

Edge Analytics: Analysis of Social Media to Support Tactical Users

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Carnegie Mellon University

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Agenda

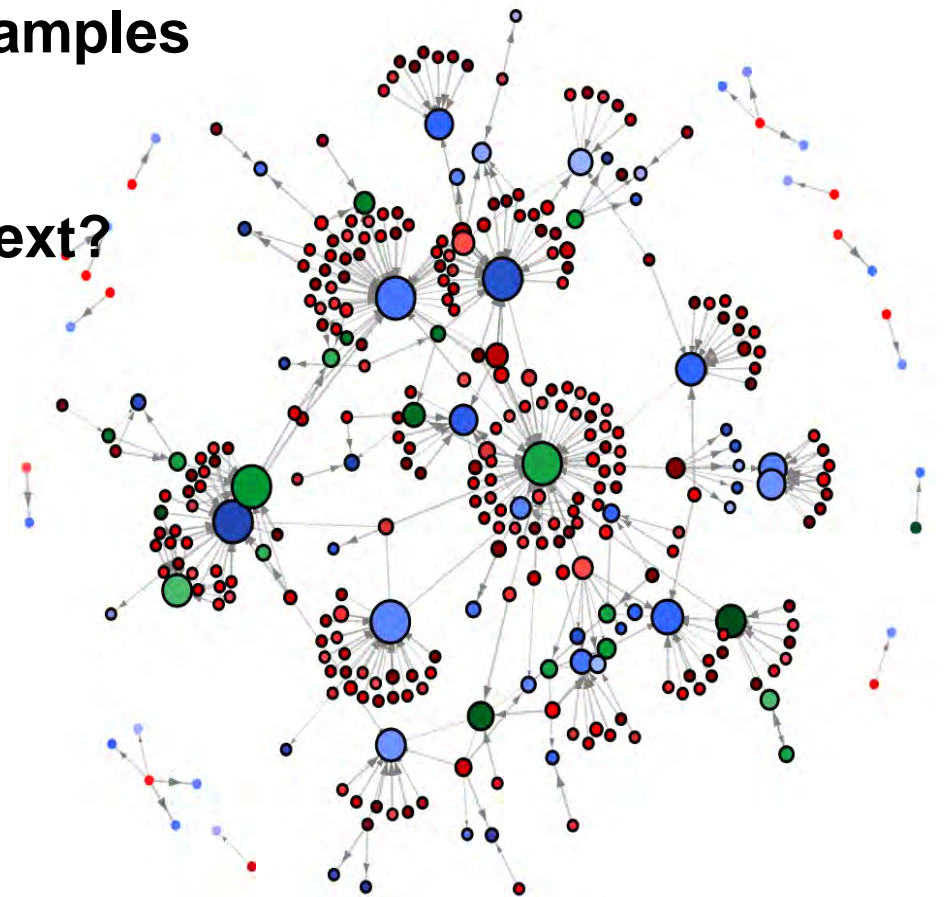
Our Mission

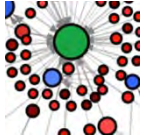
Tactical Analytics

Some Examples

A Demo!

What's Next?





Advanced Mobile Systems (AMS)



Investigates efficient and easily-deployable mobile solutions for teams operating in edge environments characterized by dynamic context, limited computing resources, high stress, and poor connectivity

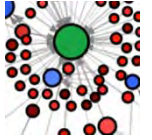
AMS prototypes capabilities to stakeholders operating in mission-critical environments that

- improve situational awareness and data analysis
- reduce cognitive load and complexity by exploiting contextual information
- increase compute power, data access and survivability while reducing power demands



AMS facilitates interactive mission assistance in edge environments by leveraging available sensors and information from other people and systems.

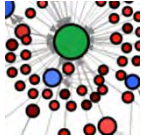




AMS Research Areas

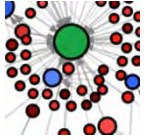
Tactical Analytics
(TA) Application of data analytics to streaming and other data for near real-time analysis and rapid decision cycles in tactical settings

Tactical Computing and Communications
(TCC) Strategies for enhanced computing capabilities in environments characterized by limited computational resources and power, and frequently disconnected, intermittent, and low-bandwidth (DIL) communications



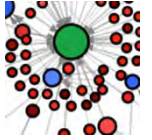
Tactical Computing and Communications (TCC)

Information Superiority to the Edge (ISE)	Mobile solutions that reduce cognitive load and conserve resources of individuals and groups by exploiting sensor, role/task, and event information, such that the right information, at the right time, is presented to the right soldier
Tactical Cloudlets	Cyber-foraging solutions that dynamically augment the computing resources of resource-limited mobile devices and address critical system qualities not considered by the commercial mobile ecosystem, such as survivability, resiliency, and trust
Delay Tolerant Networking (DTN)	Applying DTN to disconnected, interrupted, and low-bandwidth (DIL) tactical environments
Geo Intelligence	Obfuscation of queries to commercial geodatabases



Tactical Analytics (TA)

Edge Analytics	End-to-end, near real-time data analysis of static and streaming data for resource-constrained edge environments. Current research is exploring algorithms that quantify credibility of social media
Transfer Learning	Exploration of a type of machine learning called transfer learning applied to the problem of helping junior analysts perform more like experienced analysts in recognizing recurrent patterns and relating new information to these patterns, and recognizing new variants on the pattern
Supervised LDA	Exploration of enhanced use of analyst-provided input to improve the ability of machine learning technology to structure open source data in order to improve the ability of analysts to explore, interact with, and understand the data
Fusion	Strategies to assist analysts in correlating and relating various forms of open source data and intel data from other sources



Edge Analytics ₁



Near real-time situational awareness for edge users by analyzing social media and other sensor streams to provide actionable intelligence, trends, and summaries

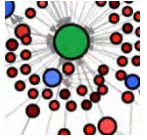
Most analyses are batch-oriented and done in the resource-rich “enterprise cloud” away from edge

Goal is to bring near-real-time analysis of data to edge environments (resource-constrained) by

- performing timeliness-fidelity tradeoffs
- maximizing resource utilization and elasticity
- leveraging contextual clues from the hyper-local edge environment
- providing more control to end users to perform on demand analysis

FY15 Research Focus: Credibility scoring of open sources data in edge environments

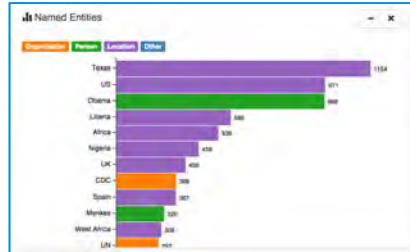




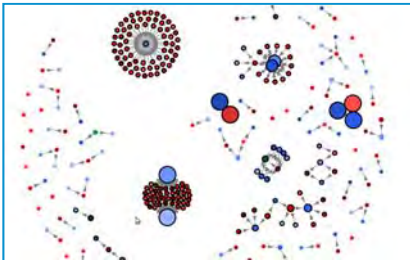
Edge Analytics 3



Location Inference



Trending Named Entities



Streaming Graph Analysis (User Mentions)



Total Tweets and Sentiment Over Time

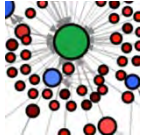


Sentiment Analysis

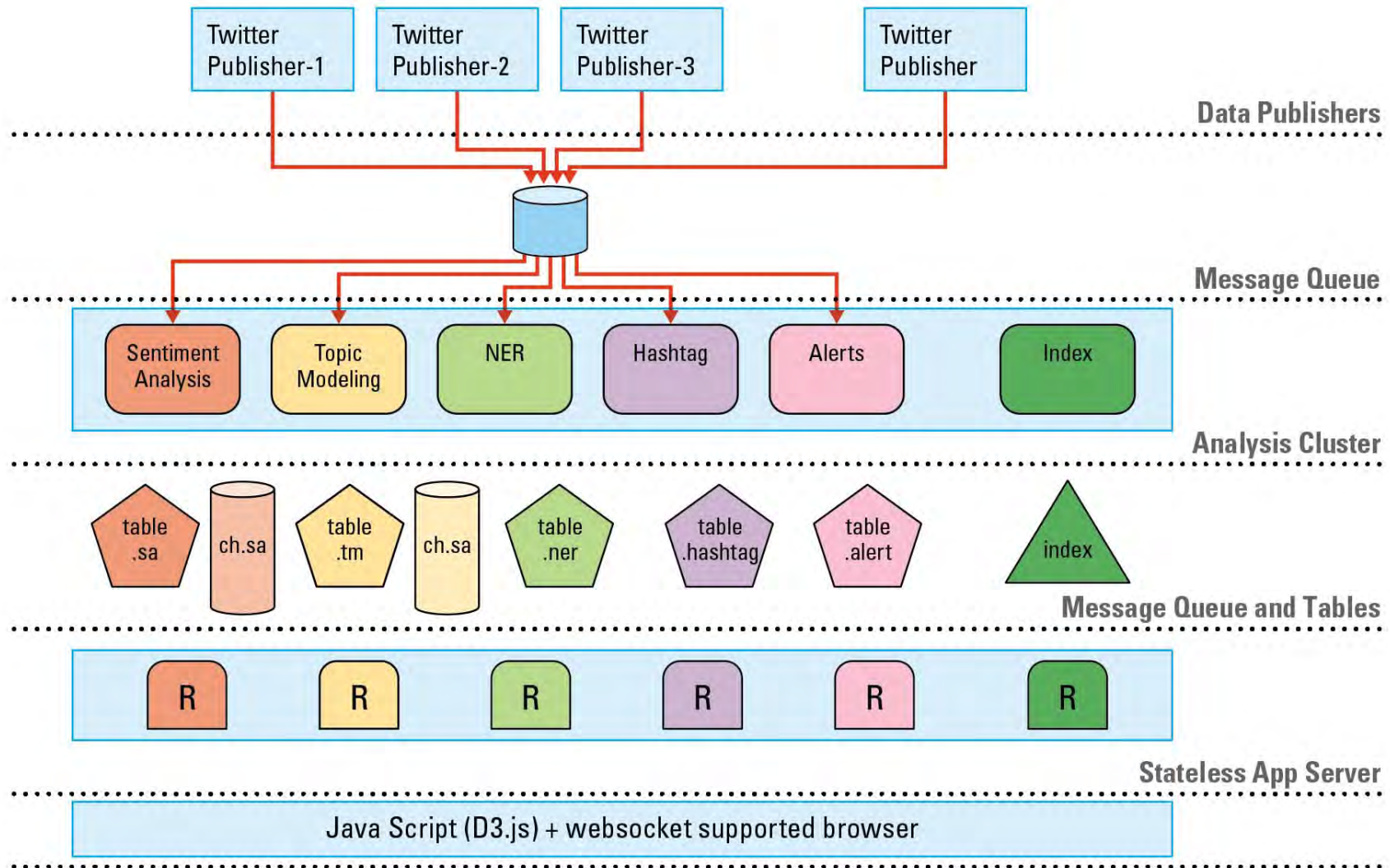
FY15 Activities

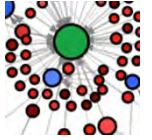
- Integration with MIT LL NICS and demonstration to IAB (Feb 2015)
- AF/A2I DEWEY new start using EA to analyze twitter data
- Deployed in support of Boston Marathon and Pope Francis visit (PA NG 3rd WMD CST)
- Research on establishing credibility of social media data





Edge Analytics High-level Architecture





Potential Applications of Edge Analytics

Forensic: Who, what, when, where, why after the event

- *Who was responsible for the bombing?*

Reactive: Response while an event is occurring

- *Power line down – redirect traffic*

Proactive/Actionable: Predictions lead to actions

- *Negative sentiment – increase security at embassy*

Preventative/Influence: Influence opinion to prevent crisis

- *Official announcement through social media that bomb threats at Little League World Series are rumors*



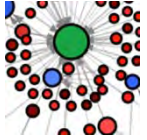


Benghazi Consulate Attack Analysis and Operations

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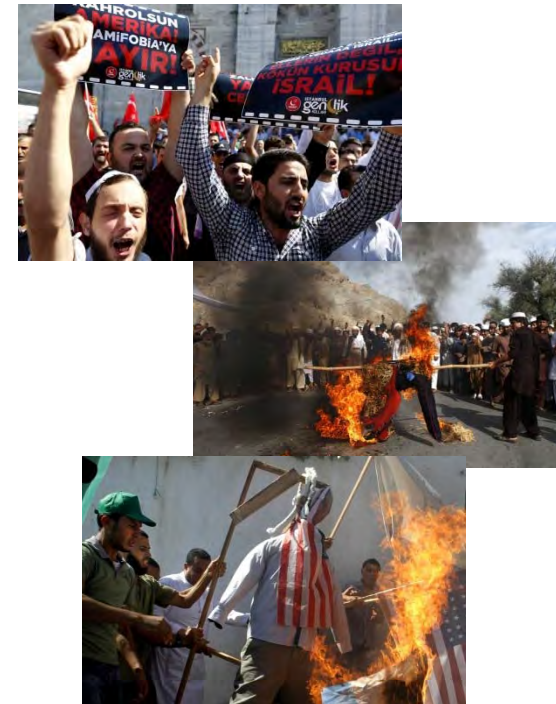
Marc Novakouski, Gene Cahill

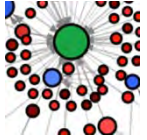
24-Mar-2014



Background

Between September 11 and 17, 2012, diplomatic missions in the Middle East, Asia, and Europe were subject to protests and violent attacks in response to an inflammatory video, [*Innocence of Muslims*](#).






Cairo Demonstration Timeline

 **Soliman_solo** @Soliman_solo Tue Sep 11 14:57:10 -0400 2012
Al-Qaeda flags flapping in the Mohamed Mahmoud Street # Egypt # _ U.S. Embassy <http://t.co/Tw0q9rb2>



 **To0okaaa** @7o0okaaa Tue Sep 11 15:54:29 -0400 2012
3 youth clothed in T-shirt Martyrs Oltras Ahlawy Perfau aware of "No God but God and Mohammed is the Messenger of Allah" place American flag <http://t.co/cp1ZOB7r>



 **Tahrir_now** @Tahrir_now Tue Sep 11 12:49:47 -0400 2012
Today's demonstration in front of the U.S. Embassy in Cairo at 5 to object to insult the Prophet Muhammad peace be upon him by some of the ... <http://t.co/hnZJUMnE>

 **RawSmackdownTNA** @RawSmackdownTNA Tue Sep 11 19:42:27 -0400 2012
Protesters angered by US film "insulting to Prophet Muhammad" breach wall of US embassy in #Cairo, #Egypt via @BBCBreaking



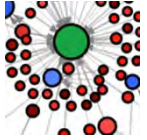
**Before
Demonstration**

**During
Demonstration**

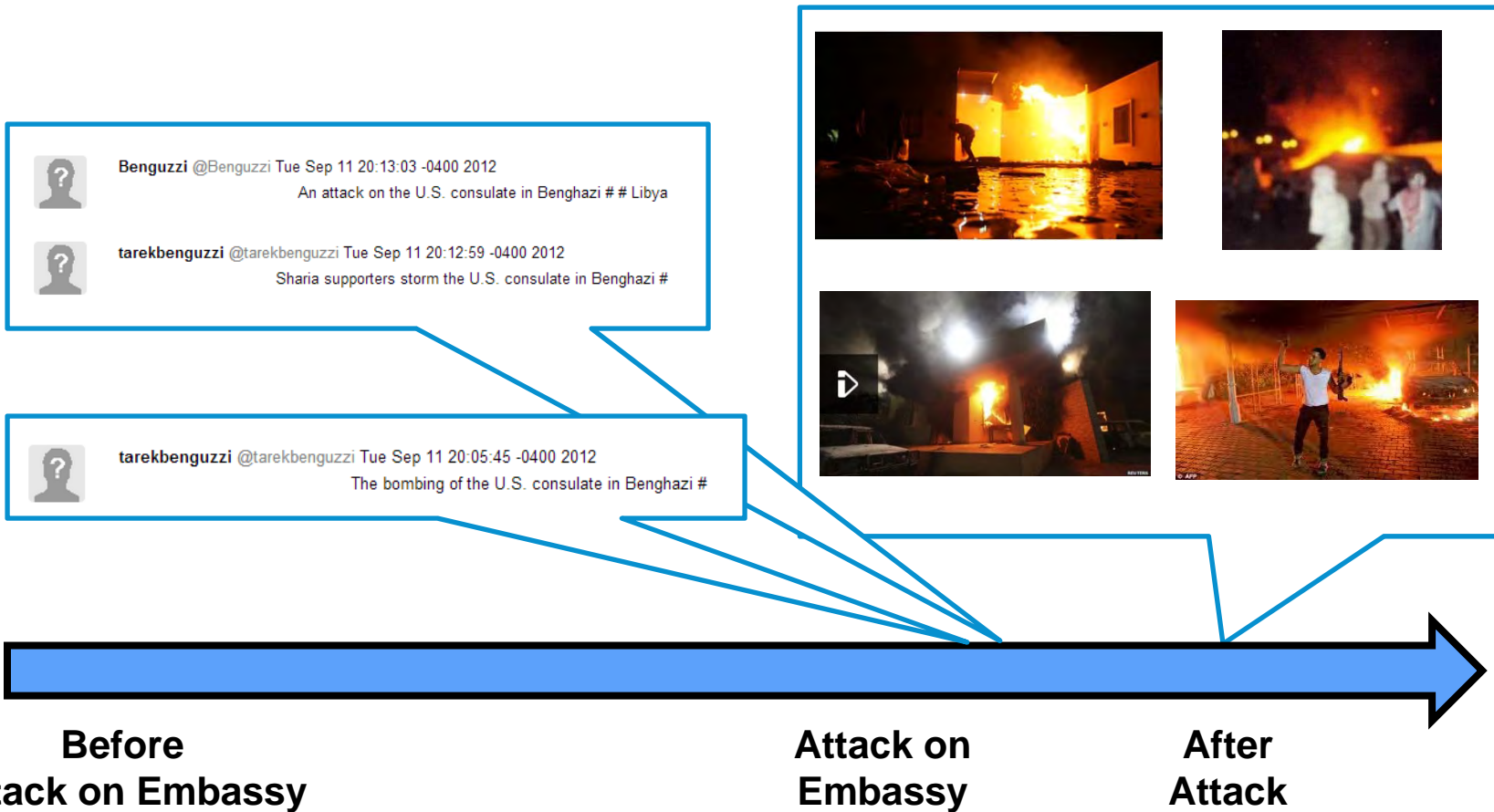
**Attack on
Embassy**

**After
Demonstration**





Benghazi Timeline

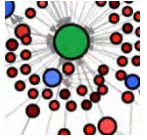


Verifying the Effectiveness of Wireless Emergency Alerts (WEA)

SEI Advanced Mobile Technologies
Initiative

25-Mar-2014



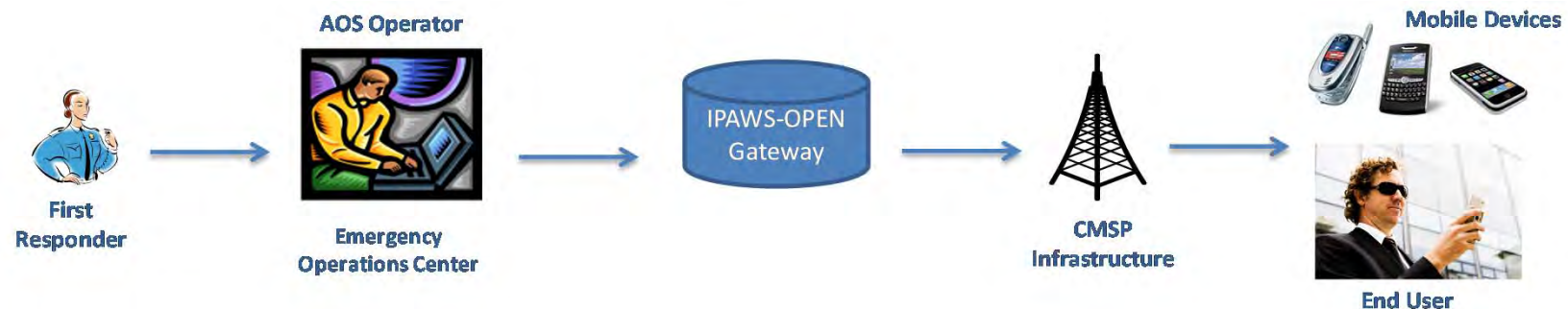


Wireless Emergency Alert Service

Operated by FEMA with collaboration from FCC

Enables authorized Emergency Management agencies to broadcast alerts to mobile devices within a specified geographic area

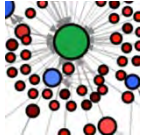
- Imminent threat alerts (flood, fire, active shooter, etc.)
- AMBER alert
- Presidential emergency (nationwide broadcast)



But how do you measure the effectiveness of WEA?

- receipt of the alert (e.g., who, what, when, where)
- reaction to the alert (annoyance, panic, compliance)





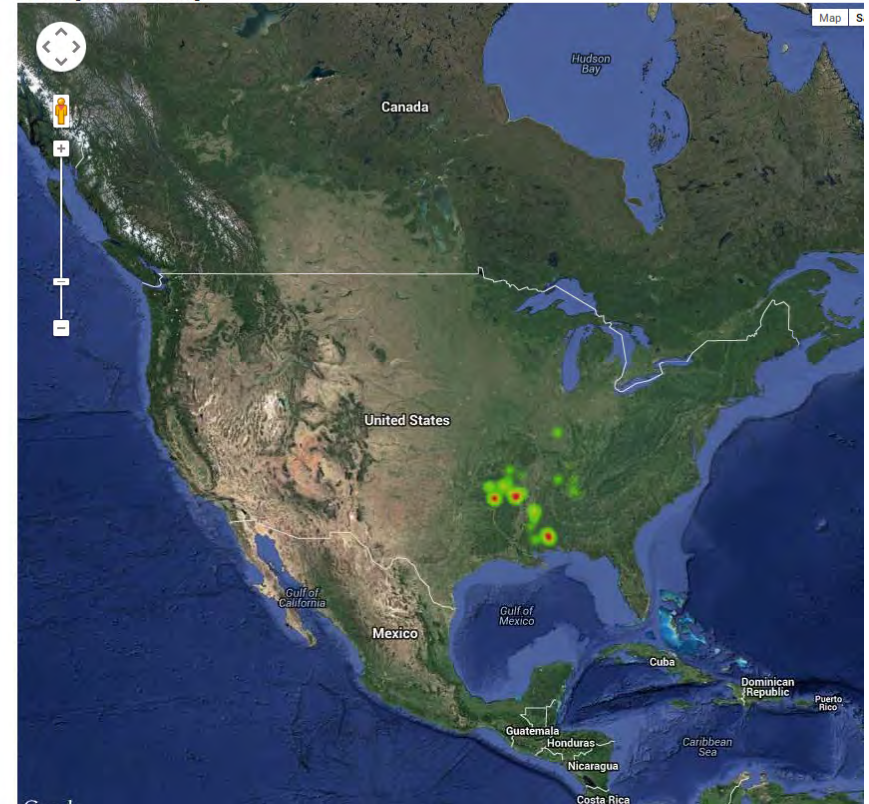
Correlation of WEA Alerts and Tweets

Correlation of WEA alerts and corresponding tweets on twitter by time (week), alert type (ex: FLASH FLOOD WARNING, TORNADO WARNING) and location (county, state)

WEA Alerts [Source: National Weather Service]

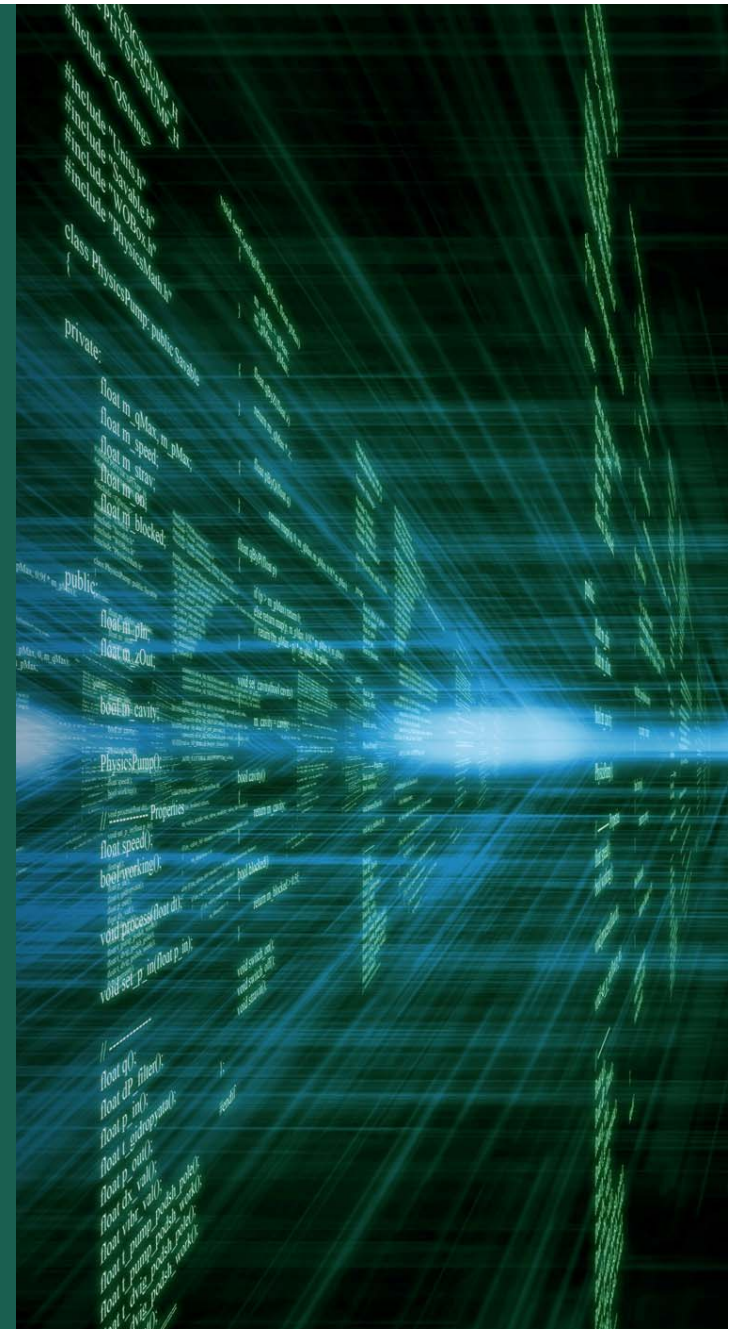


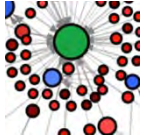
Tweets [Source: Twitter]



Edge Analytics Demonstration

Keegan Williams

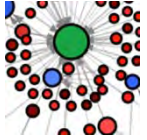




What's Next

Transfer Learning LENS	Structural Multi-Task Transfer Learning – Leverage DAG (Directed Acyclic Graphs) encoded scripts to automate computer assisted learning
LDA LENS	Generalized Supervised Latent Dirichlet Allocation (LDA) – characterize data with small seed datasets then improve precision through operator intervention
DATA	Expand the number and types of data feeds
AF A2 Innovation	Become a tool in the DEWEY Project toolkit
NG WMD-CST	Continue to gain boots on the ground experience

How Can We Help You?



Contact Information

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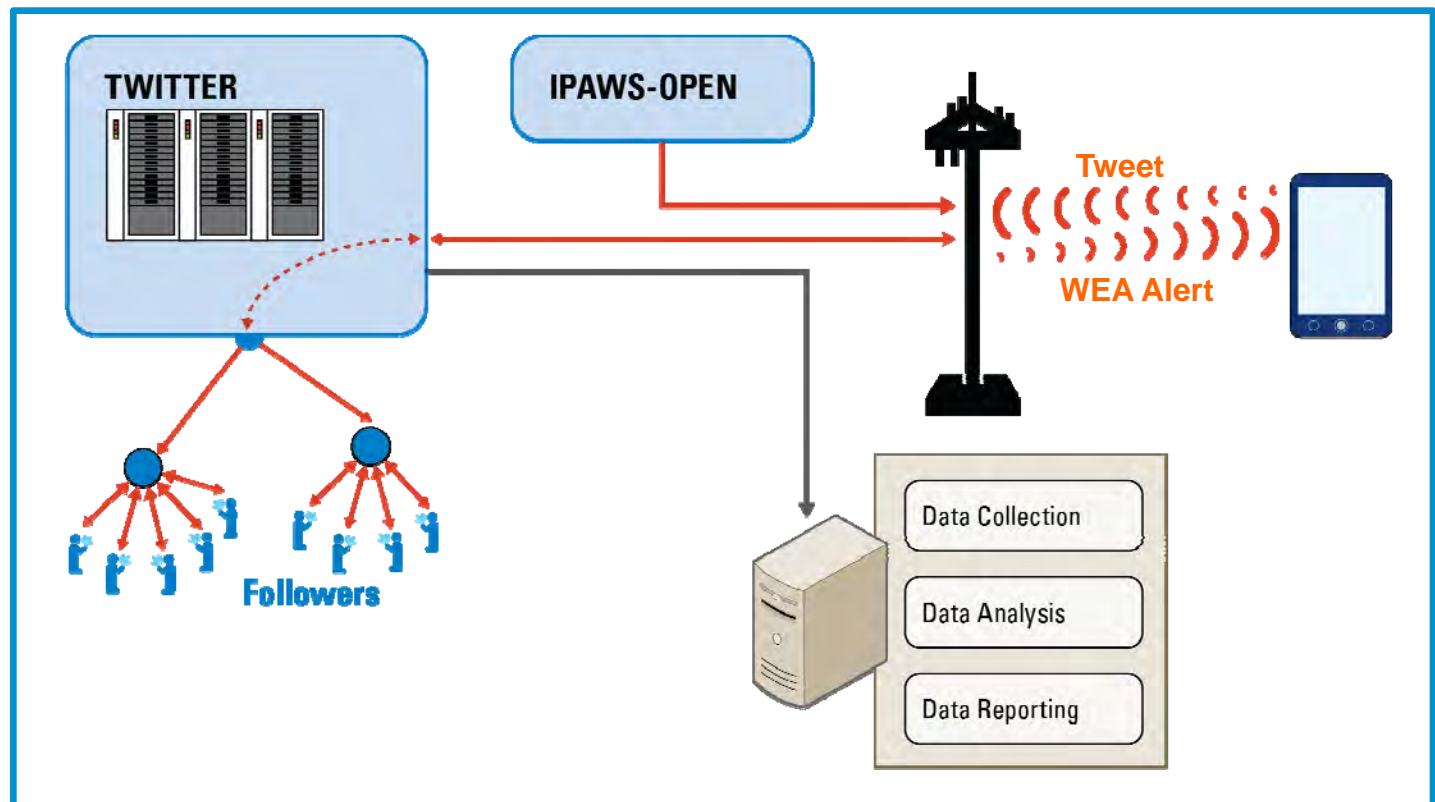
SEI Fax: +1 412-268-6257

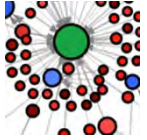


WEA Feedback from Edge Analytics (passive)

During an emergency, people often turn to social media to receive and to share information

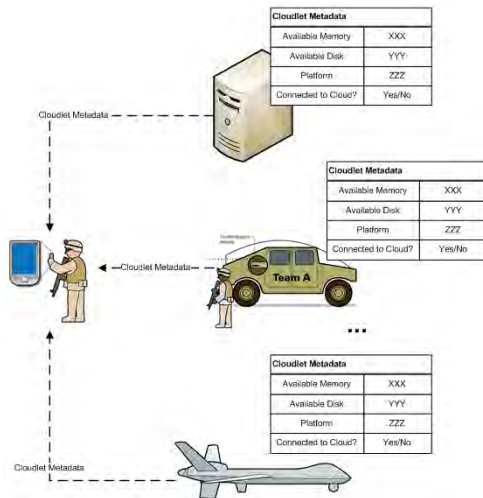
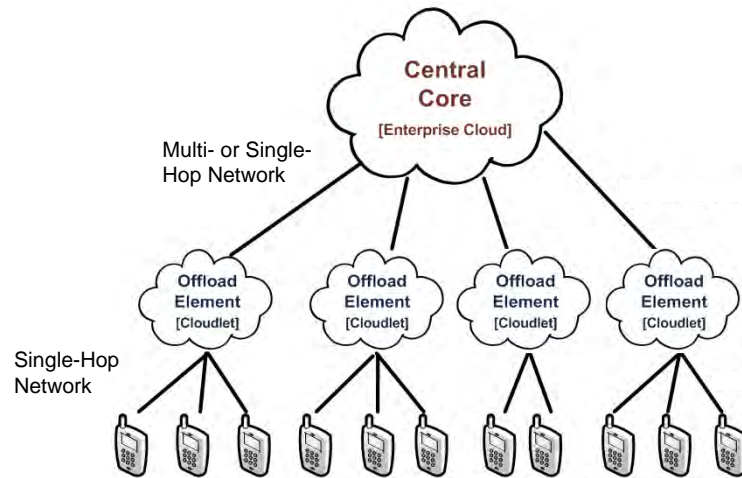
After a WEA message we can use **Edge Analytics** to monitor Twitter and other SM platforms to assess message distribution and response





Tactical Cloudlets ₁

Cyber-Foraging in Resource-Constrained Environments



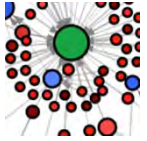
Cloud computing capabilities at the edge for computation offload, data staging, and increased survivability of mobile systems

Forward-deployed, discoverable, virtual machine (VM) based cloudlets that can be hosted on vehicles or other platforms and provide

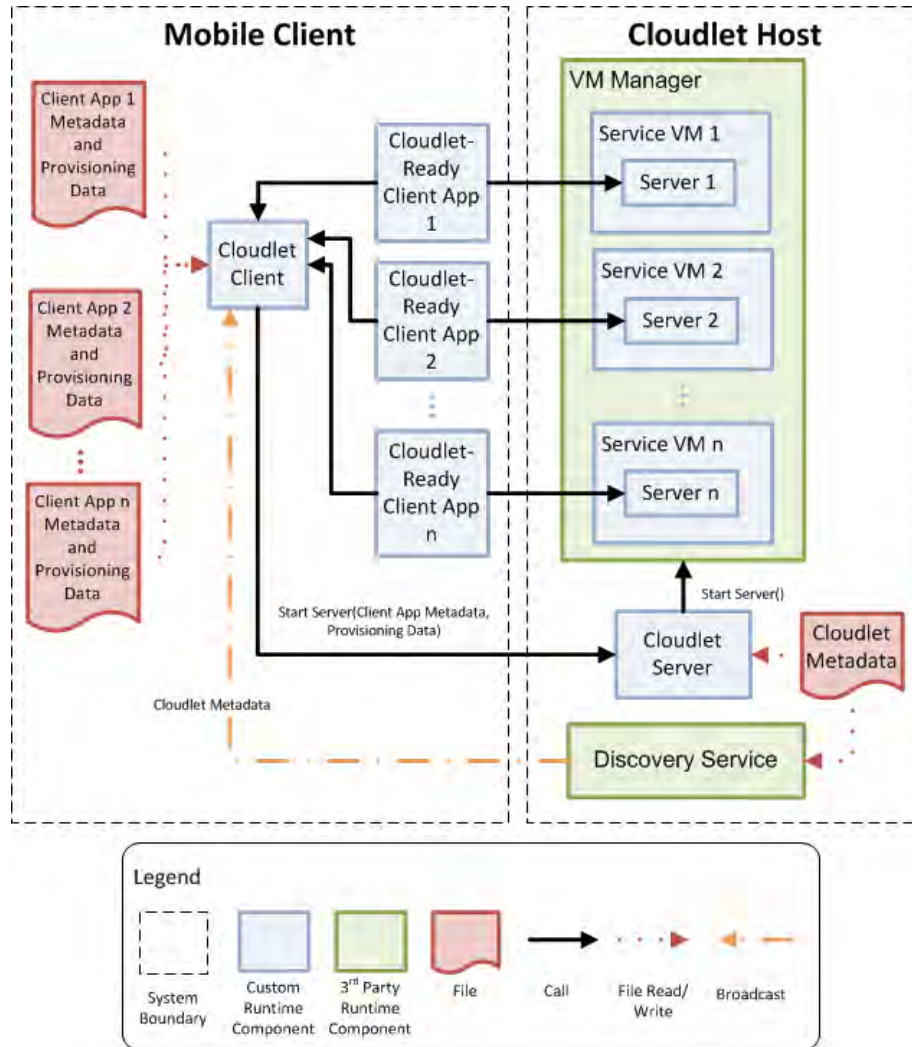
- infrastructure to offload computation
- forward data-staging for a mission
- data filtering to remove unnecessary data from streams intended for disembodied warfighters
- collection points for data heading for enterprise repositories

FY14 Research Focus: Increased survivability of tactical mobile systems

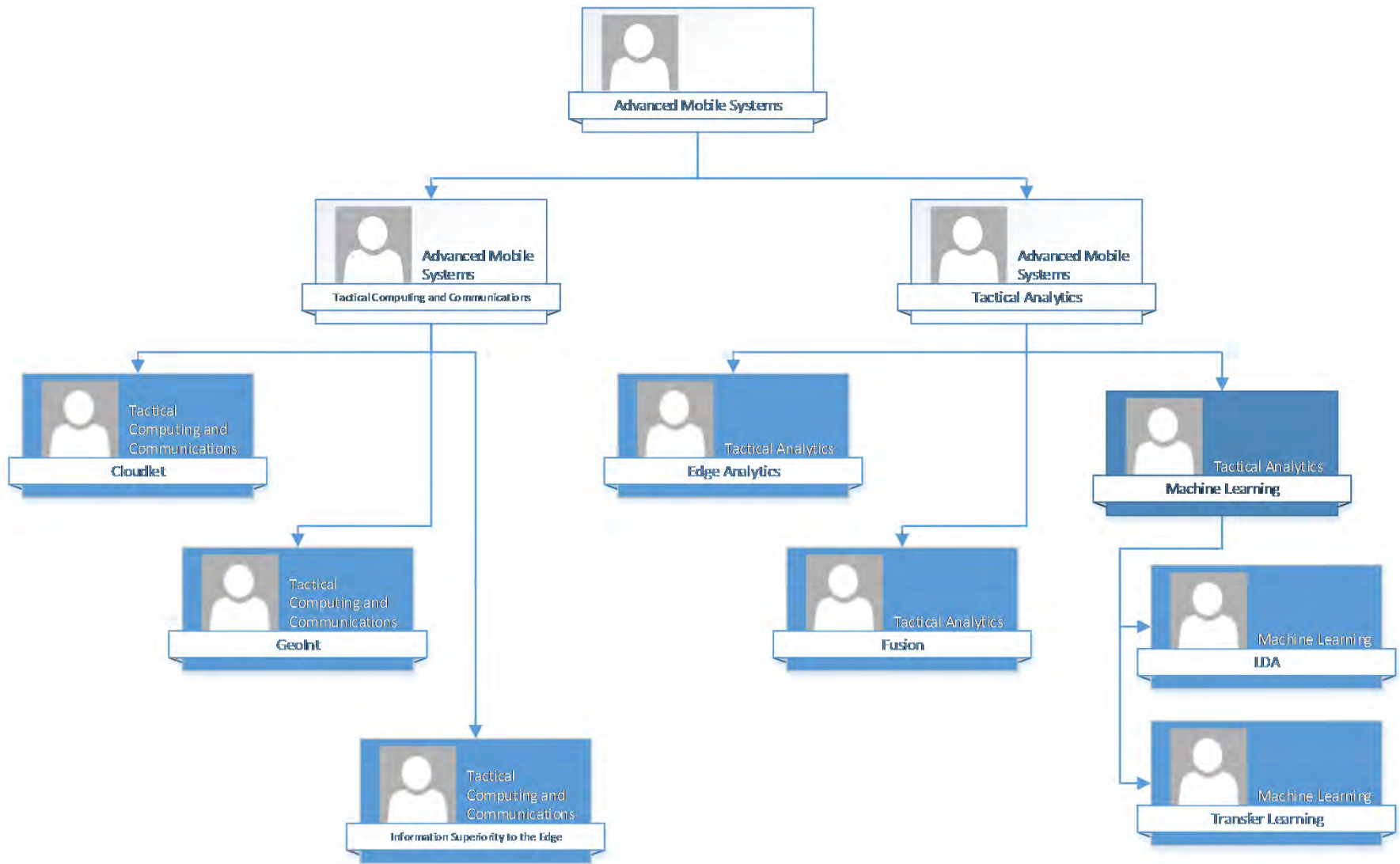


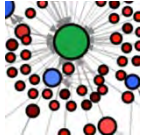


Reference Architecture for Cloudlet-Based Cyber-Foraging

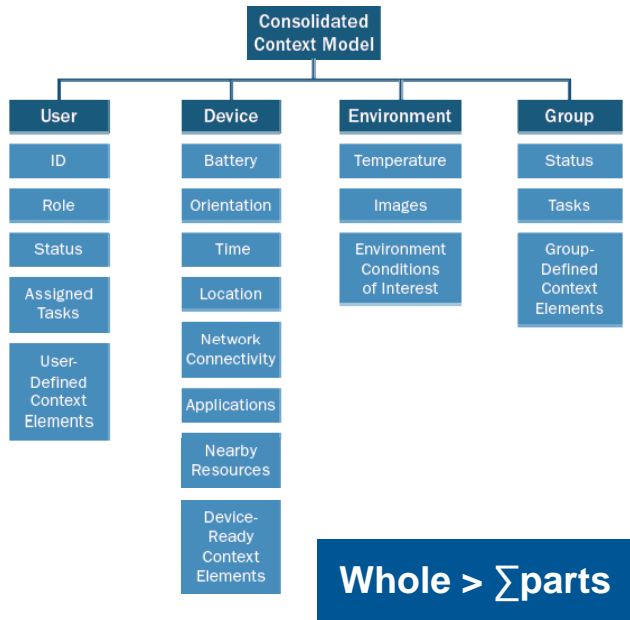


Organization





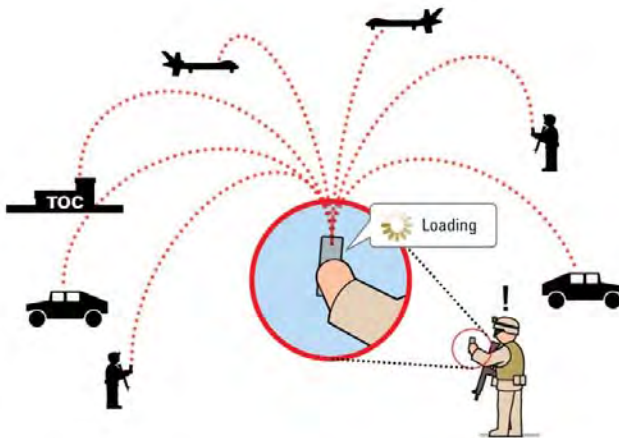
Information Superiority to the Edge ₁

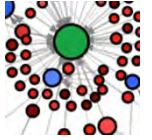


Group context aware reference architecture, middleware, data model, and prototype implementation to reduce cognitive load and conserve resources by using sensor, role/task, and event information to deliver the right information, at the right time, to the right soldier

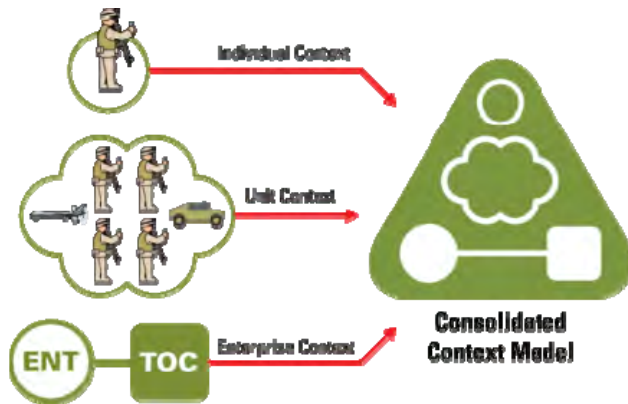
Context Model: Expand the context model beyond time and location, resulting in broader and more complete understanding

Context Reasoning: Broader context model allows reasoning and reaction to the context of the individual, other individuals, the group, and the organization.





Information Superiority to the Edge ₂



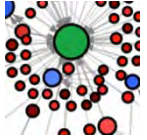
Resource Usage: Use of broader context allows smarter and more efficient resource allocation.

Cognitive Load: Richer context models can decrease the soldier's cognitive load required to capture, visualize and react to situational information.

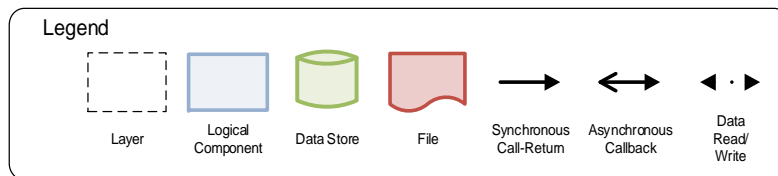
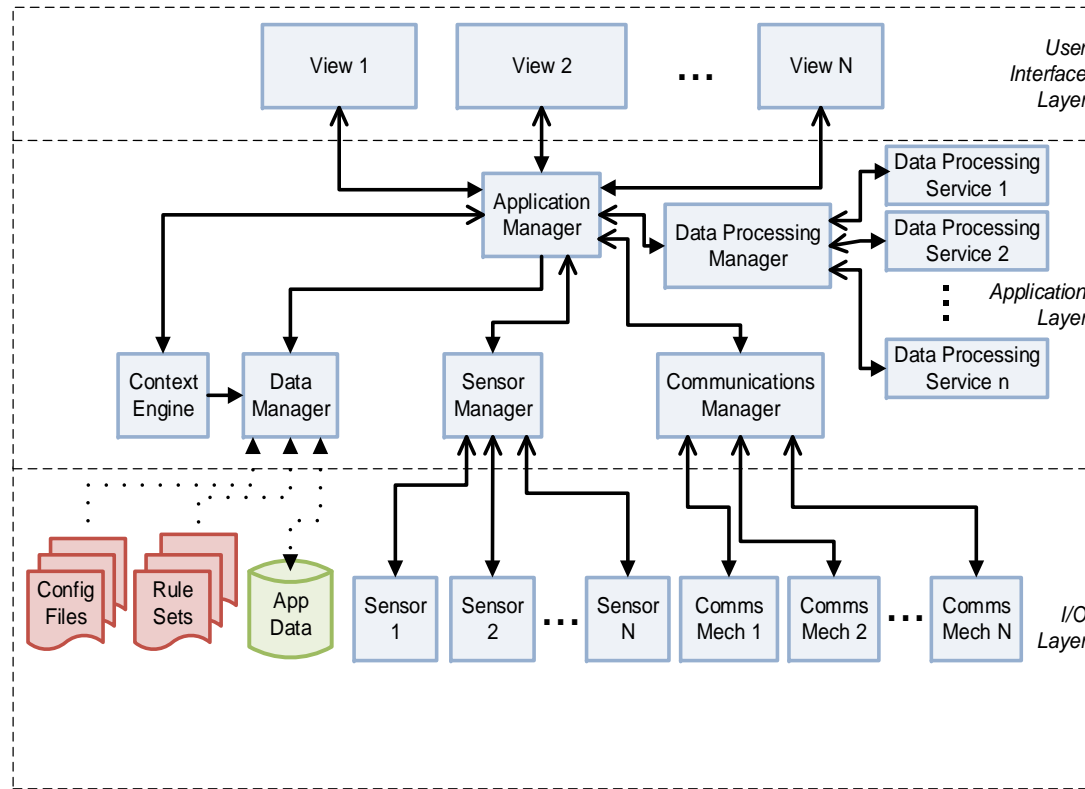


FY14 Research Focus: Leveraging individual and group context to reliably deliver the right information, to the right soldier, at the right time





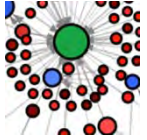
Reference Architecture for Mobile Applications at the Edge (ISE & DTN)



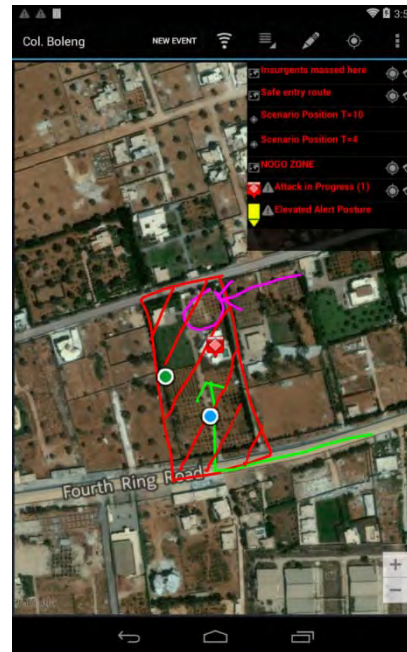
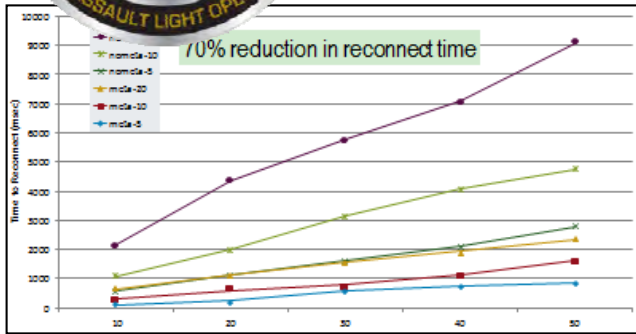
Key Qualities

- Modifiability
 - the ability to change between the views, rules, configurations, sensors, and radios without significant effort
- Extensibility
 - the ability to integrate new views, sensors, radios, profiles, and rules without impacting the rest of the architecture





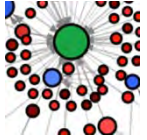
Information Superiority to the Edge 4



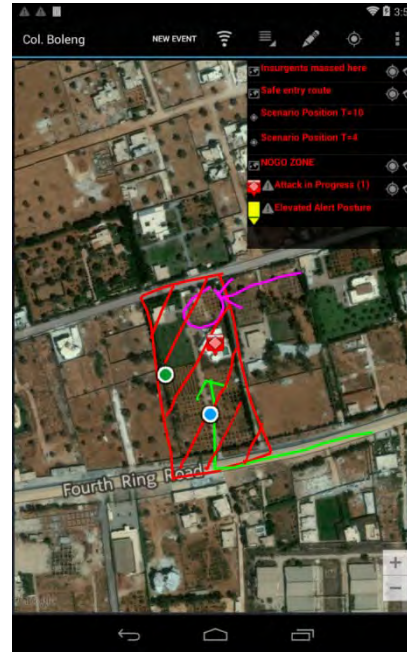
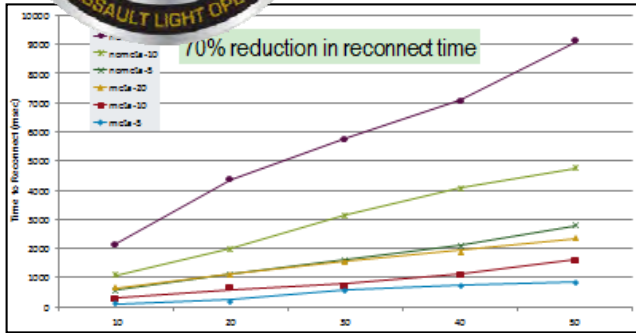
FY15 Activities

- TALOS system and software architecture, initial infrastructure, service builds
- Integration with PRC AN/117 radio, demonstration in Sept. (USMC Intel Technology Innovation Division)
- Fusion of data from ISE and Group Context Framework (GCF) on Edge Analytics platform





Information Superiority to the Edge 4



FY15 Activities

- TALOS system and software architecture, initial infrastructure, service builds
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