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CONCEPT OF OPERATIONS (CONOPS)

Version 1.1

Next-Generation Incident Command System (NICS)

Prepared By

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Preface

This paper was prepared by the Worldwide Incident Command Services (WICS) Corporation, a California Nonprofit Public Benefit Corporation[1] that is organized and operated exclusively in the public interest for Scientific, Educational, and Chartable exempt purposes within the meaning of Section 501(c)(3) of the Internal Revenue Code. WICS was granted 501(c)(3) tax-exempt status effective 14 May 2014 by the IRS.

WICS was created as an official DHS S&T Technology Transition Partner to facilitate technology transition of the NICS R&D project to a robust operational platform. In addition, the supporting effort of WICS is the recruiting, training, and education of the next generation of emergency response leaders.

Activities that WICS performs in accomplishing these goals (partial list):

(a) Standup a version of the NICS software based upon the latest published open source version; independently deploy it; test it; operate it.

(b) Prepare a series of information products for NICS administrators and first responders: Concept of Operations; Best Practices; Help & Training modules.

(c) Design and implement Managed Services at the WICS-hosted site (24x7x365 monitoring).

(d) Perform initial outreach and coordination for a selected subset of users.

For more information about WICS as well as Raven, email info@ravenwics.org

[1] Nonprofit Public Benefit - Under the California State Law for Nonprofit Public Benefit Corporations and the Internal Revenue Code for Nonprofit charitable organizations, WICS is strictly constrained in what it can and cannot do.

- *It cannot be organized for the private gain of any individual or group.*
- *It is governed by a board of directors who volunteer their time without compensation.*
- *The compensation of personnel who are employed by the corporation is strictly reviewed and must meet specific IRS standards for nonprofit organizations.*
- *Upon dissolution, all assets of the nonprofit have to be transferred to another nonprofit. No vendor can acquire any assets. There is no concept of equity.*

For more information, see the following IRS rules:
https://www.irs.gov/Charities-&-Non-Profits/Charitable-Organizations/Exemption-Requirements-Section-501(c)(3)-Organizations

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Introduction

Purpose

The purpose of this document is to describe the Concept of Operations (CONOPS) for using the Next-Generation Incident Command System (NICS) at echelons involved in emergency management. Ultimately the WICS vision extends this use to humanitarian assistance and disaster relief operations for all types of hazards and events across the full range of preparedness, planning, response, and recovery.

It is the intent of this document to provide an executive/administrative view for managers, and a technical/operational view for operators, so that both can assess the value and utility of NICS to the emergency management, first responder community.

NICS

NICS is a mobile, web-based command & control system whose long-range goal is to deal with dynamically escalating incidents, from first response to extreme-scale, and that facilitates collaboration across all levels of government, commercial, and private use for all-hazard events.

NICS grew from a Department of Defense project on commander collaboration in 2004. It became a funded project in 2007, and beginning in 2010, while still transitioning from R&D status, NICS began to be used for actual emergencies. Since then it has been used on several hundred emergency incidents, a large number involving Type 1 Incident Management Teams.

DHS S&T has funded NICS development from 2010 through the present.

CONOPS

A concept of operations (CONOPS) is a high-level description of the actions to be taken in the pursuit of mission accomplishment, in this case the use of the NICS capability within a broad spectrum of emergency management operations. This document describes the rationale for NICS, the principal components that make it function, and the design and implementation principles that have shaped its evolving form and function.

The NICS CONOPS can be thought of from the perspective of ends, ways, and means[2]: The *end* is the stated objective, ranging from a very broad strategic aim to the accomplishment of a specific task.

[2] Schmitt, John. A Practical Guide for Developing and Writing Military Concepts. Working Paper #02-4. Defense Adaptive Red Team (DART). Hicks & Associates.

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The *means* are the capabilities to be employed in a given situation. The *ways* is the description of how the means are to be employed in order to achieve the ends.

It is important to understand and clearly articulate the CONOPS for any technology or system development because this understanding directly translates into the shape that the project will take. If the CONOPS is poorly defined or without focus, the resulting system will be less than effective in achieving any desired ends.

Assumptions

The authors assume that the reader of this document has a familiarity with the Incident Command System (ICS)[3] as well as the National Incident Management System (NIMS). It is also assumed that the reader has a working knowledge of the NICS feature set such as logging in, joining an incident, opening Incidents and Rooms, viewing data (GIS, AVL, Weather, etc.), reviewing completed documents, using drawing tools, communicating via public whiteboard or private chat, and so forth.

This document should be considered a template that each user organization can tailor to meet their own needs. It is a living document that can evolve as each organization moves from an introductory project phase to an operational use phase in support of real operations.

Guidance & Best Practices

The adoption and tailoring of written "Guidelines and Best Practices" to help guide organizations in using NICS is highly encouraged. An example of one such document is in preparation and will be available to user communities soon: NICS - Emergency Management Platform Fire & Rescue Emergency Operations Guidelines & Best Practices.

[3] There are several good tutorials on ICS and NIMS. One can be found at: https://training.fema.gov/emiweb/is/icsresource/

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The Incident Command System Version 1.0

The Incident Command System[4] was developed in the 1970s following a series of deadly fires in California. After action reviews by investigation teams found that to a large extent the root cause of the failure of effective and coordinated suppression was due to inadequate management. ICS was designed to fix that by clarifying and standardizing definitions, organizational structures, and processes.

However, some 40 years later, the amount of innovation in ICS, particularly in the adoption of new technologies, has lagged. There have been missed opportunities. One of the objectives of the Next-Generation Incident Command System (NICS) program was to find areas where new technologies, techniques, tools, and CONOPS could make fundamental improvements in ICS.

The approach of NICS was to begin by looking at artifacts from the first generation of ICS, which could be called "ICS 1.0," that still hamper today's implementations, and then develop and experiment with new technologies, techniques, tools, and CONOPS, to include prototyping, field testing, evaluation, and other assessment processes.

Some of the artifacts that have been carried over from ICS 1.0 are described below:

Artifacts of ICS 1.0: Paper & Pencil

Early ICS was based upon paper and pencil. Today many forms, maps and procedures still rely on this medium. The limitation is obvious: information entered onto paper exists only in that form and is its sole copy. It must be duplicated, transmitted (faxed; emailed), etc., as hard copy in order to share with others. Until it is converted to another data format, it remains rigid copy that must be transformed to another form to be useful.

The critical result of this is latency, the aging of information as it is entered onto paper and converted and transmitted to other means.

[4] For more information see: https://training.fema.gov/emiweb/is/icsresource/assets/reviewmaterials.pdf

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Artifacts of ICS 1.0: Voice over Radio

Voice over radio, and more recently voice over mobile phone, continue to be preferred manners of communication. Operators tend to fall back on words to paint pictures of what they think is going on. One issue is that there develops a lack of available throughput when everyone who wants to talk tries to talk, especially during emergencies. Another issue is that one-to-one and even one-to-many conversations might easily leave out others that need to be part of the conversation for context purposes. A third issue is that voice communications are perishable.

The complete failure of the communication system is not uncommon in these situations, especially for emergency traffic.

Artifacts of ICS 1.0: Reliance on Face-to-Face Meetings for Coordination & Collaboration

The lack of visualizations that can communicate timely information about where the threat is, where it is going, where friendly forces are, and where they are needed, breaks down into the need for face-to-face meetings beginning with the morning commander's briefing and extending to the roadside reactive planning huddle.

These latter meetings put responders in dangerous situations just to travel to the meeting in the first place, especially when responders are tired-dirty-hungry. Face-to-face meetings are subject to the tyranny of time/space.

As above, issues of latency (dated information) and the perishable nature of communications are at play here, as are the issues of inclusiveness vs. exclusiveness: Not all who need to know are able or permitted to attend.

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Artifacts of ICS 1.0: Position Location by Map, Landmark, Radio, and Voice

Operators rely on using paper maps and local landmarks to determine location, then use voice over radio to try to describe to others where they are, where other entities are, and where they intend to go. The chance of transmitting incorrect information is well documented.

Although global positioning system (GPS) technologies can pinpoint the location of an apparatus (Automatic Vehicle Location) and individual dismounted responders (Position Location Information, PLI, using satellite trackers or smart phones), the wholesale equipping of all responders has been unnecessarily ponderous.

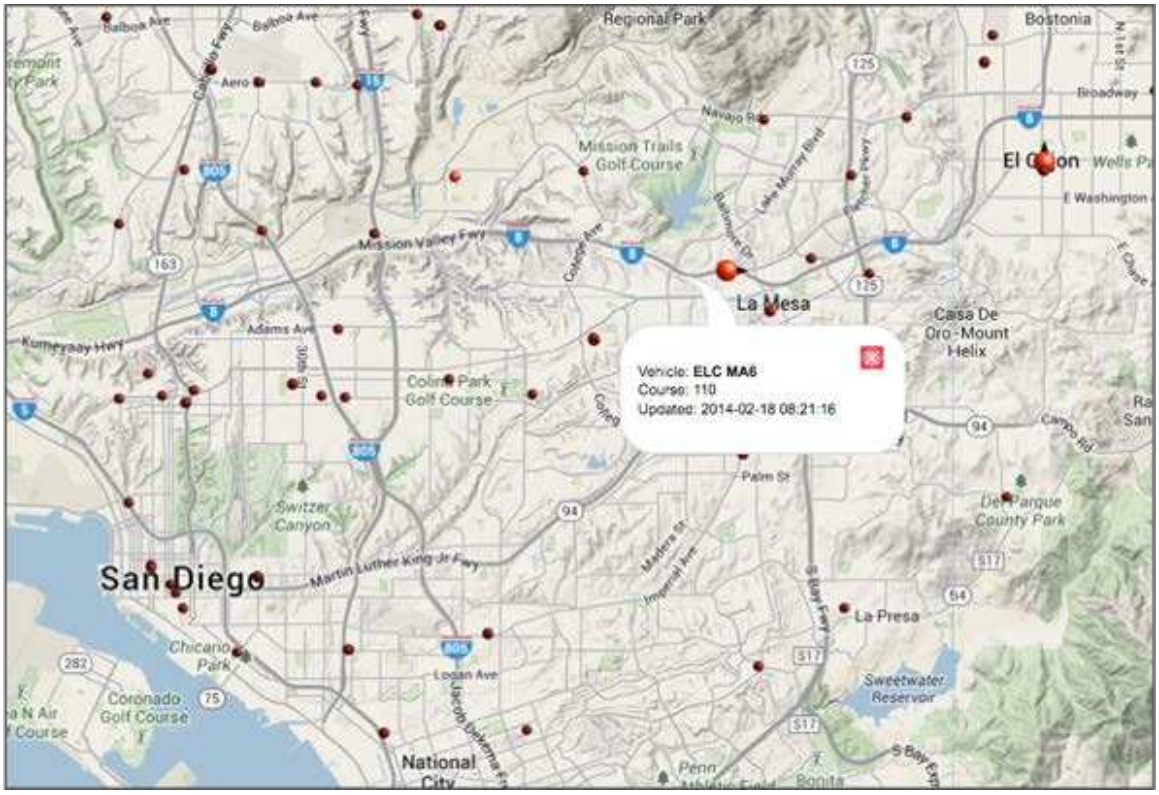

Figure 1. NICS map showing apparatus location via Automatic Vehicle Location instrumentation updated every 15 seconds.

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Moving To The Next Generation – CONOPS Enablers

Based upon these and other ICS 1.0 Artifacts and shortcomings, the cornerstone for the next major innovation in ICS should be based upon the capabilities afforded by new technologies, techniques, tools, and CONOPS, as well as design and implementation approaches that employ these. This is what the NICS program has attempted to do.

Therefore the NICS CONOPS has evolved from enablers based upon innovations in technologies, techniques, and tools. The key components are described below, followed by the design principles that have guided the development of NICS since 2007. The CONOPS Enablers are:

1. Shared Collaborative Environments
2. Ubiquitous Internet Access
3. Geolocation
4. User Created Layered Visualizations
5. Three Modalities of Human Communication
6. Technology Neutral
7. No Application Software
8. Incidents & Rooms
9. Captured History of All Actions
10. Tired - Dirty - Hungry Responder under Extreme Stress
11. General & Specific Design Guidance

1) Shared Collaborative Environments

A key concept driving the design and functionality of NICS is the use of technology to create collaborative environments which are readily shared among and between users at all levels. These environments enable the Three Modalities of Human Communication (see below) and are enabled themselves because of Ubiquitous Internet Access (also below).

The results are flexible, extensible environments that are tuned to the problems users have to solve during stressful moments, and are designed for the Tired - Dirty - Hungry Responder Under Extreme Stress (see #10).

2) Ubiquitous Internet Access

The creation of Shared Collaborative Environments is made possible because NICS is a web application that uses the Internet to connect users, staffs, data, and services in potentially multiple simultaneous collaborative environments to enable decision makers to make timely and effective decisions across a broad spectrum of natural and man-caused events.

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Access can be from any location in the world where there is Internet connectivity. The only requirement for access is that the user have:

- A computing device that can connect to the Internet through a standard web browser
- A NICS user account

NICS collaborative environments are available 24x7x365: NICS is online at all times, though users do not have to be connected continuously. Users can log in as needed when an incident occurs, return anytime to an ongoing incident after they have left, or visit an archived version of a completed incident.

Further, should a user's connectivity be interrupted, the environment will automatically update itself when service is renewed[5].

Given the ubiquity of the Internet, responders can be involved in an incident from anywhere in the world. They do not have to be on-scene. This is a powerful capability, as remote responders can assist without burdening the on-scene staff with logistic and safety needs. This can bring subject matter expertise immediately to where it is needed without having to physically travel to the Incident.

3) Geolocation

There are many methods for providing geolocation of apparatus, personnel, and other tracked entities. Some of these are installed and fixed on vehicles such as GPS-based automatic vehicle location (AVL). Others come with a well-equipped smart phone or other portable devices, under the classification PLI (Personal Location Information or Blue Force Tracker).

Knowing where people and things are enriches the NICS CONOPS significantly. It opens up the range of tactical options to include radio-less communication of movement orders and real-time re-alignment of resources as the threat condition changes. NICS consumes position location information, plots it on an easy to use map, and updates it every quarter minute, giving commanders a powerful technique for knowing if any units are in jeopardy should conditions change, and assigning resources where they are most needed (drag and drop), as examples.

[5] It is recommended that user organizations be proactive in taking as many precautions as possible to reduce the possibility of an interruption in Internet service. One way this can be done is to make Internet availability a part of an incident's communications plan. There are many techniques for providing an Internet bubble over an incident. Some of these are more costly than others. It is the responsibility of the user organization to assess these and pick options that provide the needed service for the conditions of the Incident at hand.

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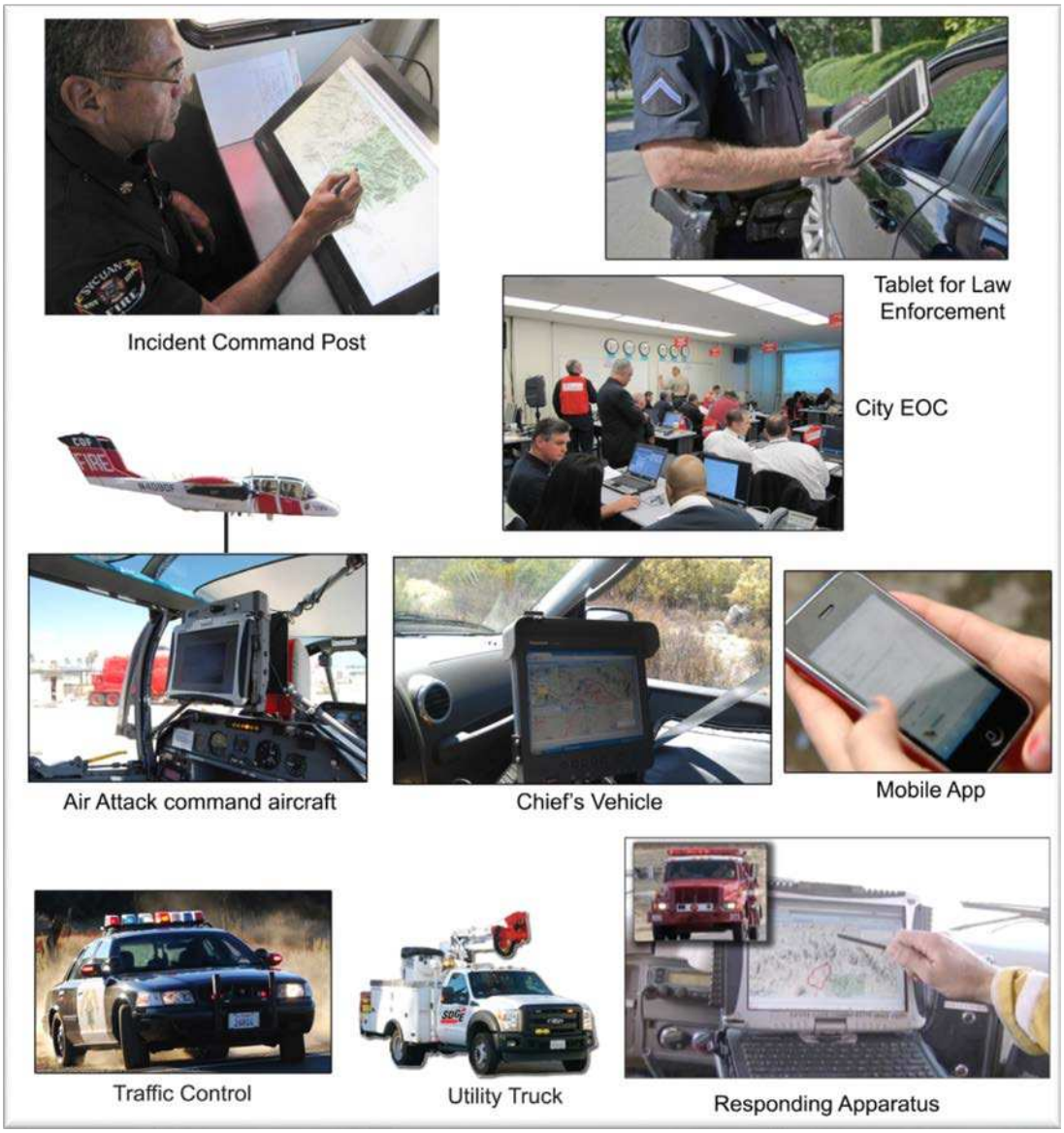

Figure 2 - NICS data is shared instantly by all entities that need to collaborate as well as those that are simply trying to keep informed. NICS works with any device, any operating system, and any browser.

4) User Created Layered Visualizations

In NICS, most data is anchored spatially and can be portrayed as a layer laminated over a map underlay. Which layers are chosen is determined by the user. Therefore a powerful technique to understanding and solving problems, as well as collaborating with others, is for the user to experiment with layering different data sets and visualizing new solution spaces. This is possible in NICS because of the sharing that is built into the technology.

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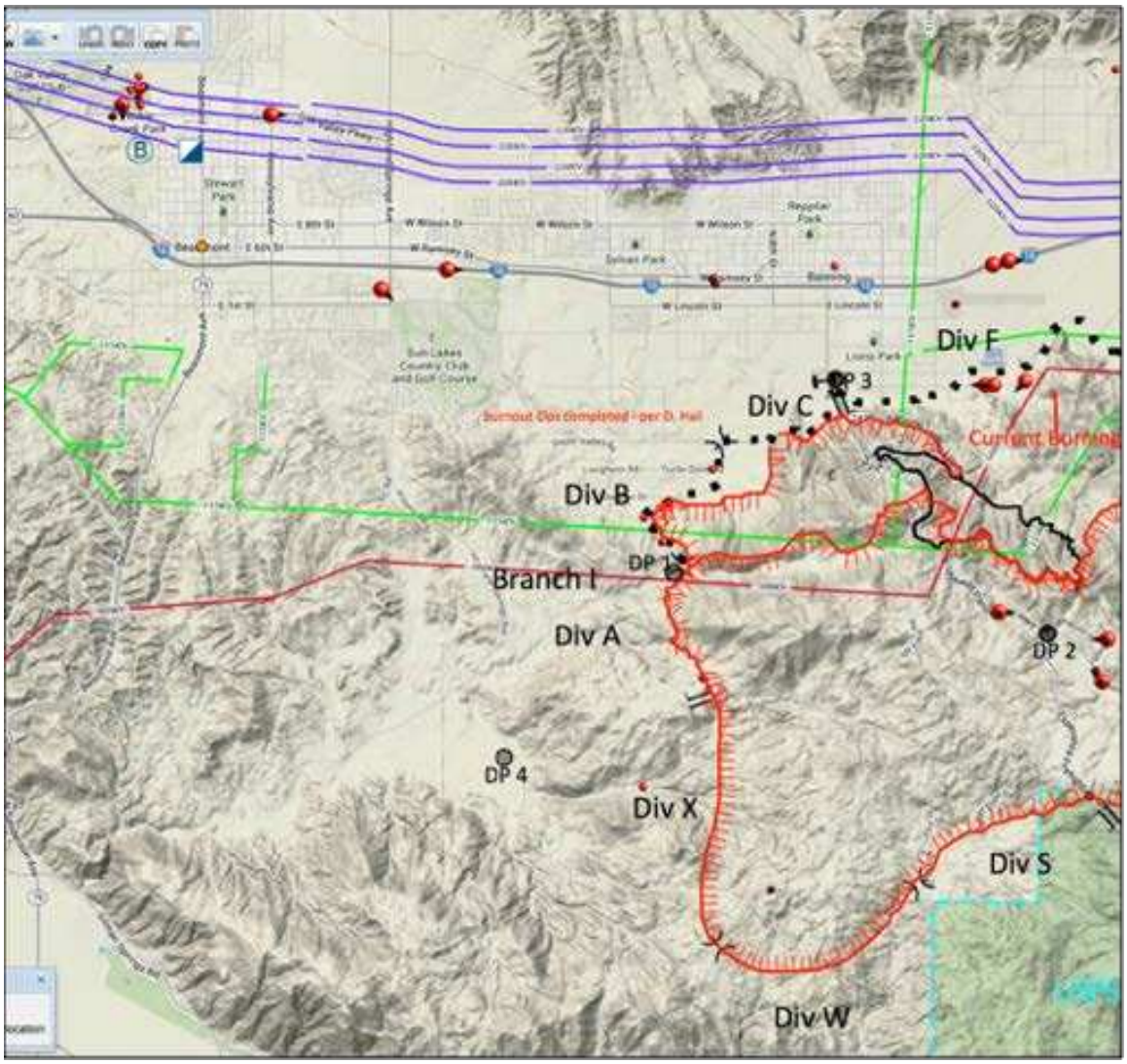

Figure 3 - A typical NICS screen shot showing the active fire line, land ownership, fire management notation (branches, divisions, drop points, other), power lines, and responding vehicle locations. At any one time this presentation could be actively viewed by dozens or even hundreds of authorized users from anywhere in the world as a shared visualization. Not shown is the public chat pane where text information can be shared.

5) Supporting Modalities of Human Communication

At the heart of the NICS collaborative environments are tools and technologies which support the three core modalities of human communication: Speech, Gesture, and Sketch.

NICS supports **Speech** via its public and private chat functions, as well as enabling spoken speech via traditional channels of communication (telephone, Internet voice, radio, etc.).

NICS supports **Gesture** by allowing users to create graphics that highlight actions, objects, directionality, and movement.

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NICS supports **Sketch** by allowing users to draw on the interactive desktop and share these graphics with other users also logged into the same space instantly anywhere in the world. NICS was designed to be easy to use, so the box of drawing tools is roughly one third of the capability of the typical PowerPoint toolset: limited but good enough.

6) Technology Neutral

NICS is technology neutral. There are no sideboards imposed on NICS users by outside vendors.

The user's computer can be any device (laptop, workstation, smart phone, tablet, etc.) running any standard operating system (Windows, OS X, iOS, Android, Linux, other) and employing any standard browser[6] (Safari, Firefox, Chrome, Internet Explorer, other). Users do not have to "buy in" and be held captive to a particular vendor's unique hardware or software solution.

7) No Application Software

There is no NICS "application software" that is loaded onto a user's computing device or must be regularly updated and maintained at the user level. NICS operates like all web applications with linking via appropriate Uniform Resource Locators (URLs) for referencing web pages (HTTP)[7], enabling file transfers (FTP)[8], sending and receiving email (EMAILTO)[9], accessing databases, and other applications.

8) Two Primary Conceptual Structures: Incidents and Rooms

At its highest level, NICS has two primary conceptual structures: **Incidents** and **Rooms.**

Incident — An Incident is any emergency management, humanitarian assistance, or disaster relief operation for any type of hazard or event across the four phases of Preparedness, Planning, Response, and Recovery. As such, an Incident can take on a wide variety of forms, sizes, complexities, life spans, and other features. It is a very flexible container.

An Incident could be a 100,000 acre vegetation fire, a train derailment, a hostage standoff, a

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[6] NICS does not work with Internet Explorer 8 and earlier. It does work with all later Internet Explorer versions.

[7] HTTP: Hypertext Transfer Protocol (HTTP) is an application protocol for distributed, collaborative, hypermedia information systems. HTTP is the foundation of data communication for the World Wide Web.

[8] FTP: File Transfer Protocol (FTP) is a standard network protocol used to transfer computer files between a client and server on a computer network.

[9] EMAILTO: A URL approach for managing email addresses within a web application

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HAZMAT spill, a search and rescue operation, or a mass casualty event.

Incidents are created, named, and defined by the organization that has jurisdictional responsibility.

The user who creates the Incident owns the Incident, i.e., is the primary administrator of the Incident. The administrator can assign permissions (by-name permission of who can see as well as interact with the content of the event), set rules for protecting and archiving the Incident, publish the details of the Incident privately or publicly, and other functions.

Room — Within every Incident is a structure called a Room, an extensible structure that creates a workspace. Most Incidents have multiple Rooms.

Rooms are created, named, and defined by a user via the Room pull-down menu.

New Rooms can be created at any time. They can be named with relevant names that are meaningful to the situation at hand.

Rooms are unique to a given Incident, i.e., multiple Incidents do not share the same room.

At this time in the NICS development, a Room is typically based upon a map, i.e., has a map underlay on which users add content (e.g., draw upon, move, modify, and annotate, such as with graphics). In the future a room might be an architectural floor plan, an organizational chart, a spreadsheet, or other data type.

Only one Incident and one Room can be open (visible) at the same time.

As with Incidents, the user who creates a Room owns that Room, e.g., is the primary administrator of that Room. The administrator can assign permissions (by-name permission of who can see as well as interact with the content of the event), set rules for protecting and archiving the Room, publish the details of the Room privately or publicly, and other functions.

9) Captured History of All Actions

Because NICS uses networks to share information among all users, it is possible to time-stamp and log all information packets that travel across the NICS network creating the shared environment and, as a result, have a complete history of the command and control of the incident, second-by-second.

As an example, if a user at one location logs into NICS and opens an Incident, those actions are captured and archived: who took the action, what action was taken, the time of the action, and any consequent reaction. If that user then opens a Room, zooms into a specific location on the map, and draws a line, that is all recorded and archived. By replaying that archive it is possible to replay and examine the exact details of what specifically took place.

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This is similar to a technique developed for the technology of distributed or networked simulation: Capturing the data packets that are being exchanged by potentially hundreds of simulation devices across a nationwide or worldwide simulation network allows the precise reconstruction of the operation being executed.

Once this archiving capability is activated in NICS, this means that, for the first time, there is a technique for capturing the micro details of the command and control of an Incident for later study, instruction, analysis, and so forth.

10) Tired — Dirty — Hungry Responder under Extreme Stress

NICS was designed from the beginning to serve a specific category of operator: The Tired - Dirty - Hungry Responder Under Extreme Stress. The result is the design of a user interface that is intuitive and easy to use. There are two ways to appreciate this user interface, and these are listed below as the General and Specific Design Guidance that was employed in the construction of NICS.

11) General & Specific Design Guidance

General - The general design guidance[10] for incorporating best practices for user-centered web design as it has been applied in NICS CONOPS is captured in the following:

a) Piggy-back on known interaction patterns
b) Limit controls and options to the most necessary
c) Keep it simple, but not stupid
d) Design for known user needs
e) Allow for errors, but provide easy recovery
f) Follow an object => action model
g) Use screen space wisely
h) Always provide a recommendation
i) Think it, try it, test it

[10] Advanced design principles for user-centered web design from J.T. Thorpe, professional web designer, personal communication. For more information email info@ravenwics.org

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Specific - The specific design guidance emerging from the CONOPS enablers described above, that have guided NICS development are:

1) Adherence to ICS/NIMS	NICS is firmly rooted in the structure, philosophy, policies, and procedures of the Incident Command System (ICS) and the National Incident Management System (NIMS). The developers of NICS and its predecessor come from the operational community and are expert practitioners of ICS/NIMS. NICS is focused at the incident command level and is designed to enable faster and more complete situational awareness at the point of the sword where responders are looking at the threat face-to-face.
2) Seamless Scalability	NICS is designed to be "All Scale", with the same tools, technologies, concepts of operation, and services relevant from initial response to extreme-scale, seamlessly. There are no new tools, concepts, procedures, design philosophies or user interfaces that the user has to master moving across the scale of incidents. The long-range goal is for NICS to support 1,000s of users from 100s of organizations working dozens of incidents simultaneously.
3) Network to the Edge	NICS is designed to connect the most remote users, those at the point of the sword looking at the evolving threat face-to-face and who are trying to develop situational awareness about what is happening and what should be done about it. With these forward users using the NICS network, information that they are collecting and sharing with others on the front lines can be easily transmitted to rear echelons to build situational awareness about the larger battlefield. Networking to the edge means that forward users will be equipped with mobile, handheld computers (smart phones, tablets) as well as vehicle-mounted laptops and other devices. Further, these need to be resilient when operating in remote, Internet-degraded settings where connectivity could be intermittent. In such cases, "fail soft" and "restore gracefully" processes aid the user.
4) Technology Neutral - Web Based	NICS is designed to be technology neutral. The user can employ any computational device (workstation, laptop, tablet, smart phone, other) running any standard operating system (Windows, OS X, iOS, Android, Linux, other) using any basic browser (Safari, Firefox, Chrome, Internet Explorer (Version 9 and later)).
5) App Store Development Approach	NICS is designed around a platform architecture where growth, expansion, and tailoring is accomplished with Apps and Plugins, as with the Apple App Store. Anyone can contribute: commercial, academia, government, uniformed responder, private citizen, as examples.

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6) All Hazard	The long term vision for NICS is to be responsive to hazards across the board, to include storms, lightening, fires, floods, hurricanes, volcanic activity, landslides, explosions, aircraft accidents, earthquakes, windstorms, tidal waves, terrorist attacks, chemical spills, and train derailments.
7) Platform for the Tired - Dirty - Hungry	NICS is first and foremost designed for simplicity of use. It is for the Tired - Dirty - Hungry responder under extreme stress. As such, it is designed to be "dirt simple to learn" and "dirt simple to use." If a user knows how to turn on a computer, surf the web, and find the local "Olive Garden" using Google Maps, then they can learn all basic NICS operations in 60 minutes or less.
8) Growth Model	NICS is not owned by a vendor. Its intellectual property is not up for sale. It is a community project for and by the community. WICS, as a non-profit organization, will offer NICS services at the minimum cost needed to support the operational community of users, maintain the technology base, and make improvements as recommended by users.

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NICS CONOPS: As viewed from an Executive/Administrator Perspective

From the view of the senior Executive or Administrator, NICS is a system that creates a web of information resources, sensors, analysis and processing nodes, and other parts of the intelligence gathering and decision support infrastructure, to allow the Executive or Administrator to move efficiently through the information space vertically and horizontally, from the front line to the rear echelon, in a manner never experienced before, effortlessly.

Rather than being constrained by the traditional hierarchical movement of information, the Executive or Administrator can log into the NICS web at any point and at any time and from any location and observe what is transpiring across multiple incidents in order develop that situational awareness. This can be done on a noninterference basis: Unlike the past when an Executive had to call to the front lines and speak directly to the Incident Commander to get an accurate assessment about what was going on, the Executive can now get the same information faster and more accurately via NICS without bothering anyone.

Importantly, the information in NICS is significantly more timely than before. Operators describe NICS as reducing the time to create situational awareness "from 12 hours to 12 minutes."

The NICS web is fluid, and fed from the front: Operators at the point of the sword feed current conditions into NICS, sharing what they see with others on the front lines on either flank. Enabled by the Internet, this information flows easily to rear echelons where Executives can stay better informed.

NICS CONOPS - As viewed from a Technical/Operational Perspective

NICS has significantly impacted the role of the frontline operator. Using any suitable device, the first responder can see the evolving situation they are about to become engaged in while en route, and be positioned at critical junctures from the beginning rather than reporting to a staging area as is standard. The responder has fingertip access to critical data (e.g., fire history) including pre-plans that can be activated up front and shared since they are in digital format rather than a paper document in the back of an SUV.

Being fed with timely and relevant data, as well as having their locations known across the incident, forward responders can be much safer than in the past. Location information is easier and less expensive to acquire than before. It is straightforward to instrument an apparatus with Global Positioning System (GPS) so it knows precisely where it is and can broadcast that location so that all others know where it is, too, via an Automatic Vehicle Location (AVL) system. Similarly a plethora of small, portable, inexpensive devices can be carried by the dismounted responder for determining and reporting their specific geolocation (Personal Location Information, PLI).

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Knowing where everyone is on the battleground is a game changer. When weather changes unpredictably, for example, anyone in jeopardy can be instantly notified and directed to safer ground, as could resources that might be called to intervene should someone find themselves in danger.

Given that NICS allows efficient communications via chat and visually via gesture, it is possible to communicate complex instructions without stressing the voice-over-radio/phone networks that should be reserved for emergency traffic.

Further, NICS facilitates operations in pedestrian ways. It can efficiently help find people needed for meetings and decision sessions, and it can show where resources are to personnel arriving on scene, as examples.

These improvements to CONOPS are possible because NICS has been carried forward to the front lines, is easy to use by operators (the Tired-Dirty-Hungry), and it is resilient and robust.

For more information, see www.ravenwics.org.

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