



*Intelligent Transportation Systems*  
U.S. Department of Transportation



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



## **Call Taker Human Factors Issues Report**

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## **1 INTRODUCTION**

The Next Generation 9-1-1 System (NG9-1-1) is designed to improve management of emergency services throughout all aspects of operations, including public access to the emergency services; facilitation of services; and delivery of emergency information to Public Safety Answering Points (PSAP), Emergency Call Centers (ECC), and first responders. The NG9-1-1 System will enable the general public to communicate with the 9-1-1 services via a variety of communication types (voice, text messages, images, and video streams) while using a number of delivery channels. The NG9-1-1 system will also facilitate information sharing among all emergency contact stakeholders (public, dispatchers, and first responders). The Human Machine Interface (HMI) within the NG9-1-1 PSAP will assist in consolidating and presenting emergency information received via Internet Protocol (IP), cellular, telematics, sensor, and public switched network (PSTN) devices in an efficient end-user format to the call taker. It is envisioned to improve call takers' efficiency and reduce response time while responding to emergency calls.

Call takers at the PSAP may face a number of challenges as a result of the introduction of the NG9-1-1 System. For example, the NG9-1-1 System is anticipated to contain a variety of new interfaces that are not currently available, including a display (or multiple displays) to assist the call taker in answering and processing a wide variety of multimedia data (e.g., voice text messages, images, and video). The NG9-1-1 System will also be able to provide linkages to supplemental or supportive data such as interactive maps, standard operating procedures (SOP), links to helpful hints, and interrogation questions.

Call information currently available to 9-1-1 call takers is voluminous and has the potential to inundate, confuse, and hinder the call taker in performing his/her job. The addition of new communication types and complexity of information will likely further exacerbate these operational challenges. Furthermore, call takers often respond to life-and-death situations and cannot afford to make any errors while handling 9-1-1 calls. Therefore, addressing the key human factors issues in 9-1-1 call taking is critical in designing the system and providing the tools to improve call takers' efficiency and accuracy in answering and processing 9-1-1 calls.

### ***1.1 Objective and Scope***

The purpose of this report is to provide a forecast of human factors issues that may affect the integration of NG9-1-1 subsystems into PSAP operations. This is a high-level report intended to draw attention to human factors challenges for PSAPs that will be addressed in the Department of Transportation (USDOT) NG9-1-1 project and may require further consideration or additional study. The emphasis on this report is placed on the HMI that will be needed to support the operation of the NG9-1-1 System as defined in the USDOT NG9-1-1 project, so the results may benefit NG9-1-1 efforts currently underway. For this reason, factors related to 9-1-1 systems that are currently being operated in the field are excluded from this examination.

Overall, this Call Taker Human Factors Issues Report has the following objectives:

- Identify human factors issues associated with introduction of the HMI solutions into the call taker operations of PSAPs
- Describe each issue and document potential impacts for implementing HMI solutions as part of the NG9-1-1 System.

The report is organized into the following sections:

- Section 2: Call Taker Human Factors Issues Development Methodology—describes the approach used to identify human factors-related issues within NG9-1-1 System
- Section 3: NG9-1-1 System and related human factors—provides a description of the NG9-1-1 System and where human factors issues can arise in the system
- Section 4: Call Taker Human Factors Issues Summary
  - Multimedia Interfaces Issues—provides an overview of issues associated with 9-1-1 call takers interfacing with multimedia data, including navigation, screen layout, and screen aesthetics
  - Data and Call Management Issues—provides an overview of issues associated with call takers answering and processing 9-1-1 calls, including the essential, supportive, and supplemental data that is part of the call stream.
  - HMI Technology Compatibility Issues—provides an overview of technical issues identified for the HMI requirements and future design
  - Call Taker Operations/Training Issues—provides an overview of issues associated with implementing HMI solutions at the PSAP and ensuring their adequate and effective use of HMI solutions
- Appendix A: Definitions
- Appendix B: Acronyms
- Appendix C: References

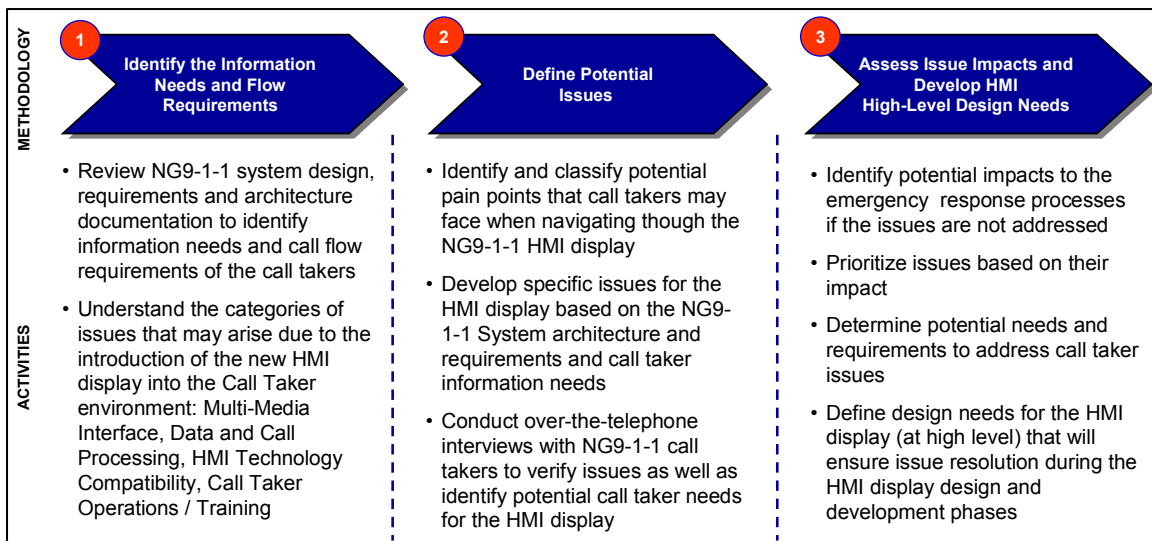
## 2 APPROACH TO IDENTIFYING AND DEVELOPING HUMAN FACTORS ISSUES IN NG9-1-1 CALL TAKING

Traditionally, the human factors issues that need to be considered when planning for the implementation of new call-taking systems within a PSAP involve the HMI for the new tools and any modifications that need to be made within operations or legacy systems to accommodate the new tool. Therefore, human factors planning for NG9-1-1 System design and development begins with analysis of the issues related to information needs and information flow requirements. For example, the information required for a call taker varies with the type of PSAP and the characteristics of the jurisdiction for which it is responsible. Information flow includes communications with dispatchers, PSAPs located in other jurisdictions, NG9-1-1 databases, and the general public calling the PSAP. In addition, human factors issues when using new NG9-1-1 tools can also arise from organizational functions such as staffing and training. The following section describes the approach used in this report to identify and document these human factors issues.

### 2.1 Human Factors Issues Development Approach

A three-phase approach was used to identify and document the human factors issues that call takers may face once they begin operating the new system. As described in Figure 1, this approach includes identifying information needs and flow requirements, defining the issues, assessing issue impacts, and developing high-level HMI display design considerations.

Figure 1—Issue Development Approach



### 2.2 Issue Classification and Prioritization

Identification and classification of human factors issues was determined based on challenges that call takers may face while using the NG9-1-1 System. Call takers have a critical need to quickly and efficiently navigate through a corresponding HMI display and accurately respond

to callers. Based on these challenges, the following high-level issue categories were identified: Multimedia Interfaces, Data and Call Management, HMI Technology Compatibility Issues, and Call Taker Operations/Training.

To assess the issues, the HMI display design team discussed and established a set of criteria to evaluate the impact of each issue on call takers. The HMI design team reviewed previous NG9-1-1 deliverables (such as the NG9-1-1 System Design & Detailed Requirements Document) to identify call taker call flow requirements and information needs. Once issues were identified, the HMI design team conducted over-the-telephone interviews with 9-1-1 call takers to discuss and validate the issues, and prioritized the issues based on their knowledge and experience. The impact of each issue on the successful implementation of the NG9-1-1 environment and call takers' ability to answer and process calls were identified. Based on the impacts, the issues were assigned a priority:

- High Priority—Impact of the issues on successful implementation of the project is significant and must be addressed
- Medium Priority—Addresses issues that may slow down the call taker's ability to identify and process the call and therefore should be addressed prior to implementation to ensure system success
- Low—Potential impact of the issue will not impede the success of the project or the call taker's ability to navigate the HMI display; however, addressing the issue will increase call taker's comfort level with using the system.

### 2.3 HMI Design—Next Steps

Issues identified in this report will serve as an input for designing and developing the HMI display for the proof of concept (POC). The design team will take into consideration issues identified in this document and design a robust HMI display that will facilitate the call taker's function when responding to emergency calls generated using next generation call origination devices. The following activities, outlined in Figure 2, will take place during the design, development, and deployment phases of the HMI display development effort initiative.

Figure 2—HMI Display Design Activities (Next Steps)

HMI Display Design Activities		HMI Display Development and Post-Development Phase Activities	
Preliminary HMI Display Design Phase	HMI Display Design Document Development Phase	HMI Display Development Phase	HMI Display Post POC Development Phase
<ul style="list-style-type: none"> <li>• Develop "High-Level" design considerations to address HMI Human Factors Issues</li> <li>• Assess current HMI designs related to 9-1-1 call taking</li> <li>• Create preliminary design of the HMI display taking into consideration Human Factors issues and system requirements               <ul style="list-style-type: none"> <li>– Identify system requirements that apply specifically to the HMI display</li> <li>– Review Call Taker HMI requirements and functional needs</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Finalize HMI display design</li> <li>• Hold design sessions and agree on the final layout of the HMI display</li> <li>• Develop HMI display mock-up</li> <li>• Document HMI Deployment Considerations and Constraints               <ul style="list-style-type: none"> <li>– Document the Design Considerations for the Industry and for the POC</li> </ul> </li> <li>• Develop final HMI Display Design and draft HMI Display Design Document</li> </ul>	<ul style="list-style-type: none"> <li>• Development team will develop HMI Display based on the HMI Design Document</li> <li>• Conduct User Acceptance / User Verification tests               <ul style="list-style-type: none"> <li>– Develop test scripts based on HMI Display design</li> <li>– Identify user group (Call Takers) to test the HMI functionality</li> <li>– Conduct verification tests</li> </ul> </li> <li>• Finalize HMI Display Look &amp; Feel and Functionality</li> </ul>	<ul style="list-style-type: none"> <li>• Develop HMI Display Training Documentation               <ul style="list-style-type: none"> <li>– Review Call Taker HMI Issues Report and Design document</li> <li>– Develop training materials addressing potential issues and based on design considerations</li> </ul> </li> <li>• Conduct User Training to all HMI Display stakeholders</li> </ul>



### 3 BACKGROUND ON NG9-1-1 AND RELATED HUMAN FACTORS

Current HMI displays used by 9-1-1 call takers include a combination of audio telephony and visual displays that convey critical information to enable them to answer and process incoming calls. The layout and presentation of information from these displays can determine how efficiently the call data is shared with the responding agencies. Lack of information can result in operational inefficiencies and failure to properly record and share call data needed for emergency responders. Display layout and presentation of information becomes even more important in an NG9-1-1 environment when multimedia data, in addition to traditional call data (e.g., phone number, address), compete for a call taker's attention. This can be especially problematic when different displays have different purposes and are designed by different vendors to differing standards. Often, call takers have to juggle a number of screens (call taking applications, databases, global information system [GIS] displays, etc.) when they answer the call. Consequently, HMI displays, as the primary mechanism for call takers to interact with the NG9-1-1 System, constitute one of the most critical design components to ensure the system can be used effectively. The HMI will process and display call information in an user-friendly format and will assist the call takers in sharing the data efficiently with the first responders.

#### **9-1-1 Human Machine Interface (HMI): Where call-takers interact with the system**

HMI within 9-1-1 systems enables direct interaction between the end-user (human) and a system (computer, machine). For the call takers at the PSAP, HMI provides them with the ability to manipulate the system via commands and inputs, and receive an output from the system based on specified criteria. HMI consists of graphical, textual, and auditory means by which the end user interacts with the system. The call takers control the system via a single (or multiple displays) by employing a set of control sequences, such as keyboard strokes, movements of a computer mouse, and touch screen selections. In the NG9-1-1 System, future HMI solutions should enhance their experience using software applications, providing them with an intuitive and simple means of navigating through the system. HMI solutions should also satisfy the operational and functional needs of the system, enabling end users to successfully perform all their job functions with minimal errors.

#### **3.1 The NG9-1-1 System**

The NG9-1-1 System will enable the general public to access enhanced 9-1-1 (E9-1-1) services from virtually any communications device, including any wired, wireless, or IP-based device. Call takers using the NG9-1-1 System will be able to process information received via numerous communication types, including text messages, images, and videos. Currently, only a 9-1-1 contact received via a voice communication channel can be received at most PSAPs. The NG9-1-1 System will also facilitate information sharing between call takers and other public safety professionals (dispatchers, first responders, etc.).



The NG9-1-1 System environment for call takers will include—

- Enable answering and processing E9-1-1 calls from any networked communication device (telephone, computer, pager, and wireless device).
- Enable geographically independent call access, information sharing, and data backup among PSAPs and between PSAPs and other authorized emergency organizations.
- Encourage a flexible, open, non-proprietary, and secure architecture to facilitate the implementation of a NG9-1-1 PSAP.

### 3.2 Human Factors and HMI within NG9-1-1

NG9-1-1 will be built based on the key need for call takers to quickly and intuitively interpret the call data and forward it as appropriate. However, the increase in the quantity and types of information accessible to the call takers, addition of next generation media and content, as well as display of the additional tools and databases, are likely to complicate the corresponding 9-1-1 HMI displays. Therefore, call takers will need to manage a more complex screen using new tools to handle the innovative communication types.

HMI solutions for the call taker should be capable of displaying, and otherwise making available, all data relevant to routing the call appropriately. Call takers (at most PSAPs) receive a wide range of information that is categorized as essential, supporting, and supplementary. The NG9-1-1 system will maintain information categories that are currently available and apply the categorization across calls received via all communication types. Table 1 provides a description for each data category and some examples of the information for that category.

**Table 1—NG9-1-1 Data Categories**

Category	Description	Examples
Essential Data	Supports the ability of call takers to deliver the call and provide adequate response capability. This information provides the ability to identify the location of the caller, the call origination device of the caller, and whether callback is possible. This essential data is automatically provided as a part of a traditional 9-1-1 call stream.	<ul style="list-style-type: none"> <li>• Emergency location / address</li> <li>• Phone number</li> <li>• Service provider of the device from which the call was received</li> <li>• Name of the caller</li> <li>• Any multimedia information (i.e., image of the intruder, video of a fire) if it is the only method of 9-1-1 communication</li> </ul>
Supportive Data	Information beyond essential data that may support call handling and dispatch. The addition of this data to the call stream is triggered by one or more of the data or reference items in essential data for a given call type.	<ul style="list-style-type: none"> <li>• Automatic Crash Notification (ACN) data such as “vehicle rollover”</li> <li>• Images of the getaway car’s license tag vehicle, if a 9-1-1 voice call is received in addition to the image</li> </ul>
Supplemental Data	Multimedia information that may complement, but is not necessary for, call handling and dispatch or emergency response	<ul style="list-style-type: none"> <li>• Images of damaged vehicle received in addition to the call for help</li> <li>• Short Message Service (SMS) message with the allergy information of the patient, that the call taker should forward to the emergency medical services (EMS) unit</li> </ul>

Based on the *NG9-1-1 Concept of Operations and Architecture Analysis*, the HMI solutions should offer the following key capabilities:

- Provide a “single point of access” for call takers to view all the essential data related to routing the call appropriately, as well as additional supportive and supplemental data.
- Support 9-1-1 calls from a variety of origination devices, including voice, text, images, and video. The answering and processing of calls needs to be performed in a consistent way, regardless of the communication method or device used.
- Facilitate “standardized call answering and processing,” regardless of call type, communication method, or device used (e.g., via scripted interrogation questions and resolution procedures/SOPs). In many cases today, interrogation questions and SOPs are available only in a printed format and are not readily available to the call taker.

HMI displays must enable the call taker to conduct call answering and processing activities, including receiving a 9-1-1 call, verifying the nature and location of the emergency, verifying the location of the call, sharing call-related data with the appropriate public safety dispatcher for response, as well as functional activities related to call records management, geospatial visualization, and data management. Section 5 (9-1-1 PSAP Operations Segment) of the *NG9-1-1 Systems Description and Requirements Document* provides a detailed overview of call taker activities, information requirements, and steps in the emergency call flow. These activities and needs will be specifically accounted for in the HMI Display Design Document. For this report, an overview of selected call taker activities and data needs is presented. Table 2 summarizes specific call taker functional activities and information needs related to call taker HMI.

**Table 2—Functional Activities Related to Call Taker HMI**

Service Area	Functional Activity	Definition	Information Needs
Call Answering	Manage Call Queues	Provide the capability to manage call queues and deliver the 9-1-1 call to a call taker workstation.	<ul style="list-style-type: none"> <li>• Call Stream</li> <li>• ACD Rules</li> <li>• Call Detail Record</li> <li>• GIS Display Rules</li> <li>• Geospatial Information</li> <li>• Status Record</li> </ul>
	Answer Call	Provide the capability to answer incoming a 9-1-1- call in response to an audible and/or visual indicator.	<ul style="list-style-type: none"> <li>• Call Detail Record</li> <li>• Call Handling Procedures</li> </ul>
	Initiate Call Back	Establish communications circuit between call taker and receiving party.	<ul style="list-style-type: none"> <li>• Call Detail Record</li> <li>• ACD Rules/Call Queue Record</li> </ul>
Call Processing	Determine Nature of the Emergency	Determine the nature of the emergency and provide an initial assessment of the situation. (This activity involves obtaining the necessary information—the “Five Ws”—to route the caller to the proper person or agency, or to dispatch the proper emergency response.)	<ul style="list-style-type: none"> <li>• Nature of Emergency</li> <li>• Call Handling SOPs</li> <li>• List of Potential Natures</li> <li>• Additional Interrogation Information</li> <li>• Geographic Call Locations</li> <li>• Call Status</li> </ul>



Service Area	Functional Activity	Definition	Information Needs
	Determine and Verify Location of the Emergency	Determine whether an emergency is located at the caller's location or elsewhere. Ensure responders are directed to the correct location.	<ul style="list-style-type: none"> <li>• Caller Location</li> <li>• GIS</li> <li>• Emergency Location</li> <li>• Verifying Location Display Rules</li> </ul>
	Update Mobile Caller's Location Information	Receive location information for mobile callers.	<ul style="list-style-type: none"> <li>• Rebidding Rules</li> <li>• Call Detail Record</li> <li>• Display Rules</li> <li>• Caller Location Details</li> </ul>
	Identify Appropriate Responding Agency or Service	Select appropriate responders based on the nature and location of the emergency, incident management procedures, and SOPs.	<ul style="list-style-type: none"> <li>• Emergency Location</li> <li>• Responding Agencies</li> <li>• Business Rules</li> <li>• Call Type/Call Handling Procedures</li> <li>• Nature of Emergency</li> <li>• Displayed Agencies</li> </ul>
	Provide Pre-Arrival Instructions to Caller	Provide pre-arrival instructions or other information to call taker. A call taker may distribute pre-arrival instructions to a caller as necessary.	<ul style="list-style-type: none"> <li>• Nature of Emergency</li> <li>• Call Handling SOPs</li> <li>• Additional Interrogation Information</li> </ul>
	Establish Conference Call	Establish communications among the call taker, caller, third-party (e.g., telematics) service providers, and appropriate public safety entities.	<ul style="list-style-type: none"> <li>• Call Detail Record</li> <li>• ACD Rules/Call Queue Record</li> </ul>
Call Records Management	Record Call	Preserve a detailed record of the interactive communications occurring during a 9-1-1 call.	<ul style="list-style-type: none"> <li>• Real Time Interactive Communications</li> <li>• Record Interactive Communication</li> <li>• Retrieve Call Recording</li> <li>• Call Detail Record</li> </ul>
	Obtain Supportive of Supplemental Data Post Call Delivery	Obtain supportive or supplemental data (e.g., medical history, telematics, geospatial, data, or interactive video) after the 9-1-1 call has been delivered to facilitate call processing.	<ul style="list-style-type: none"> <li>• Supportive/Supplemental Data</li> <li>• Call Detail Record</li> <li>• Medical History Data</li> <li>• GIS</li> </ul>
	End Call	Terminate existing 9-1-1 call and return to ready to accept next call.	<ul style="list-style-type: none"> <li>• ACD Rules /Call Queue Record</li> </ul>
	Transfer Call	Share all essential supportive, supplemental, and/or any manually-entered data concerning the call to the appropriate responding agency dispatch or authorized entity.	<ul style="list-style-type: none"> <li>• ACD Rules /Call Queue Record</li> <li>• Permission Rules</li> <li>• Transfer Protocols/Data</li> <li>• Record of Transmission Success / Failure</li> </ul>
Geospatial Visualization	Display Geospatial Visualization	Display the 9-1-1 call location and geospatial information on a map.	<ul style="list-style-type: none"> <li>• Caller Location</li> <li>• Geographic Call Locations</li> <li>• Emergency Location</li> <li>• Verifying Location Display Rules</li> <li>• GIS Display Rules</li> <li>• Geospatial Information</li> </ul>

Service Area	Functional Activity	Definition	Information Needs
	Manipulate Geospatial Data	Manipulate 9-1-1 call location and geospatial information.	<ul style="list-style-type: none"> <li>• GIS Display Rules</li> <li>• Geospatial Information</li> </ul>
Data Management	Submit Caller Information Error Report	Submit caller information error report to the originating data provider for correction.	<ul style="list-style-type: none"> <li>• ACD Rules/Call Queue Record</li> <li>• Call Detail Record</li> <li>• ACD Rules/Call Queue</li> </ul>

The HMI solution will correlate and aggregate data automatically without intervention by the call taker—and whether that data is essential, supportive, or supplemental. The aggregation of call data will be performed consistent with the nature of the inbound call; calls established with text messages, images, or video will cause the HMI to display additional screens or windows containing those transmissions and controls for interacting with that data. To achieve these objectives, the HMI display must facilitate the call taker’s recognition and processing of the emergency calls, while minimizing response time.

### 3.3 Existing PSAP Conditions and Design Considerations

The HMI design team evaluated existing conditions faced by call takers across selected PSAP locations and determined a number of existing challenges that should be addressed by the HMI display design. Table 3 contains a summary of identified challenges, as well as potential design considerations identified for the HMI display.

**Table 3—Design Considerations**

Current PSAP Conditions	HMI Design Considerations
HMI screens are not standardized across PSAPs. At each location the call takers see a different presentation of information for the emergency call. Some PSAPs allow call takers to configure their screen individually.	<ul style="list-style-type: none"> <li>• The HMI display should gather and display essential information (i.e. Location, Phone Number, Name, Service Provider) for each emergency call, regardless of the communication medium in which it was received (i.e., voice, text, image, video).</li> <li>• Presentation of essential, supplementary, and supporting information on the HMI display should be similar across all emergency call types (text, image, video, voice, etc.).</li> <li>• The HMI display should offer some customization features to enable call takers to customize their display.</li> </ul>
Call takers operate a variety of screens when responding and processing calls, including screen(s) for: Computer Aided Dispatch (CAD), Mapping/GIS, Radio Dispatch, and other screens depending on location. Often, the screens are not integrated.	<ul style="list-style-type: none"> <li>• The HMI display should be able to integrate with most screens and systems that are used at the PSAP locations. The display should support appropriate receiving (responding) Police/Fire/and EMS agencies’ and should be easily usable by call takers.</li> <li>• The HMI display should present all NG9-1-1 features and components in a simple and intuitive way, enabling the call taker to quickly find and access all features</li> <li>• The HMI display should enable the call taker to enter the type of emergency and select the appropriate dispatch unit in a standard way for all communication mediums directly from the screen.</li> <li>• The ability to link to the CAD function should be available to the call taker at all times during the call.</li> <li>• The HMI display design should fully address call taker needs for intuitive navigation through the application, provide adequate mapping and imaging features, as well as enable quick access to features such as response unit dispatch.</li> </ul>



Current PSAP Conditions	HMI Design Considerations
<p>Most PSAPs generally do not have the capability to receive SMS, image, or video calls. Call takers may not be able to easily identify call emergency for issues received via new communication types, in particular because they are already using a number of screens and technologies.</p>	<ul style="list-style-type: none"> <li>• The HMI display should facilitate the call taker’s ability to recognize the issue received via all the communication types.</li> <li>• The HMI display should provide for standardized placement of essential information and multimedia contents (such as text/image/video) and provide a set of standard controls to interact with the multimedia data (i.e., zoom functions).</li> <li>• The HMI display should account for the possible information needs (essential, supplementary, and supportive) and ensure that data is displayed accurately in a meaningful way to the call takers.</li> </ul>
<p>Information gathered by a call taker that needs to be shared with another PSAP or Secondary PSAP does not follow to the next PSAP, resulting in the caller having to repeat information.</p>	<ul style="list-style-type: none"> <li>• The HMI display should enable call takers to share call data and send emergency information to the response unit quickly and at any moment during the call.</li> <li>• The HMI display should automatically capture the caller’s location, emergency type, and other necessary information, and make this data available for data sharing across PSAPs and other agencies, without the call taker having to reenter it.</li> </ul>
<p>Scripting is not generally used across PSAPs. Call takers have a common way to answer calls and gather information; however, the flow of the call is usually at the call taker’s discretion.</p>	<ul style="list-style-type: none"> <li>• The HMI display should provide embedded scripting features that enable the call taker to guide the call in a standard manner.</li> <li>• SOPs for most of the emergency calls should be developed and available from the HMI display via pop-up messages or links.</li> <li>• The HMI display should be able to display the scripting feature based on the emergency type of the call. The feature should be non-intrusive and be displayed on the HMI screen without blocking the view of essential data.</li> </ul>
<p>Training materials, SOPs, FAQs are not available directly from the call taker’s screen. Most of these documents are in manual format and are not easily accessible to the call taker during a call.</p>	<ul style="list-style-type: none"> <li>• The HMI display should provide access to the SOPs, training materials, FAQs, interrogation questions, and emergency resolution procedures via pop-up messages or links.</li> </ul>

## 4 NG9-1-1 CALL TAKER HUMAN FACTORS ISSUES

With the introduction and rollout of NG9-1-1, HMI solutions will correlate data from disparate sources and databases and selectively include data on the display based on the call content. Call takers at the PSAP may face the challenge of new data, data sources, and how that new data can be presented and manipulated. With next generation multimedia information sources, it is anticipated that HMI solutions will encompass a variety of new functionalities and screens that are not currently available, including—

- Screens to process a wide variety of communication types (telephone, e-mail, text messages, images, sensors, and video)
- Interactive maps
- Automatic Call Management functions such as call forwarding, data sharing, and call conferencing tools
- Embedded links to supportive or supplementary materials (e.g., medical history, telematics, geospatial, interactive video, interrogation questions, SOPs).

To maximize call takers’ efficient use of HMI solutions and to enable call takers to quickly manage the call and dispatch the appropriate response unit, the design of HMI displays will adhere to the User Centric Design (UCD) principles,<sup>1</sup> including intuitive navigation, simplicity and consistency of information presentation, accessibility of information, visibility of key functional and navigational elements, and legible visual design. However, call takers may still face a variety of challenges in managing a significant increase in information on the HMI display, processing of calls received via various multimedia sources, and using a variety of new and innovative controls while handling the 9-1-1 calls. Table 4 summarizes identified call taker issues listed by four categories: 1) multimedia interfaces, 2) data and call management, 3) HMI technology compatibility, and 4) call taker operations/training. The HMI Display design will take into consideration and address all of the identified issues. Specifics regarding the design and issue resolutions will be available in the HMI Display Design Document.

**Table 4—NG9-1-1 Call Taker Human Factors Issues Summary**

	Issue	Priority	Description	Issues Addressed
Multimedia Interfaces	Placement of Data on the Screen	High	HMI display may be too complex because of the amount of information it will contain. Additional multimedia data (such as text/images/videos) and “secondary” data may further complicate the HMI display.	<ul style="list-style-type: none"> <li>• Manageable and intuitive layout of all applications and features</li> </ul>
	Navigation Complexity	High	Navigation and processing information will be increasingly difficult given the additional of text, images, and video.	<ul style="list-style-type: none"> <li>• Intuitive and quick navigation between applications</li> </ul>
	Screen Aesthetics	Medium	An HMI display that is not user friendly may take away from the call taker’s ability to process calls quickly and efficiently.	<ul style="list-style-type: none"> <li>• User-friendly screen aesthetics (fonts/color schemes)</li> </ul>

<sup>1</sup> *User-Centered Design*. IBM Methodology for User Centric Design— <http://www-03.ibm.com/easy/page/570>.





**NG9-1-1 Call Taker Human Factors Issues Report**

	<b>Issue</b>	<b>Priority</b>	<b>Description</b>	<b>Issues Addressed</b>
<b>Data and Call Management</b>	Format of Essential Data Received via Varying Access Methods and Communication Devices	High	The HMI display layout may present essential information pulled from various message types (text, image, video, voice, etc.) in a format that is different from a 9-1-1 call.	<ul style="list-style-type: none"> <li>Standardization of essential information available across all communication types (i.e., Location, Phone Number, Name, and Service Provider)</li> </ul>
	Complex Call Management and Information Sharing Procedures	High	Output to other systems (requests to emergency units/ forward of callers and messages) may be difficult for the call taker.	<ul style="list-style-type: none"> <li>Location of the Dispatch Unit function on the HMI display</li> <li>Selection of Dispatch Unit via the HMI display</li> </ul>
	Management of Supportive and Supplementary Data	Medium	HMI may receive data that may not be relevant to routing the call or may not be applicable to the emergency response.	<ul style="list-style-type: none"> <li>Information to be displayed for emergencies on the HMI display</li> <li>Storage of supplementary data received with each call</li> <li>Management of supplementary data (i.e., forwarding of data to the dispatch unit)</li> </ul>
<b>HMI Technology Compatibility</b>	HMI Compatibility With Other Public Safety Systems located at the PSAP	High	Other Public Safety Systems (CAD/GIS) may not be compatible with the HMI design.	<ul style="list-style-type: none"> <li>Data sharing between HMI and legacy systems</li> <li>Number of screens and systems available to call takers</li> <li>Similar display of data across all systems</li> </ul>
	Bandwidth Limitations	High	PSAPs may not be able to process some of the next generation multimedia communication types because of bandwidth limitations.	<ul style="list-style-type: none"> <li>Impact on download and processing speed of HMI display that will provide the capability to receive next-generation multimedia video and image streams</li> </ul>
<b>Call Taker Operations / Training</b>	Receipt and Interpretation of Non-Voice Emergency Contacts	High	Call takers may not be adequately prepared to receive and understand messages from non-voice delivery channels (i.e., picture messages, text messages, and instant messages). Many new data sources will require training at the call taker level to understand this data.	<ul style="list-style-type: none"> <li>Receipt and interpretation of emergency requests received by non-standard communication types</li> <li>Training required to ensure call takers can process emergencies received via various communication types</li> </ul>
	Determining the Nature of Emergency	High	A variety of communication types introduced with the NG9-1-1 System (image, video, text messages) may complicate the call taker's ability to determine the nature of the emergency.	<ul style="list-style-type: none"> <li>Identification of appropriate Interrogation Questions for the variant emergency types</li> <li>Identification of prank calls</li> <li>Training required to equip call takers with understanding emergency requests</li> </ul>
	Call Taker Technical Expertise	Low	Some call takers may not have adequate technical expertise to operate new systems being built by the HMI vendors.	<ul style="list-style-type: none"> <li>Training specific to navigation of the HMI display</li> <li>Availability of training materials online and customer support by the vendor</li> <li>Direct access to help tools from the HMI display</li> </ul>



The following sections of this document describe, in detail, issues that call takers may face when using the NG9-1-1 HMI display.

#### **4.1 *Multimedia Interfaces Issues***

Issues associated with the layout of the HMI display are related to specific placement of the HMI components in order to ensure that the screen is intuitive and clearly displays all information necessary to assist call takers in processing of emergency calls. The HMI display aims to facilitate call taker access to information and improve emergency call resolution by providing accurate and timely access to information. The screen should enable call takers to quickly identify the emergency issue at hand and resolve the call by forwarding it to the appropriate response agency or dispatch unit.

This section of the document details issues identified for the multimedia interfaces and potential issue impacts on the call taker. This section also identifies HMI design needs to address the issues and ensure that their impacts are not realized.

##### **4.1.1 Placement of Data on the Screen—Description and Impacts**

The NG9-1-1 HMI display will offer a number of features to assist call takers with responding to emergencies and dispatching response units, such as zooming tools, scripting features, links to supporting documentation (SOPs, FAQs, training materials), sophisticated display of call-related data, and access to dispatch function directly from the HMI display. However, the amount of information that will be available with the introduction of the NG9-1-1 System may be difficult to manage from a single screen. As a result of the introduction of new features, including processing of images, video, and text messages, as well as linkages to other public safety systems located at the PSAP, the HMI display may become crowded with information, impeding the call takers' ability to find necessary functions on the display and prolonging the response time to the emergency.

If the HMI display is not simple and does not provide quick (one-click) access to all necessary tools and components, call takers may dedicate additional time to searching for features on the HMI display, thus increasing the time necessary to respond to the emergency and dispatch of the response unit. The call taker's ability to quickly respond to the caller is essential in 9-1-1 operations. If the layout of HMI display components is not optimized, call takers may not be able to clearly view all necessary information on the screen at once and spend valuable time in searching for essential data. Furthermore, call takers may not use the sophisticated NG9-1-1 System successfully if the presentation of applications and features is too complex.

##### **4.1.2 Navigation Complexity—Description and Impacts**

The addition of new screens and applications that will become available to the emergency responders with the addition of the NG9-1-1 System, the NG9-1-1 HMI display may prove to be difficult to navigate, consuming valuable time when responding to the caller. Navigation between applications and screens of the HMI display may be complex for the call taker because of the amount of information that it will contain.

The Navigation Menu may contain numerous features that may not be grouped intuitively for the call taker, preventing him/her from quickly finding and accessing a necessary screen or application. Timely response to callers is the most critical aspect of emergency operations. In the case that the HMI display does not provide for intuitive navigation through the application, or enable quick access to mapping features and response unit dispatch tools, call takers may spend valuable time navigating through the system, instead of focusing on the emergency situation.

#### **4.1.3 Screen Aesthetics—Description and Impacts**

The HMI display should facilitate the call taker's ability to navigate through the application. Poor HMI display aesthetics, such as small font size or non-user-friendly color schemes may distract the call taker from responding to an emergency, increasing the emergency response time. Furthermore, consistency of screen look and feel throughout the application is also important. If the screen aesthetics are inconsistent between NG9-1-1 HMI applications, call takers may spend additional time readjusting to the new screen layout, thus delaying the emergency response time.

Call takers may become distracted with non-call-taker-friendly color schemes, small fonts, and non-standardized layouts across HMI. Call takers may require additional time to understand content displayed by each section of the HMI display if the appearance of each section is different and displayed in a non-standard/non-user-friendly format.

### **4.2 Data and Call Management Issues**

Data and call management issues focus on understanding the obstacles that may prevent call takers from being effective in answering and processing 9-1-1 calls. This section of the document describes the data and call management issues pertaining to call taker HMI within the NG9-1-1 System.

#### **4.2.1 Format of Data Received via Varying Access Methods and Communication Devices—Description and Impacts**

During most 9-1-1 calls, call takers receive calls and can communicate with callers to obtain information via a set of standard interrogation questions and have a dialogue with the caller. Generally, the information obtained during the call includes location of the incident, telephone number associated with the caller, name of the caller, and the emergency type. Call takers have the ability to further investigate the emergency and share the call data with appropriate public safety dispatchers. Call takers also have the ability to call the caller back using the telephone number provided if the caller has prematurely disconnected from the line.

As the result of the introduction of the next generation multimedia and content, such as text, image, and video, call takers may not have the opportunity to communicate with the caller to obtain additional information necessary to process the call. Furthermore, some information presented by the varying communication types may contain pictures, text, or videos that may be essential to the call stream and may be open for the call taker's interpretation.

Inconsistent presentation of essential data across communication types may cause call takers to spend additional time in identifying the communication type used and in recognizing the issue, thus delaying the process of responding to the emergency. Quick and reliable recognition of the nature and type of call is critical to the call takers—if the HMI display does not present essential data received via all communication types (voice, text, image, and video) in a standard format, the call taker may spend additional time understanding the communication medium used and gathering information about the emergency contact instead of quickly processing and responding to the emergency.

#### **4.2.2 Complex Call Management and Information Sharing Procedures— Description and Impacts**

The NG9-1-1 HMI display will offer a number of automated tools to assist call takers with answering, processing, and recording calls, as well as sharing data. The HMI display will contain an automated call handling application that will include the capability to answer incoming calls, select a call from a call queue, place the caller on hold, initiate conference calls, and forward calls. The HMI display will also use sophisticated mapping capabilities that will enable call takers to automatically select an appropriate dispatch unit based on the emergency type and location. The influx of multimedia data may complicate the sharing of call data and may become increasingly unintuitive to the call taker. Call takers may become overburdened with the number of automated call handling features available from the HMI display, impeding the call takers' ability to handle calls quickly and forward the information to dispatch units.

Processing the call as quickly and accurately as possible is critical to the call taker and to PSAP operations. If call takers spend any additional time navigating through the HMI displays, quick response to the call is jeopardized. No time should be lost in answering and processing the call appropriately and sending the call to the appropriate dispatcher or response unit. Due to the time pressure faced by the call takers, the dispatch unit function needs to be available at all times and from any point of the HMI display.

#### **4.2.3 Management of Supplementary Data—Description and Impacts**

NG9-1-1 will allow a variety of data to be captured from the next generation multimedia communication types (voice, text, image, video, etc.). The HMI display will capture and make available “essential data” directly from the screen at all times. However, there will be a quantity of “supplementary data” that may need to be captured and forwarded on to the emergency responders. This type of information may not be necessary for the call takers; however, it may be useful for the dispatch/first response units. For example, call takers may not need to know a requestor's medicinal allergies; however, this information may be vital for the medical response unit.

If supplementary information is displayed from the HMI display, it may make the screen to become too cumbersome to navigate. An excessive amount of information presented to the call taker may slow down his/her ability to quickly identify and respond to emergencies.

However, if the supplementary information is not stored, pertinent information for the emergency response units may be lost and may result in negative consequences to the caller.

### ***4.3 HMI Technology Compatibility Issues***

HMI technology compatibility issues include integrating the HMI display into the existing PSAP's technical environments. These issues include the compatibility of the new HMI display with the legacy systems and data sources used by the Emergency Response Centers. This section of the document presents issues identified for the HMI Technology Compatibility category.

#### **4.3.1 HMI Compatibility With Other Public Safety Systems—Description and Impacts**

Whenever it is essential that two or more computer systems communicate, delivering data in a two-way environment, there may be incompatibility between the HMIs of the two systems. Without full data standardization in place, there needs to be some kind of translation software to read and reformat data appropriately.

In the public safety environment, various (and often separate) screens and systems are used by call takers who may also perform dispatch functions. A number of public safety systems, such as CAD, GIS, and Automatic Number Identification (ANI)/ Automatic Location Identification (ALI) database tools are used. Essential data resides on a variety of databases and may be displayed to the call taker from two or more screens. Data interoperability between these systems is critical; therefore, the HMI should be capable of integrating with the other systems if there is no standardization across platforms.

For the call taker, it is important that any data shown on more than one screen is displayed similarly. As an example, a street address in the HMI display should be consistent with the other systems (CAD/Mapping). If the street is displayed as "Third Street, City, State," in the HMI display; the CAD and/or GIS should not display the address as "3rd ST, Zip Code." Another example is telephone numbers displaying differently across screens (800-555-1212/(800)5551212). Such differences can both complicate the call taker's task of answering and processing a call and lead to errors when a call taker must provide data input to multiple systems.

Other potential impacts include call taker confusion, mishandling of 9-1-1 calls, incorrect data capture, and entering of incorrect data that may cause erroneous data capture about the incident and about the caller. Results of non-standardized data displays may cause the call taker to take additional time to understand the location and nature of the emergency, thus delaying the submission of the call to the appropriate dispatcher or responding agency. Inconsistent data capture across systems may cause the call taker to manually reenter information in each of screens. Finally, erroneous data capture by the emergency systems may result in inaccurate caller history data, faulty incident investigations and/ or court actions, potentially degradation of the perception of "9-1-1" operations as efficient, and most importantly, result in failure to protect public safety.

### **4.3.2 Bandwidth Limitations—Description and Impacts**

PSAPs infrastructure and network limitations may not allow the PSAPs to receive sophisticated next generation multimedia data from the NG9-1-1 network. Although the HMI display may provide the technology necessary to receive and present the NG9-1-1 information on the call taker's workstation, infrastructure and network capacity limitations may impede efficient downloading and processing of the data. For example, if the PSAPs do not have adequate circuit capacity to support video and other bandwidth-intensive applications, then information cannot be efficiently transferred from the caller to the NG9-1-1 PSAP.

Bandwidth limitation may result in poor download speed of video and image streams, thus impeding the call taker's ability to quickly respond to the emergency situation. Furthermore, if the PSAP's network does not have adequate capacity to support interactive multimedia applications, then during peak usage times, there could be significant performance issues that would directly affect the call taker's ability to respond to NG9-1-1 calls.

## **4.4 Call Taker Operation/Training Issues**

Call taker operation/training issues focus on ensuring that call takers receive adequate training prior to being introduced to the NG9-1-1 environment. Call takers should be competent with operating the HMI display and managing all of its automated and innovative features. This section evaluates the challenges and obstacles that call takers may face while operating the HMI display and evaluates their training needs.

### **4.4.1 Receipt and Interpretation of Non-Voice Emergency Contacts—Description and Impacts**

Call takers may not be adequately prepared to receive and understand messages from non-voice delivery channels (i.e., picture messages, text messages, and instant messages). The use of many next generation multimedia data sources will require call takers to be trained to understand this data. The skills needed to handle emergency calls in a next generation environment will involve new knowledge and abilities. Call takers will need additional training on the various new data sources (including text messages, images, and video streams) that will be received by PSAPs with the introduction of the NG9-1-1 System. Special training curriculum to prepare call takers to receive non-voice calls will have to be developed, including spatial recognition ability (bio-location/geo-location/picture/video), text message (short words) decryption, and video interpretation. It may also be useful to develop a dictionary of terms used for each data source to provide call takers with quick reference in processing new calls.

The call takers will need to understand the source or origination of the 9-1-1 call. This is similar to the issues faced with the introduction of wireless technology. When wireless 9-1-1 came into the PSAPs, the ALI screen changed. There was new data, and the data that was familiar, such as address, was not always the data the call taker could use.

The call takers will need to develop new skills to query the people reporting emergencies. A voice call allows the call taker to evaluate the tone of voice and background noises to assist in

understanding the type of emergency being reported. Several of the new data sources will not allow this type of evaluation. In addition, one-way messages, such as text messages, will drive the need of call takers to gather additional information. Call takers will need to understand how and when to send questions back to the person originally reporting the emergency. This knowledge is important in gathering information as well as in providing the reporting person with pre-arrival instructions if appropriate.

Call takers without the skills to handle the new access methods and communication types of the NG9-1-1 may put the PSAP at risk for liability. The call taker may incorrectly categorize the incident or put the caller at risk with improper techniques such as ringing a telephone of a hiding victim.

#### **4.4.2 Determining the Nature of Emergency—Description and Impacts**

A variety of communication types that will be introduced with the NG9-1-1 System (image, video, and text messages), may make complicate the ability of the call taker to quickly determine the nature of the 9-1-1 call. People sending information to a PSAP may not fully understand the needed information. These people may send information that they believe is helpful but not include all of the essential data for a call taker to determine the nature and location of the emergency. Furthermore, some calls for help may actually be prank calls, which the call taker should be able to identify.

An example of incomplete would be a picture of a running person. The person sending it knows the context of the picture, but the call taker does not. The call taker needs further information, such as the building the running person came from is a bank or store with an alarm ringing. Another example would be a text message of “help” and nothing more. The person who sent it thinks it is enough, but the call taker needs more information to properly determine the nature of the emergency, as well as to verify whether the call for help is actually legitimate. In addition to this problem, call takers will need to learn the language of text messaging in use today.

Incorrectly categorizing an emergency may put the PSAP at risk for liability. Not being able to determine the nature of an emergency may put the response agencies and the public at risk. The process of following up on the information may put the person reporting the incident at risk.

#### **4.4.3 Call Taker Technical Expertise—Description and Impacts**

Some call takers may not have adequate technical expertise to operate the new systems being built by the HMI vendors. Call takers may not be familiar with more sophisticated computer features such as managing images on the screen (zoom/fragmentation), video menu selections, complex mapping programs, embedded scripts and pop-up messages, as well as extensive navigation menus. The HMI screen will also contain a list of “helpful links,” including links to FAQs, SOPs, and direct vendor support. Therefore, the next generation HMI solutions may require a higher level of technical knowledge and different skill set. When new CAD systems





were introduced, call takers were required to have skills that had not been previously required (e.g., typing). Similar skill issues will apply with the next generation systems.

In the future, call takers will need to have a more in depth understanding of mapping technologies. As an example a GIS is more detailed than a simple mapping program because it enables one to visualize geographic aspects of a body of data, contains the ability to translate geographic data into an explicit map location, has the ability to query and analyze data in order to receive the results in the form of a map, and can be used to graphically display coordinates on a map (i.e., latitude/longitude) from a wireless 9-1-1 call. The call taker should understand the benefits and limitations of GIS as an integral part of call taker HMI in order to facilitate improved call answering and processing. In addition, PSAP personnel may require new skills; these skills will need to be taught to the existing supervisory personnel, and job descriptions will need to be changed to reflect these new skills. In some instances, these changes may affect the staffing of all PSAPs because employees who are not able to acquire the new skills will leave the industry.

Finally, the need to acquire new skills may lead to employee relation issues with contracts and employment regulations. In PSAPs with employee contracts, these contracts will need to be reviewed and possibly changed. Federal, state, and local employment regulations will need to be reviewed. These skills will need to be examined to ensure they are job requirements and to determine what accommodations may be available.

During the rollout/deployment phase of the HMI tool, comprehensive training sessions will be hosted in a regional basis and call takers will be extensively trained on features and functionalities of the HMI. The sessions will include vendor training to familiarize the call takers with the new product and its features. For large PSAPs, local customized training can be organized to reduce travel and training cost.



## APPENDIX—A: DEFINITIONS

Term	Definition
<b>9-1-1</b>	A three-digit telephone number to facilitate the reporting of an emergency requiring response by a public safety agency.
<b>Analog</b>	Continuous and variable electrical waves that represent an infinite number of values; as opposed digital.
<b>Authentication</b>	Determination or verification of a user's identity and/or the user's eligibility to access to a system, network, or data; measures to prevent unauthorized access to information and resources.
<b>Automatic Call Distributor (ACD)</b>	Equipment or application that automatically distributes incoming calls to available PSAP attendants in the order the calls are received, or queues calls until an attendant becomes available.
<b>Automatic Location Identification (ALI)</b>	The automatic display at the PSAP of the caller's telephone number, the address or location of the telephone, and supplementary emergency services information.
<b>Automatic Number Identification (ANI)</b>	Telephone number associated with the access line from which a call originates.
<b>ANI key</b>	A value that is used to correlate the number identified for the call with a query that determines the caller's location via Automatic Location Identification (ALI).
<b>Bandwidth</b>	Capacity of a network line to transfer data packets (includes speed of transfer and number of packets processed per second).
<b>Call</b>	For the purposes of this NG9-1-1 System Description & High-Level Requirements document, any real-time communication—voice, text, or video—between a person needing assistance and a PSAP call taker. This term also includes non-human-initiated automatic event alerts, such as alarms, telematics, or sensor data, which may also include real-time communications.
<b>Callback</b>	The ability to re-contact the calling party.
<b>Call Delivery</b>	The capability to route a 9-1-1 call to the designated selective router for ultimate delivery to the designated PSAP for the caller's Automatic Number Identification (ANI) key.
<b>Call Detail Record</b>	All system (including network) data accessible with the delivery of the call, and all data automatically added as part of call processing. This includes Essential Data (including reference key to network component and call progress records) and Supportive Data. Part of the Call Record.
<b>Caller Location Information</b>	Data pertaining to the geospatial location of the caller, regardless of whether the caller is a person or an automatic event alert system.



Term	Definition
<b>Call Recording</b>	The electronic documentation of the interactive communication (e.g., audio, video, text, image) between the caller, call taker, and any conferenced parties. Part of the Call Record.
<b>Call Routing</b>	The capability to selectively direct the 9-1-1 call to the appropriate PSAP.
<b>Call Taker</b>	As used in 9-1-1, a person (sometimes referred to as a telecommunicator) who receives emergency and non-emergency calls by telephone and other sources, determines situations, elicits necessary information, and relays essential information to dispatches, staff, and other agencies, as needed, using telephony and computer equipment.
<b>Call Transfer</b>	The capability to redirect a call to another party.
<b>Call Type</b>	Classification of a 9-1-1 call that indicates the call access method, which can affect call treatment, routing, and processing. Call types may include voice caller, short message service (SMS) text, Simple Mail Transfer Protocol (SMTP) text, multimedia, telematics data, ANI, silent alarms, etc.
<b>Computer Aided Dispatch (CAD) system</b>	A software package that utilizes a variety of displays and tools that allows Call Takers at the PSAP locations to dispatch emergency services (Police, Fire, Emergency Medical Service) to the identified emergency location. CAD uses a variety of communication types to dispatch a unit (paging, SMS, radio, etc.).
<b>Customer Premises Equipment (CPE)</b>	Communications or terminal equipment located in the customer's facilities; terminal equipment at a PSAP.
<b>Dispatch Operations</b>	The distribution of emergency information to responder organizations responsible for delivery of emergency services to the public.
<b>Emergency Call</b>	A telephone request for public safety agency emergency services that requires immediate action to save a life, to report a fire, or to stop a crime. May include other situations as determined locally.
<b>Emergency Location Information</b>	Data pertaining to the location of the emergency, which may be different from the caller location.
<b>Emergency Medical Service (EMS)</b>	A system providing pre-hospital emergency care and transportation to victims of sudden illness or injury.
<b>Emergency Response</b>	An effort by public safety personnel and citizens to mitigate the impact of an incident on human life and property.
<b>Enhanced 9-1-1 (E9-1-1)</b>	An emergency telephone system that includes network switching, database, and Customer Premises Equipment (CPE) elements capable of providing selective routing, selective transfer, fixed transfer, caller routing and location information, and ALI.
<b>Essential Data</b>	Data that support call delivery and adequate response capability. These data, or a reference to them, is automatically provided as a part of call or message initiation. Examples include location, callback data, and call type.

Term	Definition
<b>Human Machine Interface (HMI)</b>	HMI enables direct interaction between the end-user (human) and a system (computer, machine) via commands and inputs, and receives an output from the system based on a specified criteria
<b>Human Machine Interface (HMI) Display</b>	Graphical and visual User Screen through which Call Takers (end-users) are able to manipulate a system
<b>Geographic Information System (GIS)</b>	A computer software system that enables one to visualize geographic aspects of a body of data. It contains the ability to translate implicit geographic data (such as a street address) into an explicit map location. It has the ability to query and analyze data in order to receive the results in the form of a map. It also can be used to graphically display coordinates on a map (i.e., latitude/longitude) from a wireless 9-1-1 call.
<b>IP Telephony</b>	The electronic transmission of the human voice over IP Protocol, using data packets
<b>Internet Protocol (IP)</b>	The set of rules by which data are sent from one computer to another on the Internet or other networks.
<b>Interoperability</b>	The capability for disparate systems to work together.
<b>Interrogation Questions</b>	Questions that Call Takers ask callers during an emergency call to obtain additional information.
<b>Multi-Media Communication Types</b>	Communication mediums that will be used to receive emergency requests from the public, including text, images, and video.
<b>Navigation Menu</b>	A tool used by a variety of computer systems that contains links to the features and applications available in the system, and allows end-users to access the applications by selecting the feature. Generally is grouped via links / hyperlinks to the application.
<b>Nature of Emergency</b>	Reason for a citizen's request for response from emergency services (e.g., heart attack, vehicle collision, burglary)
<b>Network</b>	An arrangement of devices that can communicate with each other.
<b>Overflow</b>	The telecommunications term for the condition when there are more calls than the primary network path is designated to handle. This condition invokes the need to perform some form of call treatment, such as busy signals or alternate routing.
<b>Public Safety Answering Point (PSAP)</b>	A facility equipped and staffed to receive 9-1-1 calls; a generic name for a municipal or county emergency communications center dispatch agency that directs 9-1-1 or other emergency calls to appropriate police, fire, and emergency medical services agencies and personnel.
<b>Records Management System (RMS)</b>	A computer software system that enables the storage or archival of data records related to public safety (e.g., 9-1-1 call logs, incident information, cases).



Term	Definition
<b>Router</b>	An interface device between two networks that selects the best path to complete the call even if there are several networks between the originating network and the destination.
<b>Screen Aesthetics</b>	Look and Feel of the Human Machine Interface. This includes fonts, color schemes, and display layout.
<b>Selective Routing (SR)</b>	Direction of a 9-1-1 call to the proper PSAP based on the location of the caller.
<b>Selective Transfer</b>	The capability to convey a 9-1-1 call to a response agency by operation of one of several buttons typically designated as police, fire, and emergency medical.
<b>Service Provider</b>	An entity providing one or more of the following 9-1-1 elements: network, Customer Premises Equipment (CPE), or database service.
<b>Short Message Service (SMS)</b>	A text message service that enables messages generally no more than 140–160 characters in length to be sent and transmitted from a cellular telephone. Short messages are stored and forwarded at SMS centers, allowing their retrieval later if the user is not immediately available to receive them.
<b>Supportive Data</b>	Information beyond essential data that may support call handling and dispatch. The addition of this data to the call stream is triggered by one or more of the data or reference items in essential data for a given call type. An example is Automatic Crash Notification (ACN) data such as “vehicle rollover.”
<b>Supplemental Data</b>	Information that may complement, but is not necessary for, call handling and dispatch or emergency response.
<b>Telematics</b>	The system of components that supports two-way communications with a motor vehicle for the collection or transmission of information and commands.
<b>Trunk Lines</b>	Analog phone lines coming from the telephone provider into the Public Branch Exchange (PBX) of the PSAP.
<b>User Centric Design (UCD)</b>	Design principle that enable the development of a computer system based on the needs, wants, and limitations of the end user, including intuitive navigation, simplicity and consistency of information presentation, accessibility of information, visibility of key functional and navigational elements, and legible visual design.
<b>Voice over Internet Protocol (VoIP)</b>	A set of rules that provides distinct transfer of voice information in digital format using the Internet Protocol. The IP address assigned to the user’s telephone number may be static or dynamic.



Term	Definition
<b>Wireless</b>	In the telecommunications industry, typically refers to mobile telephony and communications through handheld devices that make a connection using radio frequency (in particular frequency bands often reserved for mobile communications) for personal telecommunications over long distances.
<b>Wireline</b>	Standard telephone and data communications systems that use in-ground and telephone pole cables. Also known as landline or land-based.

## **APPENDIX—B: ACRONYMS**

<b>Acronym</b>	<b>Definition</b>
<b>ACD</b>	Automatic Call Distributor
<b>ACN</b>	Automatic Crash Notification (Voice)
<b>ALI</b>	Automatic Location Identification (Data)
<b>ANI</b>	Automatic Number Identification
<b>CAD</b>	Computer-Aided Dispatch
<b>CPE</b>	Customer Premises Equipment
<b>E9-1-1</b>	Enhanced 9-1-1
<b>EMS</b>	Emergency Medical Services
<b>GIS</b>	Geographic Information Systems
<b>HMI</b>	Human Machine Interface
<b>IP</b>	Internet Protocol
<b>NG9-1-1</b>	Next Generation 9-1-1
<b>PBX</b>	Private Branch eXchange
<b>POC</b>	Proof of Concept
<b>PSAP</b>	Public Safety Answering Points
<b>PSTN</b>	Public Switched Telephone Network
<b>RMS</b>	Records Management System
<b>SMS</b>	Short Message Service
<b>SOPs</b>	Standard Operating Procedures
<b>UCD</b>	User Centric Design
<b>USDOT</b>	U.S. Department of Transportation
<b>VoIP</b>	Voice Over Internet Protocol

## APPENDIX—C: REFERENCES

The following documents are primary sources of information used in this document.

1. *Next Generation 9-1-1 (NG9-1-1) System Initiative: Concept of Operations*. USDOT ITS JPO. April 2007. [http://www.its.dot.gov/press/pdf/911\\_network.pdf](http://www.its.dot.gov/press/pdf/911_network.pdf) —This is a formal document that provides a user-oriented vision of NG9-1-1 in the context of an emergency services internet work that can be understood by stakeholders with a broad range of operational and technical expertise. It is intended to communicate the vision of this system to stakeholders so that they can be actively engaged in its development and deployment.
2. *Next Generation 9-1-1 (NG9-1-1) System Initiative: System Description and Requirements Document*. USDOT ITS JPO. November 2007. [http://www.its.dot.gov/ng911/pdf/NG911\\_HI\\_RES\\_Requirements\\_v2\\_20071010.pdf](http://www.its.dot.gov/ng911/pdf/NG911_HI_RES_Requirements_v2_20071010.pdf)— This is a formal document that provides an overview of NG9-1-1 System Operations and requirements.
3. *Next Generation 9-1-1 (NG9-1-1) Architecture Analysis Document*. November 2007. [http://www.its.dot.gov/ng911/pdf/1.F2\\_FINAL\\_MED\\_ArchitectureAnalysis\\_v1.0.pdf](http://www.its.dot.gov/ng911/pdf/1.F2_FINAL_MED_ArchitectureAnalysis_v1.0.pdf) — This is a formal document that provides an architectural Analysis for the Next Generation 9-1-1 (NG9-1-1) System (or “system of systems”) and presents an evolved 9-1-1 architecture able to support next generation technologies, access methods, and operational capabilities.
4. *Thematic Synthesis of Transport Research Results, Human Factors*. August 2001. The EXTRA project, within the European Community’s Transport RTD Program. – This document provides a structured guide to the findings and policy implications of research relating to human factors carried out in the Transport RTD Program.
5. *Unmanned Aerial Vehicles for Maritime Patrol: Human Factors Issues*. May, 2006. DSTO Defense Science and Technology Organization, Commonwealth of Australia. – This document outlines the human factors issues associated with the operation of unmanned aerial vehicles (UAVs). In particular, consideration is given to how these issues might be relevant to the acquisition of highly autonomous, high altitude long endurance (HALE) UAVs for maritime patrol and response operations.
6. *The Role of User Centric Design in Value Creation to Customers and Changes Foreseen to Current Business Models*. WWI Symposium MobiLife Workshop, October 2004. [http://www.wireless-world-initiative.org/1WWI\\_presentations/PDF\\_Presentations/Day\\_2/MobiLife/4\\_MobiLife-WS-UCD-and-Business-Models-HAYRYNEN.pdf](http://www.wireless-world-initiative.org/1WWI_presentations/PDF_Presentations/Day_2/MobiLife/4_MobiLife-WS-UCD-and-Business-Models-HAYRYNEN.pdf) – This document outlines principles of developing tools and technologies based on user functional and business needs.





7. *User-Centered Design*. IBM Methodology for User Centric Design— <http://www-03.ibm.com/easy/page/570>. - This website outlines principles and methodologies for user centric design and processes.
8. *The User-Centric Design Trap*. The ClickZ Network, Sep 17, 2004 - <http://www.clickz.com/showPage.html?page=3408411>. – This document outlines User-centric design (UCD) principles and describes how it enables the enhancement of the end-users experience with a computer system.