Edge Analytics: Analysis of Social Media to Support Tactical Users

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Agenda

Our Mission
Tactical Analytics
Some Examples
A Demo!
What’s Next?
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

<table>
<thead>
<tr>
<th>AMS Research Areas</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Tactical Analytics</strong> (TA)</td>
<td>Application of data analytics to streaming and other data for near real-time</td>
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<td></td>
<td>analysis and rapid decision cycles in tactical settings</td>
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<tr>
<td><strong>Tactical Computing and Communications</strong></td>
<td>Strategies for enhanced computing capabilities in environments characterized</td>
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<tr>
<td>(TCC)</td>
<td>by limited computational resources and power, and frequently disconnected,</td>
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<tr>
<td></td>
<td>intermittent, and low-bandwidth (DIL) communications</td>
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# 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)

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
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<tr>
<td><strong>Edge Analytics</strong></td>
<td>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.</td>
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<td><strong>Transfer Learning</strong></td>
<td>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.</td>
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<tr>
<td><strong>Supervised LDA</strong></td>
<td>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.</td>
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<tr>
<td><strong>Fusion</strong></td>
<td>Strategies to assist analysts in correlating and relating various forms of open source data and intel data from other sources.</td>
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Edge Analytics

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 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

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

- **Data Publishers**
  - Twitter Publisher-1
  - Twitter Publisher-2
  - Twitter Publisher-3
  - Twitter Publisher

- **Message Queue**
  - Sentiment Analysis
  - Topic Modeling
  - NER
  - Hashtag
  - Alerts
  - Index

- **Analysis Cluster**
  - Table .sa
  - Table .tm
  - Ch.sa
  - Table .ner
  - Table .hashtag
  - Table .alert
  - Index

- **Message Queue and Tables**
  - R
  - R
  - R
  - R
  - R
  - R
  - R

- **Stateless App Server**

- **Java Script (D3.js) + websocket supported browser**

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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
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

**Before Demonstration**

@Soliman_solo Tue Sep 11 14:57:10 -0400 2012
Al-Qaeda flags flapping in the Mohamed Mahmoud Street # Egypt # _ U.S. Embassy http://it.ca/Twilq18q2

@Tahir_now @Tahir_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 insulting the Prophet Muhammad peace be upon him by some of the ... http://it.ca/x1kZ2/5AlE

**During Demonstration**

@Tolokaaa @Tolokaaa Tue Sep 11 16:54:29 -0400 2012
3 youths clothed in T-shirt Martyrs Ossras Ahlawy Perfu aware of "No God but God and Mohammed is the Messenger of Allah" place American flag http://it.ca/cp1Z0B7r

@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 @ESCBreaking

**Attack on Embassy**

**After Demonstration**
Benghazi Timeline

**Before**  
Attack on Embassy

**Attack on Embassy**

**After**  
Attack
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]

Tue Jan 08 2013
Edge Analytics Demonstration

Keegan Williams
# What’s Next

<table>
<thead>
<tr>
<th>Transfer Learning LENS</th>
<th>Structural Multi-Task Transfer Learning – Leverage DAG (Directed Acyclic Graphs) encoded scripts to automate computer assisted learning</th>
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<tbody>
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<td><strong>LDA LENS</strong></td>
<td>Generalized Supervised Latent Dirichlet Allocation (LDA) – characterize data with small seed datasets then improve precision through operator intervention</td>
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<tr>
<td><strong>DATA</strong></td>
<td>Expand the number and types of data feeds</td>
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<td><strong>AF A2 Innovation</strong></td>
<td>Become a tool in the DEWEY Project toolkit</td>
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<tr>
<td><strong>NG WMD-CST</strong></td>
<td>Continue to gain boots on the ground experience</td>
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## How Can We Help You?
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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.
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 dismounted 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
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

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
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

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