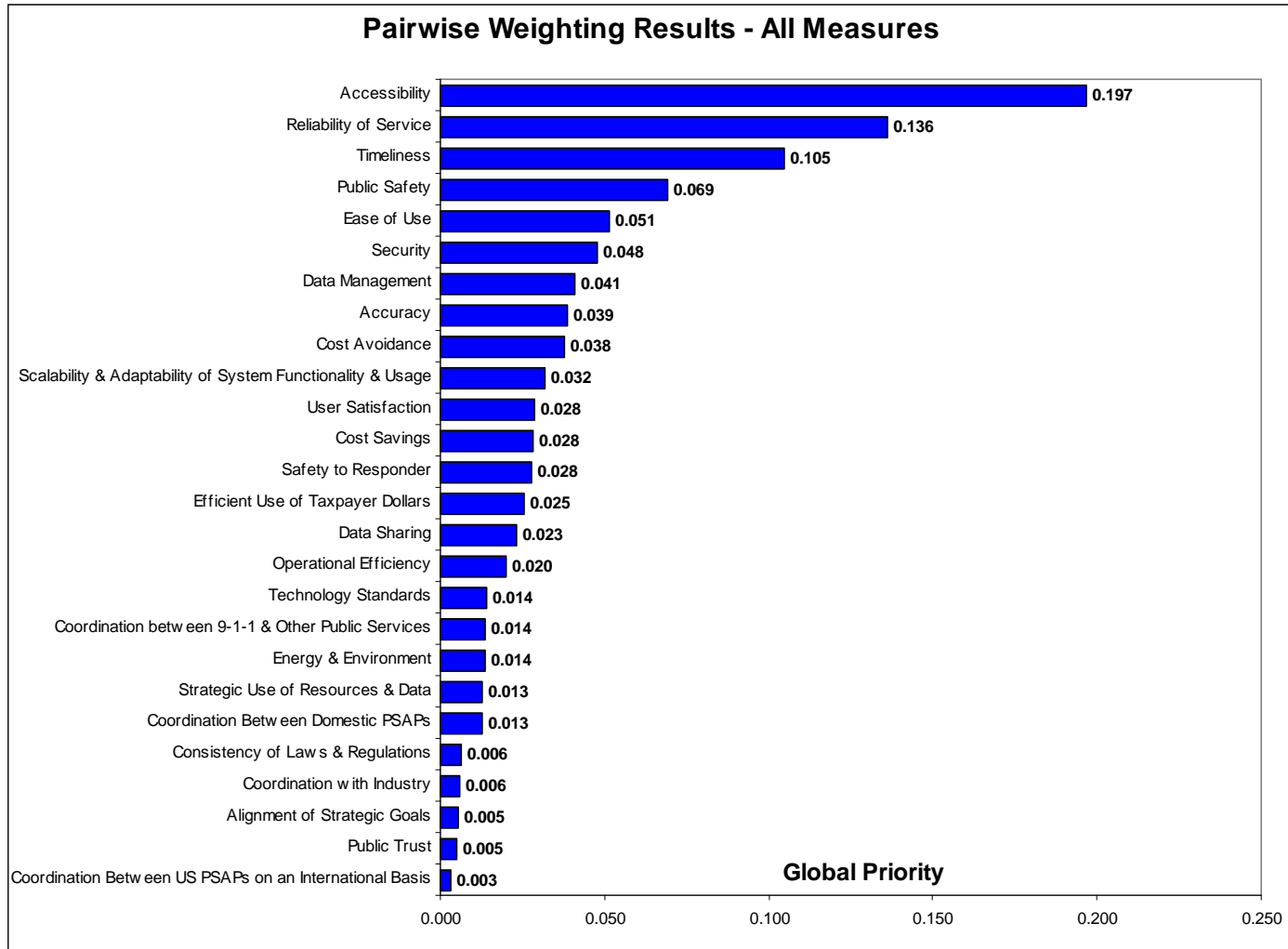
Social Value (continued)

VALUE STRUCTURE	Measure Definition	Metrics
Social: Benefits related to non-direct users (ie. those not immediately involved in specific 9-1-1 incident), communities of stakeholders, the larger economy and society as a whole		
Safety to responder	The team responding to emergency calls has all of the information necessary to address the situation appropriately	<ul style="list-style-type: none"> ▶ General level of responder safety
Energy and environment	Timeliness of emergency response systems directly impact energy and the environment	<ul style="list-style-type: none"> ▶ Level of pollutants, emissions and fuel consumption based on average delay (based on traffic congestion) for highway incidents
		<ul style="list-style-type: none"> ▶ Hazmat 9-1-1 calls provide a clear indication of incident cause / full information on nature of incident

Financial Value captures cost savings and avoidance that may be realized by implementing the defined alternative in comparison to the baseline

VALUE STRUCTURE	Measure Definition	Metrics
Financial: Financial benefits (e.g., cost savings, cost avoidance) realized in the Federal, State, or Local entities or by identified constituent groups		
Cost savings	Cost savings are savings that directly impact budgets/direct expenditures. Examples: Decreased cost of contractor costs, equipment or supplies	▶ Total Cost Savings to Investment
Cost avoidance	Cost avoidance is also known as efficiency/productivity benefits, where an increase in productivity can be measured in dollars, but does not result in a reduction of the budget for the government (agency, department, bureau, etc.). Examples: Staff/Personnel time savings ("Business Area Reinvestment"), Savings to other federal agency or private industry (material, staff time, etc.)	▶ Total Cost Avoidance to Investment

Comparing all Value Measures, the highest priority values for 9-1-1 to realize are Accessibility and Reliability of Service



Indirect benefit opportunities remain significant in comparison to NG9-1-1 costs and will be an area of focus in the final analysis

- ▶ It is critical to consider not only the improvements in performance that will result, but the savings those benefits translate to the greater public
- ▶ Our Value Framework prioritized the key benefit drivers of the NG9-1-1 initiative
 - Direct User benefit of **Accessibility** was deemed the highest priority for NG9-1-1 at 20% of overall priority
 - Direct User benefit of **Reliability** of 9-1-1 was second to accessibility, at 13.6% of overall priority

Accessibility Scenario: Looking at abandoned call statistics, data suggests that 15 percent of calls may be abandoned. In this scenario, assuming that due to NG9-1-1 call overflow capabilities – if only less than .02 of 25% of calls resulted in fatalities that could be avoided by quicker response times, annual savings would be estimated at \$3B

Illustrative

Assumption	Description
200,000,000	Annual 9-1-1 Calls
10%	Estimated Abandoned Calls (Studies indicate range of 6% to 15%*)
20,000,000	Estimated Abandoned Calls
\$ 3,000,000	DOT guidance on Value of a Life
25%	Estimated Calls Abandoned Due to Time to Answer
5,000,000	Estimated Calls Abandoned Due to Time to Answer
.020%	Estimated Fatalities Resulting
1000	Number of Abandoned Calls Resulting in Fatality
\$ 3 B	Estimated Annual Benefit: Abandoned calls now received at PSAP resulting in fatality not occurring

**6% cited in Vermont 2005 data
15% cited in California 2007 Gap Analysis Study*

Percent of Fatalities Resulting from Abandoned Calls

Estimated Abandoned Calls

	0.005%	0.010%	0.020%	0.050%
5%	\$ 150,000,000	\$ 300,000,000	\$ 600,000,000	\$1,500,000,000
10%	\$ 300,000,000	\$ 600,000,000	\$ 1,200,000,000	\$3,000,000,000
15%	\$ 450,000,000	\$ 900,000,000	\$ 1,800,000,000	\$4,500,000,000
25%	\$ 750,000,000	\$ 1,500,000,000	\$ 3,000,000,000	\$7,500,000,000
30%	\$ 900,000,000	\$ 1,800,000,000	\$ 3,600,000,000	\$9,000,000,000

Direct User Benefits were scored on a 1-5 scale for each metric based on a combination of 9-1-1 data and SME input;

Benefit Name	Current Environment	NG9-1-1
	Current Environment Expected	NG9-1-1 Expected
Accessibility		
Overall percent of population with 9-1-1 service	3	5
Number of types of communications devices or services that enable the general public to make a 9-1-1 call (including event devices)	3	5
Number of PSAPs where call takers can receive, process, and transfer 9-1-1 calls to PSAPs (Primary and Secondary) beyond their local system to facilitate correct 9-1-1 call delivery and dispatch.	3	5
Timeliness		
Call set up times (from gateway to (NG) network to PSAP) for call delivery and associated data	3	3
Time to process data at PSAP (ACN, queuing)	3	3
Call taker processing (receive, process, and release call to dispatch)	3	4
User Satisfaction		
Number of complaints with regards to the system in urban (read: measurable) areas, both by callers and by PSAP operators	3	4
Reliability of Service		
Percentage of calls identified by system, but not processed	3	4
Capability of system to route calls appropriately (regardless of path) in times of PSAP evacuation and overload	3	4
Peak workload accommodated by system	3	5
Frequency (or number) of PSAP failures	3	5
Ease of Use		
All incidents are documented and reported appropriately (Y/N?)	3	5
Percent of calls received/distributed with data/information in a standard data format	3	4
Number of discrepancies documented and reported by call takers	3	4

Operational and Foundational Benefits were scored on a 1-5 scale based on a combination of 9-1-1 data and SME input;

Benefit Name	Current Environment	NG9-1-1
	Current Environment Expected	NG9-1-1 Expected
Scalability & Adaptability of System Functionality & Usage		
Level of hardware and software scalability and adaptability in software and additional hardware to address future requirements and demands.	3	4
Carrying capacity (ability of the system to manage increasing margin of calls)	3	5
Information Accuracy		
Ability to validate accuracy of location data received	3	4
Percent of calls misrouted	3	4
Data Management		
How long it takes between point when customer information changes in outside world and when it gets updated in the system	3	3
Operational Efficiency		
Workforce is optimized across the system to ensure that 100% of 9-1-1 calls are answered	3	5
Ability of the call taker to notify and transfer necessary emergency incident information and calls to appropriate emergency responders regardless of which PSAP may initially receive the call.	3	5
System resources are sufficient to receive and forward supplemental data from third party service providers	3	5
Data Sharing		
Number of PSAPs that can receive multiple forms of data from other PSAPs and interface with internal and external databases	3	5
Security and Privacy		
Impermeability of system to unlawful access	3	1
Are there end to end security processes and systems between the 9-1-1 Authorities?	3	2

Strategic and Political Benefits were scored on a 1-5 scale based on a combination of 9-1-1 data and SME input;

Benefit Name	Current Environment	NG9-1-1
	Current Environment Expected	NG9-1-1 Expected
Coordination between 9-1-1 & Other Public Services		
Number of public service agencies with which system interacts	3	5
Alignment of Strategic Goals		
Level of shared vision in the implementation of strategic plans moving forward	3	4
Technology Standards		
Number of systems that are based on open and defined standards	3	4
Consistency and standardization of Laws & Regulations		
Number of states planning or implementing revised 9-1-1 laws, policies and regulations that support or promote interconnected institutional arrangements and architecture	3	4
Coordination Between Domestic PSAPs		
Number of PSAPs able to send and receive 9-1-1 calls, share data, and provide services to another state	3	5
Number of data-sharing/cooperation agreements between PSAPs within each state	3	5
Number of Governance agreements between PSAPs across states	3	5
Coordination Between US PSAPs on an International Basis		
Number of inter-jurisdiction / counties / state agreements for data and resource sharing	3	5
Strategic Use of Resources & Data		
Number of agreements for data and resource sharing between states/counties and Federal/not-for-profit agencies	3	3
Amount of new useful public safety-related data created through sharing of resources	3	4
Coordination with Industry		
Number of agreements for data and resource sharing between states/counties and private companies	3	5

And finally, Indirect and Financial Benefits were scored on a 1-5 scale based on a combination of 9-1-1 data and SME input

Benefit Name	Current Environment	NG9-1-1
	Current Environment Expected	NG9-1-1 Expected
Public Safety		
Number of outreach initiatives to educate the general public on the 9-1-1 system and operations	3	4
Average traffic delay time per incident (incident management capabilities / average time to respond to highway related incidents) - impact will be linked to downstream effects such as secondary accidents, diversion of police resources (etc.)	3	4
Percent of affected-public that can be reached in case of large-scale public emergency	3	4
Safety to Responder		
General level of responder safety	3	3
Efficient Use of Taxpayer Dollars		
Operational efficiencies minimize the funds necessary for 9-1-1 infrastructure investment and maintenance	3	5
Energy & Environment		
Level of pollutants, emissions and fuel consumption based on average delay (based on traffic congestion) for highway incidents	3	4
Hazmat 9-1-1 calls provide a clear indication of incident cause / full information on nature of incident	3	4
Cost Savings		
Total Cost Savings to Investment	3	5
Cost Avoidance		
Total Cost Avoidance to Investment	3	5

Appendices

- ▶ Appendix A: Benefit Details
- ▶ Appendix B: Cost Details
- ▶ Appendix C: Risk Details
- ▶ Appendix D: Acronym List

Cost Element Structure and Data Dictionary

1.0 Program Planning and Research & Development (R&D)

Program Planning and R&D

includes Federal, state, and local Government and Government contractor personnel costs associated with the planning, documentation, research and development work and analysis required for the 9-1-1 program, along with any hardware and software necessary for the design, development, and testing for the ongoing **Proof of Concept** module(s) or other development and testing environments for the defined alternative.

Cost Element Structure: 1.0 Program Planning and R&D

Cost Element Description	
1.0	Program Planning and Research and Development
1.1	Program Planning Personnel
1.2	Research and Development
1.3	Network Operations
1.4	Other Direct Costs

1.0 Program Planning and Research & Development (continued)

- ▶ **1.1 - Program Planning and Personnel: Government & Contractor.** Includes personnel costs associated with the planning at the Federal/state/local levels, including documentation and analyses required for the program; along with any personnel management. Includes Government and contractor program management personnel costs are captured here as well as public outreach and communications activities
 - **Program Planning and Management.** Includes all costs incurred in the business management effort expended by both the Government and contractors in the process of developing, implementing, and integrating the proof of concepts for the purposes of national deployment. Included are costs for administrative planning, organization, direction, coordination and control, and approval actions designed to define and accomplish overall information management objectives. Includes all costs resulting from the responsibility and authority for contractor management, project controls, project planning, and acquisition management. .
 - **Business Process Reengineering.** Includes all costs incurred for business process reengineering during the planning, research & development phase of the project. This category may include any support necessary for reorganization and related workflow coordination.
 - **Outreach and Communications.** Includes all costs dedicated to public outreach through Federal funding, communications across the public safety community, and general public relations across the 9-1-1 community.

1.0 Program Planning and Research & Development (continued)

▶ 1.2 – Research & Development

- **Research & Development Personnel.** Includes support needed for additional required design, development and testing of system at the state level, including technical design and management efforts related to additional POCs or pilot studies. Also includes certification & accreditation (C&A) of applications, licenses and implementation of C&A tools, security testing, security training, and the implementation of authentication / certification capabilities. Includes all processes and procedures to establish security procedures for the proof of concept module(s).
- **R&D Acquisition**
 - **Development Hardware.** Includes acquisition costs of hardware for use during the planning and R&D period. It includes all elements of hardware, such as servers, upgraded CPE / workstations, routers, printers, & miscellaneous equipment, as well as costs for first destination transportation, warranties, and user's manuals. Where appropriate this category may also include the cost for operating systems.
 - **Development Software.** Includes all costs incurred to acquire, lease or modify software necessary during the planning and R&D period. It may include licensing fees and/or the cost of development efforts required to modify or integrate products.

1.0 Program Planning and Research & Development (continued)

- ▶ **1.3 - R&D Network Operations.** Includes the Government costs to maintain the networking communications infrastructure for the Proof of Concept. It also includes telecommunication fees and upgrades to bandwidth, LAN, or WAN.
- ▶ **1.4 - Other Direct Costs.** Includes costs such as facilities, travel, supplies, etc.

2.0 Acquisition and Implementation

Acquisition and Implementation

includes all costs associated once a State or 9-1-1 authority determines it will be moving to a defined alternative. This also includes the full deployment of the defined alternative to end users, managing the organizational change efforts associated with the deployment, and initial training of both end users and the technical support team. It also includes all procurement of hardware and software. Refresh /upgrades to the hardware/software/infrastructure are also included in this element.

Cost Element Structure: 2.0 Acquisition and Implementation

Cost Element Description	
2.0	Acquisition and Implementation
2.1	Implementation Personnel
2.2	Acquisition
2.3	Initial Training
2.4	Travel and ODCs

2.0 Acquisition and Implementation (continued)

- ▶ **2.1 - Implementation Personnel.** Includes personnel costs associated with planning at the State / 9-1-1 Authority level, including documentation, design oversight, and analyses required for the project; along with any personnel management, and acquisition of hardware and software necessary for deployment of the system.
 - **Program Planning and Management.** Includes all costs incurred in the technical and business management effort expended by both the state / local government and potentially contractors in the process of implementation of the defined alternative. Included are costs for technical and administrative planning, organization, direction, coordination and control, assignment of roles and responsibilities, and approval actions designed to define and accomplish overall program management objectives.
 - **Business Process Reengineering.** Includes all costs incurred for business process reengineering during deployment planning and development phase of the project. This category may include any support necessary for reorganization and related workflow coordination.
 - **Change Management.** Change Management personnel will implement new methods and processes, in coordination with the deployment of the next generation system. Change Management consists of personnel that will be communicating with the end user community. These activities include creating training, as well as policy and process documentation.
 - **System Requirements and Design.** Includes any modification or customizations to the system(s) to meet business and technical requirements specific to the domain (state / 9-1-1 authority). Also includes the costs to identify, modify, and develop system interfaces to support the production environment.

2.0 Acquisition and Implementation (continued)

▶ 2.1 - Implementation Personnel (cont.)

- **System Integration & Installation.** Includes installation and integration of the production environment in preparation for testing.
- **Data Conversion.** Includes the costs associated with transferring data to the new system from an existing system or systems. This also includes the cost of preparing, revising, and reproducing drawings, test plans, testing procedures, manuals and other elements of internal documentation to support all aspects of deployment. Includes the costs incurred to build or modify databases to support testing of the system being developed. Also includes the costs of any contracts to collect, analyze, and distribute data required in support of the implementation.
- **Testing and Evaluation.** Includes the costs incurred to obtain or validate relevant data on the performance of the module during deployment. This element includes the detailed planning, conduct, and support of such testing, as well as data reduction and reporting. It also includes all costs associated with the design and production of models and documentation in support of implementation.
- **Security.** Includes the costs to establish the security procedures for the system. This includes establishing user profiles, monitoring access, and managing passwords.

2.0 Acquisition and Implementation (continued)

▶ 2.2 - Acquisition

- **Hardware.** Includes acquisition costs of hardware for implementation and refresh. It includes all elements of hardware, such as servers, upgraded CPE / workstations, routers, printers, & miscellaneous equipment, as well as costs for first destination transportation, warranties, and user's manuals.
- **Software.** Includes all costs incurred to acquire, lease or modify software necessary during the implementation of the defined alternative. It may include licensing fees and/or the cost of development efforts required to modify or integrate products.

▶ 2.3 - Initial Training.

Includes all costs associated with training services, devices, accessories, equipment, facilities, and parts used to facilitate initial training to end users and technical support staff.

▶ 2.4 - Travel and Other Direct Costs.

Includes costs such as facilities, travel, supplies, etc.

3.0 Operations and Maintenance

Cost Element Structure: 3.0 Operations and Maintenance

Operations and Maintenance addresses costs associated with the system cost (operations and administration, PSAP, and database services, and network). It includes costs incurred in providing maintenance and repairs for the system hardware regardless of who has "ownership" of the equipment or responsibility for repair. These costs include hardware and software maintenance expenses, network operations and connectivity, training and recurring costs, as well as the cost of parallel operations for legacy systems.

Cost Element Description	
3.0	Operations and Maintenance
3.1	Hardware
3.2	Software
3.3	O&M Personnel
3.4	Network Operations
3.5	Security
3.6	Recurring Training
3.7	Facilities
3.8	Other Direct Costs

3.0 Operations and Maintenance (continued)

- ▶ **3.1 - Hardware.** This category addresses costs associated with contract and maintenance labor (both corrective and preventive) for the system, PSAP system, and database administration. It includes costs incurred in providing maintenance and repairs for the system hardware regardless of who has "ownership" of the equipment or responsibility for repair. These costs include, but are not limited to, overhaul expenses, programmed maintenance expenses, component repairs, minor facilities modifications and upkeep, support equipment repairs and administrative support required for maintenance operations. Periodic upgrades to the hardware are also included in this element.
- ▶ **3.2 - Software.** Software maintenance costs include recurring maintenance fees as a result of vendor contracts as well as labor to maintain the software and install upgrades and fixes. Periodic upgrades to the software are also included in these elements. Some upgrades are included, as part of a vendor maintenance fee, and other upgrades will be beyond this fee. Licensing costs are also included.
- ▶ **3.3 - O&M Personnel.** Operations and Maintenance Personnel includes all expenditures necessary to maintain and operate the system. The following O&M costs are separated into government and contractor costs: System Costs (Operations and Administration), PSAP management and staff, and Database Management, and 9-1-1 Authority administration management and staff.
- ▶ **3.4 - Network Operations.** Includes all connectivity costs, fees, and charges for 9-1-1 operations.

3.0 Operations and Maintenance (continued)

- ▶ **3.5 - Security.** Includes the costs to support and maintain the security procedures and necessary certifications for the system.
- ▶ **3.6 - Recurring Training.** This element contains all costs associated with ongoing training services, devices, accessories, aids, equipment, facilities, and parts used to facilitate recurring training. Recurring training classes will include refresher courses for existing users, initial training for new users, and training for system upgrades and enhancements.
- ▶ **3.7 - Facilities.** Includes facility costs (lease / building costs / etc.) for PSAP and any administrative support centers for 9-1-1 operations.
- ▶ **3.8 - Travel and Other Direct Costs.** Includes travel, supplies, and other direct costs that are expended to operate and maintain the 9-1-1 environment.

Several key assumptions are made throughout both baseline and NG cost estimates

Global Cost Assumptions

Global Assumptions	Basis	Source
Inflation	2.24%	OMB Circular A-94 Appendix C
Discount Rate	5.1%	Nominal Interest Rate, OMB Circular A-94 Appendix C
Labor Step	5	Average Step
Work Hrs in Year	1776	365 day year assumed
Work Hrs in Month	148.0	365 day year assumed
Fiscal Year Start Month	1	Project assumed to begin Jan 1, 2009
Project Start Year	2009	Project assumed to begin Jan 1, 2009
Cost Year	2009	Project assumed to begin Jan 1, 2009
Lifecycle	20 years	10 years after full operational capability (FOC)
Hardware Maintenance	15%	Annual BAH Estimate
Software Maintenance	20%	Annual BAH Estimate

Baseline segmentation was derived based on population served and the current operating environment at the county level

- ▶ Segments are created by grouping counties based on population and their current level of 9-1-1 service. These profiles will provide a basis from which to estimate the costs, value, and risk of moving to the defined alternatives
- ▶ Our segmentation will also consider the seven states that have state-wide systems and state administration components that are not included in table below
 - State systems are assumed to be Wireless Phase 1 or 2

County Segmentation for Cost Profile Development*

	1 RCF	2 Basic	3 E-9-1-1	4	5 Wireless**	6	7	8 Total
Less than 50,000	98	114	304		1684			2200
50,001 to 250,000	0	2	62		588			650
250,001 to 1,000,000	0	0	4		175			175
More than 1,000,000	0	0	2		25			25
Total	98	116	366		2472			3052***

*For the purpose of this analysis, it is assumed that a county is equivalent to a 9-1-1 Authority

**Includes Phase I and Phase II as well as counties that have started wireless deployments as of 7/7/07

***Does not include counties participating in state-wide systems

Source: Wireless Deployment Profile, www.nena.org

Segment 1 Costs and Assumptions: Remote Call Forwarding (no local 9-1-1 service), Population Served of less than 50,000

Baseline Segment 1 Annual Estimated Costs and Assumptions

RCF		SEGMENT 1			
Annual Recurring Costs		RCF serving population less than 50,000			
		PSAP	Database	9-1-1 Authority	Total
3.0 Operations and Maintenance					
3.1	Hardware	\$0			\$0
3.2	Software	\$0			\$0
3.3	Operations and Maintenance Personnel	\$1,200			\$1,200
3.4	Network Operations	\$150			\$150
3.5	Security	\$0			\$0
3.6	Recurring Training	\$500			\$500
3.7	Facilities	\$0			\$0
3.8	Travel and Other Direct Costs	\$0			\$0
Total		\$1,850	\$0	\$0	\$1,850

Cost Assumptions	
Calls per day	2
Duration of calls	10 minutes
Total time on phone in one year	120 hours
Cost per hour of calls	\$10
Cost of phone line per month	\$12.50
Cost of staff training per year	\$500
Cost of Labor per hour	\$10

Segment 2: Basic 9-1-1 Service (no wireless), Population Served of less than 50,000

Baseline Segment 2 Annual Estimated Costs and Assumptions

E911 Basic		SEGMENT 2			
Annual Recurring Costs		Basic serving population less than 50,000			
		PSAP	Database	9-1-1 Authority	Total
3.0 Operations and Maintenance					
3.1	Hardware	\$3,000			\$3,000
3.2	Software	\$0			\$0
3.3	Operations and Maintenance Personnel	\$75,000		\$50,000	\$125,000
3.4	Network Operations	\$1,440			\$1,440
3.5	Security	\$0			\$0
3.6	Recurring Training	\$1,250		\$500	\$1,750
3.7	Facilities	\$9,000		\$1,500	\$10,500
3.8	Travel and Other Direct Costs	\$1,000		\$1,000	\$2,000
Total		\$90,690		\$53,000	\$143,690

Cost Assumptions			
CPE Costs (includes both hardware & software) per month	\$250	Number of Trunks needed	2
Number of telecommunicators	5	Cost of trunks per month	\$60
Salary of telecommunicators per year	\$30,000	Training Costs per telecommunicator per year	\$250
Time devoted by each telecommunicator to 9-1-1 only	0.5	Facility Costs per square foot	\$15
Number of FTE 9-1-1 Coordinators needed	1	Facility Size for telecom. Office	600 sq. ft
Salary of 9-1-1 Coordinator per year	\$50,000	Facility Size for Coord. Office	100 sq. ft

Segment 3 Costs: E-9-1-1 Phase 0 (Some wireless capability installed), Population Served of less than 50,000

Baseline Segment Three Annual Estimated Costs and Assumptions

E911 Phase 0		SEGMENT 3			
Annual Recurring Costs		E-9-1-1 serving population less than 50,000			
		PSAP	Database	9-1-1 Authority	Total
3.0 Operations and Maintenance					
3.1	Hardware	\$16,800	\$6,000	\$1,200	\$24,000
3.2	Software	\$1,200	\$600	\$1,200	\$3,000
3.3	Operations and Maintenance Personnel	\$210,000	\$40,000	\$50,000	\$300,000
3.4	Network Operations	\$3,120			\$3,120
3.5	Security	\$0			\$0
3.6	Recurring Training	\$3,500	\$1,000	\$500	\$5,000
3.7	Facilities	\$9,000	\$1,500	\$1,500	\$12,000
3.8	Travel and Other Direct Costs	\$2,000	\$1,000	\$1,000	\$4,000
Total		\$245,620	\$50,100	\$55,400	\$351,120

Segment 3 Assumptions: E-9-1-1 Phase 0 (Some wireless capability installed), Population Served of less than 50,000

Baseline Segment 3 Assumptions

Cost Assumptions			
Number of call taker positions	2	Number of FTE 9-1-1 Coordinator	1
Cost of CPE hardware and software (includes recording & other equipment)	\$700	Salary of 9-1-1 Coordinator	\$50,000
Database hardware costs per month	\$500	Number of trunks	2
9-1-1 Authority hardware costs per month	\$100	Cost of trunks plus ALI and network monitoring/maintenance costs per month	\$260
9-1-1 Authority software costs per month	\$100	Training costs per telecommunicator per year	\$500
Number of telecommunicators	7	Facility cost per square foot	\$15
Telecommunicator annual salary	\$30,000	Facility size for telecommunications office	600 Sq. ft.
Database Managers (number of FTE)	1	Facility size for coordinator office	100 Sq. ft.
Database Manager annual salary	\$40,000		

Segment 4 Costs: E9-1-1 Basic (some wireless capability installed), Population Served between 50,001 and 250,000

Baseline Segment 4 Annual Estimated Costs

E911 Basic		SEGMENT 4			
Annual Recurring Costs		E-9-1-1 serving population 50,001 to 250,000			
		PSAP	Database	9-1-1 Authority	Total
3.0 Operations and Maintenance					
3.1	Hardware	\$42,000	\$6,000	\$2,400	\$50,400
3.2	Software	\$3,000	\$600	\$2,400	\$6,000
3.3	Operations and Maintenance Personnel	\$430,000	\$60,000	\$80,000	\$570,000
3.4	Network Operations	\$4,560		\$2,400	\$6,960
3.5	Security	\$0			\$0
3.6	Recurring Training	\$7,000	\$1,500	\$500	\$9,000
3.7	Facilities	\$30,000	\$2,250	\$1,500	\$33,750
3.8	Travel and Other Direct Costs	\$5,000	\$1,500	\$1,000	\$7,500
Total		\$521,560	\$71,850	\$90,200	\$683,610

Segment 4 Assumptions: E9-1-1 Basic (some wireless capability installed), Population Served between 50,001 and 250,000

Baseline Segment 4 Assumptions

Cost Assumptions					
Number of call taker positions	5	Telecommunicator annual salary	\$30,000	Number of trunks	3
Cost of CPE hardware, software (includes recording & other equipment) per month	\$700	Telecommunicator supervisors	2	Cost of trunks plus ALI and network monitoring/maintenance costs per month	\$260
Number of 911 Authority staff positions	2	Telecommunicator supervisor annual salary	\$35,000	Network costs at 9-1-1 Authority per month	\$200
9-1-1 Authority hardware costs per month (per staff member)	\$100	Database Managers (FTE)	1.5	Training costs per telecommunicator & supervisor per year	\$500
9-1-1 Authority software costs per month (per staff member)	\$100	Database Manager annual salary	\$40,000	Facility costs per square foot	\$15
PSAP software costs per call taker position per month	\$50	9-1-1 Coordinators (FTE)	1	Facility size for telecommunicator. office	2000 sq. ft.
Hardware costs for database per month	\$500	9-1-1 Coordinator annual salary	\$50,000	Facility size for Database Office	150 sq. ft.
Database software costs per month	\$50	9-1-1 Coordinator Admin (FTE)	1	Facility Size for Coordinator Office	100 sq. ft.
Number of telecommunicators	12	9-1-1 Coordinator Admin annual salary	\$30,000		

Segment 5 Costs: E9-1-1 Phases I & II (full wireless capability installed), Population Served of less than 50,000

Baseline Segment 5 Annual Estimated Costs

* E9-1-1 Phases I or II		SEGMENT 5			
Annual Recurring Costs		Wireless serving population less than 50,000			
		PSAP	Database	9-1-1 Authority	Total
3.0 Operations and Maintenance					
3.1	Hardware	\$24,000	\$12,000	\$1,200	\$37,200
3.2	Software	\$1,800	\$3,000	\$1,200	\$6,000
3.3	Operations and Maintenance Personnel	\$210,000	\$40,000	\$50,000	\$300,000
3.4	Network Operations	\$3,120			\$3,120
3.5	Security	\$0			\$0
3.6	Recurring Training	\$5,250	\$2,000	\$500	\$7,750
3.7	Facilities	\$9,000	\$1,500	\$1,500	\$12,000
3.8	Travel and Other Direct Costs	\$2,000	\$1,000	\$1,000	\$4,000
Total		\$255,170	\$59,500	\$55,400	\$370,070

Segment 5 Assumptions: E9-1-1 Phases I & II (full wireless capability installed), Population Served of less than 50,000

Baseline Segment 5 Assumptions

Cost Assumptions					
Number of call taker positions	2	9-1-1 Auth Software costs per person	\$100	Number of trunks	2
Cost of CPE Hardware, Software (now includes recording & other equipment) and GIS functionality per month	\$1,000	Number of Telecommunicators	7	Cost of trunks plus ALL and network monitoring/maintenance costs per month	\$260
Database hardware costs per month	\$1,000	Telecommunicator annual salary	\$30,000	Network costs at 9-1-1 Authority Level per month	\$200
Number of 911 Authority staff positions	2	Database Manager (FTE)	1	Training costs per telecommunicator and supervisor	\$750
9-1-1 Authority hardware costs per month per staff member	\$100	Database Manager annual salary	\$40,000	Facility costs per square foot	\$15
PSAP software costs per position per month	\$75	9-1-1 Coordinators (FTE)	1	Facility size for telecommunicator office	600 sq. ft
Database software costs per month	\$250	9-1-1 Coordinator annual salary	\$50,000	Facility size for coordinator office	100 sq. ft.

Segment 6 Costs: E9-1-1 Phases I & II (full wireless capability installed), Population Served between 50,001 to 250,000

Baseline Segment 6 Annual Estimated Costs

* E9-1-1 Phases I or II		SEGMENT 6			
Annual Recurring Costs		Wireless 9-1-1 serving population 50,001 to 250,000			
		PSAP	Database	9-1-1 Authority	Total
3.0 Operations and Maintenance					
3.1	Hardware	\$60,000	\$18,000	\$2,400	\$80,400
3.2	Software	\$4,500	\$4,200	\$2,400	\$11,100
3.3	Operations and Maintenance Personnel	\$430,000	\$60,000	\$80,000	\$570,000
3.4	Network Operations	\$4,560		\$2,400	\$6,960
3.5	Security	\$0			\$0
3.6	Recurring Training	\$9,000	\$2,000	\$500	\$11,500
3.7	Facilities	\$30,000	\$2,250	\$2,250	\$34,500
3.8	Travel and Other Direct Costs	\$5,000	\$1,500	\$1,000	\$7,500
Total		\$543,060	\$87,950	\$90,950	\$721,960

Segment 6 Assumptions: E9-1-1 Phases I & II (full wireless capability installed), Population Served between 50,001 to 250,000

Baseline Segment 6 Assumptions

Cost Assumptions					
Number of call taker positions	5	Telecommunicator annual salary	\$30,000	Number of trunks	3
Cost of CPE Hardware, Software (now includes recording & other equipment) per month	\$1,000	Number of telecommunicator supervisors	2	Cost of Trunks plus ALI and network monitoring/maintenance costs per month	\$260
Database hardware costs per month	\$1,500	Telecommunicator supervisor salary per year	\$35,000	Network costs at 9-1-1 Authority level per month	\$200
911 Authority Staff positions	2	Database Managers (FTE)	1.5	Training costs for telecommunicator and supervisor per year	\$750
9-1-1 Authority hardware costs per month per staff member	\$100	Database Manager annual salary	\$40,000	Facility costs per square foot	\$15
PSAP software costs per position per month	\$75	9-1-1 Coordinators (FTE)	1	Facility size for telecommunicator office	2000 sq. ft.
Database software costs per month	\$350	9-1-1 Coordinator annual salary	\$50,000	Facility size for database office	150 sq. ft
9-1-1 Authority software costs per person	\$100	Number of 9-1-1 Coordinator Administrators	1	Facility size for coordinator office	150 sq. ft
Number of telecommunicators	12	9-1-1 Coordinator Admin annual salary	\$30,000		

Segment 7 Costs: E9-1-1 Phases I & II (full wireless capability installed), Population Served between 250,001 to 1,000,000

Baseline Segment 7 Annual Estimated Costs

* E9-1-1 Phases I or II		SEGMENT 7			
Annual Recurring Costs		Wireless serving population 250,001 to 1,000,000			
		PSAP	Database	9-1-1 Authority	Total
3.0 Operations and Maintenance					
3.1	Hardware	\$120,000	\$20,000	\$3,600	\$143,600
3.2	Software	\$9,000	\$5,000	\$3,600	\$17,600
3.3	Operations and Maintenance Personnel	\$1,100,000	\$80,000	\$165,000	\$1,345,000
3.4	Network Operations	\$10,000		\$4,800	\$14,800
3.5	Security	\$0			\$0
3.6	Recurring Training	\$26,250	\$2,500	\$1,000	\$29,750
3.7	Facilities	\$90,000	\$3,000	\$7,500	\$100,500
3.8	Travel and Other Direct Costs	\$7,000	\$2,000	\$2,000	\$11,000
Total		\$1,362,250	\$112,500	\$187,500	\$1,662,250

Segment 7 Assumptions: E9-1-1 Phases I & II, Population Served between 250,001 to 1,000,000

Baseline Segment 7 Assumptions

Cost Assumptions					
Number of Call Taker positions	10	Telecommunicator annual salary	\$30,000	Deputy Coordinator annual salary	\$60,000
Cost of CPE Hardware, Software (now includes recording & other equipment) per month	\$1,000	Telecommunicator Supervisors	4	9-1-1 Coordinator Admin (FTE)	1
Database hardware costs per month	\$1,667	Telecommunicator Supervisor annual salary	\$35,000	9-1-1 Coordinator Admin annual salary	\$30,000
Number of 911 Authority Staff positions	3	Telecom center managers (FTE)	1	Number of trunks	10
9-1-1 Authority hardware costs per month per staff member	\$100	Telecom Center Manager annual salary	\$60,000	Cost of trunks per month	\$60
PSAP software costs per position per month	\$75	Database Managers (FTE)	2	ALI and network maintenance costs per year	\$2,800
Database software costs per month	\$417	Database Manager annual salary	\$40,000	Network Costs at 9-1-1 Auth. Level per month	\$400
9-1-1 Authority software costs per person per month	\$100	9-1-1 Coordinator (FTE)	1	Training Costs per Telecommunicator, Supervisor, & Ctr. Mgr per year	\$750
Number of telecommunicators	30	9-1-1 Coordinator annual salary	\$75,000	Facility costs per square foot	\$15
Number of call taker positions	10	Deputy Coordinators (FTE)	1	Facility size for telecom. Office	6000
Facility size for database office	200 sq. ft.	Facility Size for Coordinator Office	500 sq. ft.		

Segment 8 Costs: E9-1-1 Phases I & II, Population Served above 1,000,000

Baseline Segment 8 Annual Estimated Costs

* E9-1-1 Phases I or II		SEGMENT 8			
Annual Recurring Costs		Wireless 9-1-1 serving population more than 1,000,001			
		PSAP	Database	9-1-1 Authority	Total
3.0 Operations and Maintenance					
3.1	Hardware	\$360,000	\$25,000	\$3,600	\$388,600
3.2	Software	\$27,000	\$7,000	\$3,600	\$37,600
3.3	Operations and Maintenance Personnel	\$3,280,000	\$120,000	\$165,000	\$3,565,000
3.4	Network Operations	\$21,600		\$4,800	\$26,400
3.5	Security	\$0			\$0
3.6	Recurring Training	\$75,000	\$3,000	\$1,000	\$79,000
3.7	Facilities	\$300,000	\$4,500	\$7,500	\$312,000
3.8	Travel and Other Direct Costs	\$15,000	\$2,500	\$2,000	\$19,500
Total		\$4,078,600	\$162,000	\$187,500	\$4,428,100

Segment 8 Assumptions: E9-1-1 Phases I & II (full wireless capability installed), Population Served above 1,000,000

Baseline Segment 8 Assumptions

Cost Assumptions					
Number of call taker positions	30	Telecommunicator Supervisor annual salary	\$35,000	Number of trunks	30
Cost of CPE hardware, software (now includes recording & other equipment) per month	\$1,000	Number of Telecom Center Managers	1	Cost of trunks per month	\$60
Database hardware costs per month	\$2,083	Telecom Center Manager annual salary	\$70,000	ALI and network maintenance costs per year	\$2,800
Number of 911 Authority Staff positions	3	Database Managers (FTE)	3	Network costs at 9-1-1 Auth. Level per month	\$400
9-1-1 Authority hardware costs per month per staff member	\$100	Database Manager annual salary	\$40,000	Training costs per Telecommunicator, Supervisor, & Ctr. Mgr per year	\$750
PSAP software Costs per position	\$75	9-1-1 Coordinators (FTE)	1	Facility costs per square foot	\$15
Database software costs per month	\$583	9-1-1 Coordinators annual salary	\$75,000	Facility size for telecom. Office	20000 sq. ft
9-1-1 Auth software costs per person per month	\$100	Deputy Coordinators (FTE)	1	Facility size for Database Office	300 sq. ft
Number of telecommunicators	100	Deputy Coordinator annual salary	\$60,000	Facility size for Coordinator Office	500 sq. ft
Telecommunicator annual salary	\$30,000	9-1-1 Coordinator Admin (FTE)	1		
Telecommunicator Supervisors	6	9-1-1 Coord. Admin annual salary	\$30,000		

Statewide Systems: Costs and Relevant Assumptions

▶ 7 states incur costs on a Statewide network basis:

- Total State 1 Costs: **\$14,636,239** (Population Served: 853,476)
 - Total State 2 Costs: **\$20,589,018** (Population Served: 1,321,574)
 - Total State 3 Costs: **\$29,220,219** (Population Served: 3,510,897)
 - Total State 4 Costs: **\$144,428,405** (Population Served: 6,437,000)
 - Total State 5 Costs: **\$20,484,965** (Population Served: 1,314,895)
 - Total State 6 Costs: **\$10,699,383** (Population Served: 623,908)
 - Total State 7 Costs: **\$4,750,946** (Population Served: 1,067,610)
- ▶ Est. total State-wide system costs: **\$244,809,174**

- ▶ As state data was gathered on a first-hand basis, only two basic assumptions were needed in calculating total state system costs
- ▶ 1. As data was unavailable for states 5 & 6, their total costs were estimated based on their population served and the costs of the system closest in nature to theirs
- ▶ 2. For all states but number 4, local authorities hire and train PSAP personnel, not state authorities. Therefore, personnel costs for these states were estimated based on the population served per county and the staffing costs estimated in the appropriate county segment

Many states have a state program coordinator's office to oversee inter-PSAP and inter-State activities

- ▶ 38 States have offices that manage inter-PSAP and inter-state 9-1-1 issues
- ▶ States that have a full state-system cost estimate are excluded from our calculations here (these costs are accounted for in the State-wide system cost estimates)
- ▶ Each State is assumed to have the following state-wide staff to manage these affairs:

Staff	Loaded Annual Salary 2007*
State Coordinator	\$63,068
Database Technician	\$44,922
Technical Manager	\$61,078
Administrative Staff	\$30,000
Cost per State	\$199,068

- ▶ Facility costs and overhead are assumed to be split with other state offices and therefore are insignificant for the purposes of our analysis
- ▶ Therefore, the total cost, nation-wide, of 9-1-1 State Program Coordination amounts to **\$6,171,114 per annum**

**Salary Data drawn from "NENA 2005 SWAT Analysis". Escalated at OMB annual salary inflation rate of 3.4%, state level staff are assumed to be full time*

Leveraging benchmarks to arrive at a capital cost estimate, total annual costs are estimated at \$2.2B

9-1-1 Baseline Operating Environment Total Annual Cost Estimate
(\$000)

Segment	Individual Segment Cost	Number of Segments	Annual Capital Costs	Annual Recurring Costs	Total Annual Cost
1	\$1850	98	\$36,260.00	\$181,300	\$217,560
2	\$143,690	114	\$3,276,132.00	\$16,380,660	\$19,656,792
3	\$351,840	304	\$21,391,872.00	\$106,959,360	\$128,351,232
4	\$683,610	62	\$8,476,764.00	\$42,383,820	\$50,860,584
5	\$370,790	1684	\$124,882,072.00	\$624,410,360	\$749,292,432
6	\$723,460	588	\$85,078,896.00	\$425,394,480	\$510,473,376
7	\$1,662,250	175	\$58,178,750.00	\$290,893,750	\$349,072,500
8	\$4,430,900	25	\$22,154,500.00	\$110,772,500	\$132,927,000
Total	\$529,975	3052	\$323,475,246.00	\$1,617,376,230	\$1,940,851,476
State 1	\$14,636,239	1	\$2,927,247.80	\$14,636,239	\$17,563,487
State 2	\$20,589,018	1	\$4,117,803.60	\$20,589,018	\$24,706,822
State 3	\$29,220,219	1	\$5,844,043.80	\$29,220,219	\$35,064,263
State 4	\$144,428,405	1	\$28,885,681.00	\$144,428,405	\$173,314,086
State 5	\$20,484,965	1	\$4,096,992.95	\$20,484,965	\$24,581,958
State 6	\$6,723,790	1	\$1,344,758.00	\$6,723,790	\$8,068,548
State 7	\$4,750,946	1	\$950,189.11	\$4,750,946	\$5,701,135
Total	\$240,833,581	7	\$48,166,716.27	\$240,833,581	\$289,000,298
State Program*	\$199,068	31	\$1,049,089.44	\$6,171,114	\$7,220,204
Grand Total:					\$2,237,257,111

The adjustment to the Baseline Upper cost estimate was derived by using a 2004 industry estimate and adjusting it for inflation

Baseline Upper Premium Calculations			
Industry Estimate (2004\$)	Baseline Profile Est. (2007\$)		
\$14.46	\$11.18		
Year	Inflation Rate*		
2005	3.39%		
2006	3.24%		
2007	2.74%		
RESULTS of ADJUSTMENT			
Industry Estimate Adjusted Rate (2007\$)			
\$15.86			
Year	Escalation Rate	Adj. Estimate	Cost Diff between Profile Est. and Industry Est. (%)
	Factor		
2005	103.39%	\$14.95	-41.84%
2006	103.24%	\$15.43	
2007	102.74%	\$15.86	

*http://www.inflationdata.com/inflation/inflation_rate/HistoricalInflation.aspx

Cost estimating relationships (CERs) were used for the estimation of planning, implementation and recurring costs

Cost Estimating Relationships

Assumptions	CES Link	Benchmark / CER	Source
2.0 Implementation Costs (% of equipment costs)			
Project Management	Program Planning and Management	26%	BAH IC
Engineering	Systems Requirements and Design	39%	BAH IC
Staging	Systems Integration and Installation	2%	BAH IC
Installation	Systems Integration and Installation	10%	BAH IC
Certification and Accreditation	Security	15%	BAH IC
Training	Training	3%	BAH IC
3.0 Recurring Costs (% of equipment costs)			
System Engineering	O&M Personnel	5%	ACEIT CER Library
Program Management	O&M Personnel	5%	ACEIT CER Library
System Test & Evaluation	O&M Personnel	3%	ACEIT CER Library
Training	Training	1%	ACEIT CER Library
Data	O&M Personnel	1%	ACEIT CER Library
Support Equipment	Hardware	1%	ACEIT CER Library
Spares	Hardware	1%	ACEIT CER Library
1.0 Planning Cost as % of acquisition costs		10%	BAH SME Input

PSAP Unit Acquisition and Operating Profile

PSAP Unit Acquisition and Operating Profile

Architecture Component	Description	Units	Estimated Unit Cost	Acquisition Cost (Point)	Implementation Cost	Refresh Schedule
PSAP Unit (320 Call Takers)						
Hardware				\$ 2,295,108	\$ 2,180,353	
NG9-1-1 BCF	Firewall	2	\$ 40,000	\$ 80,000	\$ 76,000	5 year
	IPS	2	\$ 25,000	\$ 50,000	\$ 47,500	5 year
PSAP IP Routing Function	Router	1	\$ 25,000	\$ 25,000	\$ 23,750	5 year
PSAP IP ACD	IP-ACD	12	\$ 16,242	\$ 194,904	\$ 185,159	10 year
NG9-1-1 Call Termination	Workstations (with HMI)	32	\$ 55,000	\$ 1,760,000	\$ 1,672,000	10 year
	Peripherals	1	\$ 20,000	\$ 20,000	\$ 19,000	5 year
GIS	Server	12	\$ 13,767	\$ 165,204	\$ 156,944	5 year
Software				\$ 56,340	\$ 53,523	
PSAP IP ACD	ACD Software	12	\$ 1,840	\$ 22,080	\$ 20,976	
NG9-1-1 Call Termination	HMI (bundled in CPE)	0	\$ -	\$ -	\$ -	
GIS	GIS Software	12	\$ 2,855	\$ 34,260	\$ 32,547	
Total PSAP Unit Estimate				\$ 2,351,448	\$ 2,233,876	

NG9-1-1 Additional Considerations

- ▶ For the purpose of this analysis, labor and facilities remain constant to the baseline in the NG9-1-1 scenarios
- ▶ In addition to leveraging the CERs defined, Change Management / Outreach and Communications were estimated for planning and implementation

PSAP Unit Change Management / Outreach Estimate

Change Management / Outreach	People	% of Time	Months	FTE	Cost per FTE	Total Cost
Planning						\$33,666
Contractor	2	100%	2	0.2	\$ 81,995	\$13,666
Government	2	50%	2	0.1	\$ 240,000	\$20,000
Implementation						\$33,666
Contractor	2	100%	2	0.2	\$ 81,995	\$33,666
Government	2	50%	2	0.1	\$ 240,000	\$20,000

Data Services Acquisition and Operating Profile

Data Services Acquisition and Operating Profile

Architecture Component	Description	Units	Estimated Unit Cost	Acquisition Cost (Point)	Implementation Cost	Refresh Schedule
Data Services (Serving 10 PSAP Units)						
Hardware				\$2,880,000	\$2,736,000	
Database Management System	Storage Area Network	2	\$ 500,000	\$ 1,000,000	\$ 950,000	
	Peripherals	1	\$ 200,000	\$ 200,000	\$ 190,000	
	Internal Networking Switch	8	\$ 150,000	\$ 1,200,000	\$ 1,140,000	
Databases	Servers	16	\$ 30,000	\$ 480,000	\$ 456,000	
Software				\$320,000	\$304,000	
Database Applications	RDBMS	16	\$ 20,000	\$ 320,000	\$ 304,000	
	0					
Total Data Services				\$ 3,200,000	\$ 3,040,000	

Data Services and Network staff and facility costs were estimated based on SME input

Data Services FTE Summary

Staff Positions	FTE	Loaded Salary Estimate	Total Costs
Network engineers**	6	\$ 117,579	\$ 705,474
Applications engineers	6	\$ 96,330	\$ 577,981
Database administrators	6	\$ 96,330	\$ 577,981
System Administrators	6	\$ 96,330	\$ 577,981
Security Engineers	6	\$ 96,330	\$ 577,981
Other	6	\$ 81,995	\$ 491,967
Total			\$ 3,509,365

Data Services Facility Cost Summary

	Low	Expected	High
Space Required (Sq Ft)	400	500	700
Cost per Square Foot	\$21.84	\$24.57	\$29.80
Cost per Data Center	\$8,736	\$9,828	\$11,920
	\$10,920	\$12,285	\$14,900
	\$15,288	\$17,199	\$20,860
Total Cost	\$873,600	\$982,800	\$1,192,000
	\$1,092,000	\$1,228,500	\$1,490,000
	\$1,528,800	\$1,719,900	\$2,086,000

Network Acquisition and Operating Profile

Network Acquisition and Operating Profile

Architecture Component	Description	Units	Estimated Unit Cost	Acquisition Cost (Point)	Implementation Cost	Refresh Schedule
Network (Serving 10 PSAP Units)						
Hardware				\$ 3,501,037	\$ 3,325,985	
Selective Router Gateway	Gateway	5	\$ 12,500	\$ 62,500	\$ 59,375	
Legacy PSAP Gateway	Gateway	5	\$ 12,500	\$ 62,500	\$ 59,375	
Legacy Responder Gateway	Gateway	5	\$ 12,500	\$ 62,500	\$ 59,375	
Legacy Data Gateway	Gateway	5	\$ 12,500	\$ 62,500	\$ 59,375	
IP Network BCF	Firewall	16	\$ 40,000	\$ 640,000	\$ 608,000	
	Intrusion Prevention system	16	\$ 25,000	\$ 400,000	\$ 380,000	
ESRP	Server	2	\$ 27,611	\$ 55,221	\$ 52,460	
NG9-1-1 IP Routing Function	Router	8	\$ 50,000	\$ 400,000	\$ 380,000	
	Switch	8	\$ 20,000	\$ 160,000	\$ 152,000	
IP ACD	ACD	1	\$ 650,000	\$ 650,000	\$ 617,500	
Call Record /Conference	Call Server	24	\$ 13,767	\$ 330,408	\$ 313,888	
	Conferencing Server	24	\$ 13,767	\$ 330,408	\$ 313,888	
	Call Recording	1	\$ 45,000	\$ 45,000	\$ 42,750	
Network Management Servers	Servers	8	\$ 30,000	\$ 240,000	\$ 228,000	
Software				\$ 326,296	\$ 309,982	
ESRP		1	\$ 26,296	\$ 26,296	\$ 24,982	
IP ACD	IP ACD SW Bundled with HW	0	0	0	-	
Network Management Software	Network Management System	2	\$ 150,000	\$ 300,000	\$ 285,000	
Call Record	Bundled with Hardware (abov	0	\$ -	\$ -	\$ -	
Total Network				\$ 3,827,333	\$ 3,635,967	

Network connectivity costs were estimated based on connectivity averages over a range of sample distances and locations

Network Price Range Sensitivity			Marginal Cost		
From:	To:	Distance:	Vendor 1	Vendor 2	Vendor 3
Phoenix, AZ	Paradise Valley, AZ	7 Miles	\$1,669.20	\$1,454.04	\$2,144.28
Arlington, VA	Vienna, VA	9 Miles	\$1,689.00	\$1,460.88	\$2,086.56
Tallahasee, FL	Havana, FL	11 Miles	\$1,705.20	\$1,454.04	\$2,600.16
Lincoln, NE	Crete, NE	20 Miles	\$1,669.20	\$1,454.04	\$2,054.40
Denver, CO	Longmont, CO	27 Miles	\$1,733.88	\$1,509.48	\$2,208.48
Chicago, IL	Libertyville, IL	32 Miles	\$1,701.60	\$1,509.48	\$2,259.84
Washington, DC	Baltimore, MD	36 Miles	\$1,732.08	\$1,534.92	\$2,279.16
Tallahasee, FL	Madison, FL	54 Miles	\$1,669.20	\$1,454.04	\$2,080.08
Baltimore, MD	Wilmington, DE	64 Miles	\$1,784.28	\$2,181.72	\$2,471.76
Phoenix, AZ	Congress, AZ	64 Miles	\$1,791.48	\$1,539.48	\$2,542.32
Chicago, IL	Milwaukee, WI	82 Miles	\$1,814.76	\$2,226.12	\$2,561.64
Lincoln, NE	Grand Island, NE	89 Miles	\$1,825.56	\$2,243.76	\$2,606.52
Washington, DC	Wilmington, DE	95 Miles	\$1,845.36	\$2,279.28	\$2,690.04
Average		45 Miles	Per month Avg: \$1,741	\$1,715	\$2,353
			Yearly Avg: \$20,890	\$20,586	\$28,233

Source: Networx Unit Pricer
<https://networx.gov/unit/#>

Data Range:	Lo	Med.	Hi
	\$20,586	\$23,236.10	\$28,232.53

Uncertainty Analysis

- ▶ Based on AACE International Cost Estimating Guidance
- ▶ Order of Magnitude estimates where project is defined as the *Concept Screening* phase
 - Low end range of -15% to -30%
 - High end range of +2% to +50%
- ▶ For uncertainty analysis, a **-25% to +50%** range was applied to the following factors
 - Personnel Salaries (Current and NG environments)
 - NG9-1-1 Hardware
 - NG9-1-1 Software
- ▶ 1000 trials / iterations were run to arrive at the defined resultant ranges

In order to highlight potential changes in key costs, uncertainty analysis was conducted on a number of cost drivers

Baseline Segment Costs – Uncertainty Range Midpoints

Cost Per Unit Assumptions	
Baseline	Mid Value
Segment Costs	
All segments - Salary of Telecommunicators/year	\$30,000
Segments 2,3,4,5,6 - 9-1-1 Coord. Salary/year	\$50,000
All segments - Database Mgr. Salary/year	\$40,000
Segs. 4, 6, 7, 8 - Telecom. Supervisor Salary/year	\$35,000
Segs. 4, 6, 7, 8 - 911 Coord. Admin Salary/year	\$30,000
Seg. 7 - Telecom. Ctr. Manager Salary/year	\$60,000
Seg. 8 - Telecom Ctr. Manager Salary/year	\$70,000
Segs. 7, 8 - 911 Coord. Salary/year	\$75,000
Segs. 7,8 - Deputy 911 Coord. Salary/year	\$60,000

Uncertainty analysis: NG Alternative

Next Generation Acquisition Costs – Uncertainty Range Midpoints

Cost Per Unit Assumptions	Mid Value	Cost Per Unit Assumptions	Mid Value
Next Generation Costs		Next Generation Costs	
PSAP - HW		Network - HW	
Firewall	\$ 80,000	Gateway	\$ 62,500
IPS	\$ 50,000	Gateway	\$ 62,500
Router	\$ 25,000	Gateway	\$ 62,500
IP-ACD	\$ 194,904	Gateway	\$ 62,500
Workstations -- Includes Human Mission Interface Software	\$ 1,760,000	Firewall	\$ 640,000
Peripherals	\$ 20,000	Intrusion Prevention system	\$ 400,000
Server	\$ 165,204	Server	\$ 55,221
PSAP - SW		Router	\$ 400,000
IPACD	\$ 1,840	Switch	\$ 160,000
GIS Software	\$ 34,260	ACD	\$ 650,000
Data Services - HW		Call Server	\$ 330,408
Storage Area Network	\$ 1,000,000	Conferencing Server	\$ 330,408
Peripherals	\$ 200,000	Call Recording	\$ 45,000
Internal Networking Switch	\$ 1,200,000	Servers	\$ 240,000
Servers (EPAD, LoST, Business Rules, Call Record, Data Rights)	\$ 480,000	Network - SW	
Database - SW		ESRP	\$ 26,296
RDMBS	\$ 320,000	Network Management	\$ 300,000
		PSAP Network Connectivity Costs per year (all PSAPs)	\$278,833.18
		Data Services Network Connectivity Costs per year (all Data Centers)	\$23,236.10
		Data/Network Planning Costs per 10 units	\$ 702,733
		PSAP Planning Costs per Unit	\$ 233,121
		Data Services - Facilities	\$ 12,285

Uncertainty analysis: NG Alternative

Next Generation PSAP Implementation and Recurring Service Costs – Uncertainty Range Midpoints

Cost Per Unit Assumptions	
Next Generation Cost Type	Mid Value
PSAP Initial Service Costs (% of equipment costs)	
Project Management - PSAP	\$ 601,717
Engineering - PSAP	\$ 918,176
Staging - PSAP	\$ 50,310
Installation - PSAP	\$ 237,927
Training - PSAP	\$ 70,743
C&A - PSAP	\$ 344,749
PSAP Recurring Service Costs (% of cumulative equip costs)	
System Engineering - PSAP	\$ 116,560
Program Management - PSAP	\$ 116,560
System Test & Evaluation - PSAP	\$ 58,280
Training - PSAP	\$ 23,312
Data - PSAP	\$ 23,312
Support Equipment - PSAP	\$ 23,312
Spares - PSAP	\$ 23,312

Uncertainty analysis: NG Alternative

Next Generation Data and Network Implementation and Recurring Training Costs – Uncertainty Range Midpoints

Cost Per Unit Assumptions	
Next Generation Costs	Mid Value
Data Initial Service Costs (% of equipment costs)	
Project Management - Data	\$ 825,965
Engineering - Data	\$ 1,260,361
Staging - Data	\$ 69,059
Installation - Data	\$ 326,598
Training - Data	\$ 97,107
C&A - Data	\$ 473,229
Data Recurring Service Costs (% of cumulative equip costs)	
Training - Data	\$ 32,000
Network Initial Service Costs (% of equipment costs)	
Project Management - Network	\$ 987,888
Engineering - Network	\$ 1,507,444
Staging - Network	\$ 82,597
Installation - Network	\$ 390,625
Training - Network	\$ 116,144
C&A - Network	\$ 566,002
Network Recurring Service Costs (% of cumulative equip costs)	
Training - Network	\$ 38,273

Appendices

- ▶ Appendix A: Benefit Details
- ▶ Appendix B: Cost Details
- ▶ Appendix C: Risk Details
- ▶ Appendix D: Acronym List

Risk Mapping – Cost

Cost Risk Mapping			
Risk Description	1. Planning	2. Implementation & Acquisition	3. O & M
1.0 Program Resources / Acquisition			
1.1 Monopolies in the supply chain due to natural supply shortages or mergers and acquisitions lead to increasing costs, incomplete/untimely design & standards and keep new competitors out of markets		X	X
1.2 Ineffective Program Controls/Project Management	X	X	
1.3 Budget mis-estimation (both over and under)		X	X
1.4 Procurement and maintenance processes for 9-1-1 IT services and equipment transferred to a central IT procurement authority, multiple parties share the use of the items procured, new approval processes delay or discourage optimal procurement practices at local levels		X	X
2.0 Technology			
2.1 Inability of system to meet functional requirements		X	X
2.2 Interoperability roadblocks with legacy systems (both interface and data exchange) continue to exist		X	
2.3 Use of proprietary standards (open standards not developed)		X	X
2.4 Vendors systems do not keep pace with required system goals			X
2.5 Continued practice of vendor workarounds prevents system development and evolution			X

Risk Mapping – Cost (cont)

Cost Risk Mapping			
Risk Description	1. Planning	2. Implementation & Acquisition	3. O & M
3.0 Security and privacy			
3.1 Inadequate internal controls			X
3.2 Unauthorized access of confidential information			X
3.3 Degradation of security performance over time - security controls to do not keep up with security threats			X
4.0 Political / strategic			
4.1 Inadequate Federal, State, and Local legislative support.	X	X	
4.2 Strategic/political alliances for the purposes of facilitating interoperability between jurisdictions do not occur	X	X	X
4.3 Regulations do not foster development and evolution of 9-1-1 system	X	X	
4.4 Lack of regulatory knowledge of what is required from the private sector for appropriate 9-1-1 system functionality	X		X
4.5 Lack of compliance with technology and operational standards leads to less than optimal system performance	X		X
5.0 Organizational and change management			
5.1 Minimal stakeholder adoption of new technologies and processes		X	X
5.2 Volume and complexity of incoming data increases call processing time			X
5.3 Loss of Human Capital			X
5.4 Unwillingness of jurisdictions to set aside traditional/historical parochial interests and collaborate with one another	X	X	X

Risk Mapping – Cost (cont)

Cost Risk Mapping			
Risk Description	1. Planning	2. Implementation & Acquisition	3. O & M
6.0 Business / industry			
6.1 Private industry may choose differing solutions than the 9-1-1 community for technology or operation of system			X
6.2 Private industry may not share resources with the 9-1-1 system	X	X	
6.3 Necessary goods and services are not provided by private sector		X	X
6.4 Changeover of service providers causes loss of 9-1-1 specific expertise in market		X	X
6.5 Private sector communications services do not ensure consumer access to 9-1-1			X
7.0 Funding			
7.1 Unclear demarcation of funding for shared expenses (e.g. backbone, interfaces)			
7.2 Funding Misuse			
7.3 Funding models cannot meet project needs			
7.4 Urban-rural funding disparities result in inequity in service			
7.5 Lack of technological equity in surcharge assessment and remittance			
7.6 Fluctuation of market rates	X	X	X
8.0 Public risk			
8.1 Public concern over amount of private information available through system and public's perception of its security			
8.2 Lack of public knowledge and awareness of 9-1-1 system capabilities and functionality			
8.3 Degradation in 9-1-1 customer service levels		X	X

Risk Mapping – Value

Value Risk Mapping				
Risk Description	Direct User	Operational / Foundational	Strategic /Political	Social
1.0 Program Resources / Acquisition				
1.1 Monopolies in the supply chain due to natural supply shortages or mergers and acquisitions lead to increasing costs, incomplete/untimely design & standards and keep new competitors out of markets		X	X	X
1.2 Ineffective Program Controls/Project Management		X	X	X
1.3 Budget mis-estimation (both over and under)		X	X	
1.4 Procurement and maintenance processes for 9-1-1 IT services and equipment transferred to a central IT procurement authority, multiple parties share the use of the items procured, new approval processes delay or discourage optimal procurement practices at local levels		X	X	
2.0 Technology				
2.1 Inability of system to meet functional requirements	X	X	X	X
2.2 Interoperability roadblocks with legacy systems (both interface and data exchange) continue to exist	X	X	X	
2.3 Use of proprietary standards (open standards not developed)		X	X	
2.4 Vendors systems do not keep pace with required system goals	X	X	X	
2.5 Continued practice of vendor workarounds prevents system development and evolution		X	X	

Risk Mapping – Value (cont)

Risk Description	Value Risk Mapping			
	Direct User	Operational / Foundational	Strategic /Political	Social
3.0 Security and privacy				
3.1 Inadequate internal controls	X		X	
3.2 Unauthorized access of confidential information	X		X	
3.3 Degradation of security performance over time - security controls to do not keep up with security threats	X			
4.0 Political / strategic				
4.1 Inadequate Federal, State, and Local legislative support.	X		X	
4.2 Strategic/political alliances for the purposes of facilitating interoperability between jurisdictions do not occur	X	X	X	
4.3 Regulations do not foster development and evolution of 9-1-1 system		X		
4.4 Lack of regulatory knowledge of what is required from the private sector for appropriate 9-1-1 system functionality	X	X	X	
4.5 Lack of compliance with technology and operational standards leads to less than optimal system performance	X	X		
5.0 Organizational and change management				
5.1 Minimal stakeholder adoption of new technologies and processes	X	X		X
5.2 Volume and complexity of incoming data increases call processing time	X	X		
5.3 Loss of Human Capital		X	X	
5.4 Unwillingness of jurisdictions to set aside traditional/historical parochial interests and collaborate with one another	X	X	X	

Risk Mapping – Value (cont)

Risk Description	Value Risk Mapping			
	Direct User	Operational / Foundational	Strategic /Political	Social
6.0 Business / industry				
6.1 Private industry may choose differing solutions than the 9-1-1 community for technology or operation of system		X	X	
6.2 Private industry may not share resources with the 9-1-1 system		X		
6.3 Necessary goods and services are not provided by private sector	X	X		
6.4 Changeover of service providers causes loss of 9-1-1 specific expertise in market		X	X	
6.5 Private sector communications services do not ensure consumer access to 9-1-1	X	X		
7.0 Funding				
7.1 Unclear demarcation of funding for shared expenses (e.g. backbone, interfaces)			X	
7.2 Funding Misuse			X	X
7.3 Funding models cannot meet project needs			X	X
7.4 Urban-rural funding disparities result in inequity in service	X			
7.5 Lack of technological equity in surcharge assessment and remittance			X	
7.6 Fluctuation of market rates				
8.0 Public risk				
8.1 Public concern over amount of private information available through system and public's perception of its security	X			
8.2 Lack of public knowledge and awareness of 9-1-1 system capabilities and functionality	X			
8.3 Degradation in 9-1-1 customer service levels	X		X	

Appendices

- ▶ Appendix A: Benefit Details
- ▶ Appendix B: Cost Details
- ▶ Appendix C: Risk Details
- ▶ Appendix D: Acronym List

Acronyms (in alphabetical order)

- AACE: Association for the Advancement of Cost Engineers
- (IP) ACD: (Internet Protocol) Automatic Call Distributor
- ACN: Action Control Number
- ALI: Automatic Location Identification
- C&A: Certification and Accreditation
- CER: Cost Estimating Relationship
- CPE: Customer Premises Equipment
- CY: Current Year
- DBMS: Data Base Management System
- DL: Download
- E9-1-1 or “Wireless”: Enhanced 9-1-1 system
- ESRP: Emergency Services Routing Proxy
- FOC: Full Operational Capability
- FTE: Full Time Equivalent
- FY: Fiscal Year
- GIS: Geographic Information System
- IP: Internet Protocol
- IT: Information Technology
- MPC/VPC: Mobile Positioning Center/ Voice over IP Positioning Center
- Kimball: L. Robert Kimball and Associates (Consulting firm)
- LAN: Local Area Network
- NENA: National Emergency Number Association
- NG9-1-1 or NG: Next Generation 9-1-1 system
- ODC: Other Direct Cost
- O&M: Operations & Management
- OMB: Office of Management and Budget
- POC – Proof of Concept
- PSAP: Public Safety Answering Point
- RCF – Remote Call forwarding
- R&D: Research & Development
- RDBMS: Relational Database Management System

Acronyms (continued)

- RIF: Reduction in Force
- ROM – Rough Order of Magnitude
- SME: Subject Matter Expert
- TN: Telephone Number
- TY: Then Year
- USDOT: United States Department of Transportation
- VMM – Value Measuring Methodology
- VoIP: Voice over IP
- WAN: Wireless Area Network

For a Master Glossary of 9-1-1 Terminology, please visit the National Emergency Numbers Association website at http://www.nena.org/media/files/NENA00-001_V1020070605.pdf

Key non-9-1-1 References:

- *Booz Allen IC: Booz Allen Intellectual Capital pulled from previous, related work*
- *ACEIT: Automated Cost Estimating Integrated Tool: a widely used cost estimating tool*