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Smartphone Application Enabling Global Graph Exploitation and Proactive Dissemination Service (DSPro) Integration (Revised Fiscal Year 2015)

by Mark R Mittrick

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Smartphone Application Enabling Global Graph Exploitation and Proactive Dissemination Service (DSPro) Integration (Revised Fiscal Year 2015)

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Computational and Information Sciences Directorate, ARL

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1. Introduction

A new tool being developed is changing combat as we know it. Smartphone applications have revolutionized information-sharing around the globe for military and civilians alike. The US Army Research Laboratory (ARL) is developing a smartphone application that will promote rapid sharing of tactical information between Soldiers in the field and military-intelligence analysts in a Company Intelligence Support Team (COIST).

This application allows a Soldier to enter tactical information into the Distributed Common Ground System–Army (DCGS-A) Global Graph (Mittrick et al. 2013) to enable near-real-time analysis using the ARL heterogeneous data proximity tool (HDPT) (Hanratty et al. 2014).

This report focuses on ARL’s HDPT smartphone application and its interaction with the DCGS-A Global Graph and HDPT at the Fiscal Year 2013 (FY13) On the Move (OTM) exercise. The OTM exercise, which focuses on cutting-edge technologies for the future force, is held annually at Fort Dix, New Jersey; for ARL, it represents the culmination months of work to integrate new technologies into tactical networks.

This document updates previous documents (Mittrick 2013, 2014) with FY15 changes that include integration of Proactive Dissemination Service (DSPro) along with an updated graphical user interface (GUI).

2. HDPT Report Application

The HDPT report application has 3 main tabs: <Create Person>, <Modify Person>, and <Settings>. These tabs allow the Soldier to collect intelligence information from the field and perform various tasks such as inputting new information, updating old information, or removing inaccurate information. Once the information is entered, the Soldier is presented with a Value of Information (VoI) screen that allows the Soldier to grade the information based on content and reliability before submitting the information to HDPT.

2.1 Create Person

When the HDPT report application is initiated, the user is presented with the <Create Person> tab (see Fig. 1), which allows a Soldier to create a new “person of interest” (who might be suspected of being an enemy supporter or combatant). The Soldier then enters all of the information from the field into the text and drop-down boxes and submits it via the <Send Report> button to the DCGS-A Global Graph for analysis by HDPT.

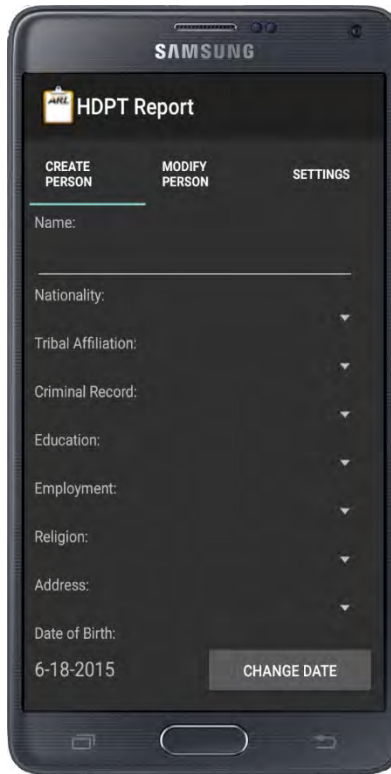


Fig. 1 HDPT report application: <Create Person>

The following Table shows the possible elements and values when creating a new person for use in this exercise. Not all elements need to be answered for the information to be submitted for analysis.

Table Revised data elements and possible values

Data Element Name	Possible Values
Name	Suspect's name
Nationality	Muslim, Afghan
Tribal affiliation	Pashtu, Baloch, Hazara, Tajik
Criminal record	Has record, no record
Education	High, medium, low
Employment	Cleric, laborer, professional, retired, unemployed
Religion	High, medium, low
Address	Times Square Village, Viet Nam Village, Vertol Village, Hanover Village, Cook Corner Village, Gredge Town, Utes Village, Horizon Village

2.2 Modify Person

The <Modify Person> tab is very similar to the <Create Person> tab. When new information becomes available in the field, the Soldier might need to update the Global Graph. To do so, the Soldier must first locate the suspect in question from a list of suspects in the Global Graph (see Fig. 2). The Soldier can then modify the suspect's characteristics, as described in Section 2.1.

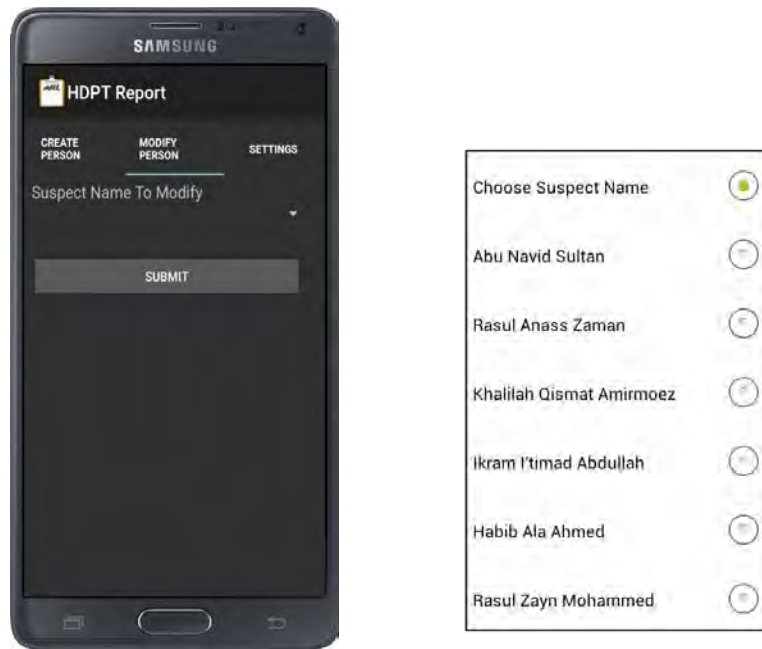


Fig. 2 HDPT report application: <Modify Person> with example drop-down box

2.3 Settings

The <Settings> tab is used to select a DCGS-A Global Graph server, as shown in Fig. 3. This allows the Soldier to quickly and easily change servers as necessary. (The FY13 OTM exercise at Fort Dix used one operational server and a backup in case the main server was not functioning properly, ensuring that the smartphone application would always be available.)

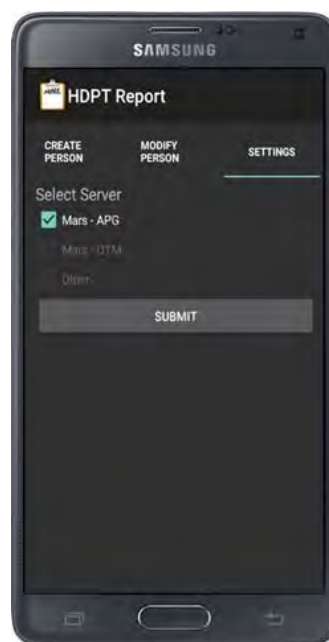


Fig. 3 HDPT report application: <Settings>

2.4 Value of Information

The VOI screen is used to determine the value of information (see Fig. 4). This allows the Soldier to quickly and easily grade information—“information content” and “reliability”—being entered into the Global Graph.



Fig. 4 HDPT report application: <VOI>

3. DSPro Integration

DSPro is a technology being developed by the Institute for Human and Machine Cognition (IHMC)¹ that efficiently and proactively disseminates information to the edge nodes by means of replication and forwarding policies. The proactive behavior is the result of the integration of policies and a distributed-learning algorithm that takes into account the history of previously requested information, along with the characteristics of the target nodes and the mission. As new information becomes available, DSPro matches it against the mission profile and pushes relevant information to the edge nodes. Information that is selected to be pushed is sorted based on the predicted time to use as well as the confidence value of the prediction.²

In FY15, the US Army Research Laboratory's Tactical Information Fusion and Battlefield Information Processing groups collaborated with the IHMC in order to expand and enhance DSPro. As part of that project, DSPro was integrated with the HDPT Report App. This new functionality

not only allows information to be entered into the DCGS-A Global Graph for analysis using the ARL HDPT, but also allows tactical information from the field to be quickly entered and disseminated via DSPro in near-real time.

Below is the HDPT Report App Java code which, in conjunction with the DSPro Smartphone App, takes the information gathered from the Soldier in the field and sends it to the DSPro database for dissemination:

```
/**
 * DSPro Code Start
 */

byte[] jsonByteArray = jsonString.getBytes();

DSProProxy dsProProxy1 = new DSProProxy();
if (0 != dsProProxy1.init()) {
    // Error occurred in connecting to DSPro service - check that the
    // service is running
    return;
}

String[] metaDataAttributes = new String[14]; String[] metaDataValues = new
String [14];

String latString = Double.toString(lat);
String lonString = Double.toString(lon);

metaDataAttributes[0] = "Data_Format";
metaDataValues[0] = "application/json";
metaDataAttributes[1] = "Data_Content";
metaDataValues[1] = "Checkpoint_Report";
metaDataAttributes[2] = "Left_Upper_Latitude";
metaDataValues[2] = latString;
metaDataAttributes[3] = "Left_Upper_Longitude";
metaDataValues[3] = lonString;
metaDataAttributes[4] = "Right_Lower_Latitude";
metaDataValues[4] = latString;
metaDataAttributes[5] = "Right_Lower_Longitude";
metaDataValues[5] = lonString;
metaDataAttributes[6] = "Source_Reliability";
metaDataValues[6] = value_reliability_String;
metaDataAttributes[7] = "Information_Content";
metaDataValues[7] = value_information_String;
metaDataAttributes[8] = "Importance";
metaDataValues[8] = voiString;
metaDataAttributes[9] = "Location";
metaDataValues[9] = address;
metaDataAttributes[10] = "Description";
metaDataValues[10] = "HDPT Report App";
metaDataAttributes[11] = "Classification";
```

```

metaDataValues[11] = "Unclassified";s
metaDataAttributes[12] = "Name";
metaDataValues[12] = name;
metaDataAttributes[13] = "Application_Metadata";
metaDataValues[13] = DSJsonString;

try {
    dsProProxy1.addMessage ("CheckpointReports", "APG",
        java.util.UUID.randomUUID().toString(), metaDataAttributes, metaDataValues,
        jsonByteArray, 0);
} catch (CommException e2) {
    // TODO Auto-generated catch block
    e2.printStackTrace();
}

/**
 * DSPro Code End
 */

```

Below is an example output (XML format) from DSPro after it receives a message from the HDPT Report App. The information is now available for dissemination to edge nodes.

```

<?xml version="1.0"?>
<Metadata>
    <Field>
        <FieldName>Message_ID</FieldName>
        <FieldValue></FieldValue>
    </Field>
    <Field>
        <FieldName>Receiver_Time_Stamp</FieldName>
        <FieldValue></FieldValue>
    </Field>
    <Field>
        <FieldName>Referred_Data_Object_Id</FieldName>
        <FieldValue>APG</FieldValue>
    </Field>
    <Field>
        <FieldName>Referred_Data_Instance_Id</FieldName>
        <FieldValue>777d51ff-cd79-446e-9395-f426a7a8a3d6</FieldValue>
    </Field>
    <Field>
        <FieldName>Pedigree</FieldName>
        <FieldValue></FieldValue>
    </Field>
    <Field>
        <FieldName>Refers_To</FieldName>
        <FieldValue>DSPro.CheckpointReports:SAMSUNG-
            SM-N900A:68</FieldValue>
    </Field>
    <Field>
        <FieldName>Prev_Msg_ID</FieldName>
        <FieldValue>77c6e072-40f6-11e5-869c-
            f4295155ca13,DSPro.CheckpointReports:SAMSUNG-SM-
            N900A:67</FieldValue>
    </Field>

```

```

</Field>
<Field>
    <FieldName>Source</FieldName>
    <FieldValue>SAMSUNG-SM-N900A</FieldValue>
</Field>
<Field>
    <FieldName>Source_Time_Stamp</FieldName>
    <FieldValue>1439386146149</FieldValue>
</Field>
<Field>
    <FieldName>Expiration_Time</FieldName>
    <FieldValue>0</FieldValue>
</Field>
<Field>
    <FieldName>Relevant_Missions</FieldName>
    <FieldValue></FieldValue>
</Field>
<Field>
    <FieldName>Left_Upper_Latitude</FieldName>
    <FieldValue>40.015560</FieldValue>
</Field>
<Field>
    <FieldName>Left_Upper_Longitude</FieldName>
    <FieldValue>-74.552498</FieldValue>
</Field>
<Field>
    <FieldName>Right_Lower_Latitude</FieldName>
    <FieldValue>40.015560</FieldValue>
</Field>
<Field>
    <FieldName>Right_Lower_Longitude</FieldName>
    <FieldValue>-74.552498</FieldValue>
</Field>
<Field>
    <FieldName>Location</FieldName>
    <FieldValue>CCV</FieldValue>
</Field>
<Field>
    <FieldName>Importance</FieldName>
    <FieldValue>0.933000</FieldValue>
</Field>
<Field>
    <FieldName>Source_Reliability</FieldName>
    <FieldValue>1.000000</FieldValue>
</Field>
<Field>
    <FieldName>Information_Content</FieldName>
    <FieldValue>1.000000</FieldValue>
</Field>
<Field>
    <FieldName>Data_Content</FieldName>
    <FieldValue>Checkpoint_Report</FieldValue>
</Field>
<Field>
    <FieldName>Data_Format</FieldName>
    <FieldValue>application/json</FieldValue>
</Field>

```

```

<Field>
    <FieldName>Target_ID</FieldName>
    <FieldValue></FieldValue>
</Field>
<Field>
    <FieldName>Target_Role</FieldName>
    <FieldValue></FieldValue>
</Field>
<Field>
    <FieldName>Target_Team</FieldName>
    <FieldValue></FieldValue>
</Field>
<Field>
    <FieldName>Classification</FieldName>
    <FieldValue>Unclassified</FieldValue>
</Field>
<Field>
    <FieldName>Description</FieldName>
    <FieldValue>HDPT Report App</FieldValue>
</Field>
<Field>
    <FieldName>Node_Type</FieldName>
    <FieldValue></FieldValue>
</Field>
<Field>
    <FieldName>Track_ID</FieldName>
    <FieldValue></FieldValue>
</Field>
<Field>
    <FieldName>Application_Metadata</FieldName>
    <FieldValue>{"Name":"Hashim Ahmad",
    "Nationality":"Afghan",
    "Tribal Affiliation":"Baloch",
    "Age":45,
    "Criminal Record":"No Record",
    "Education":"Medium",
    "Employment":"Cleric",
    "Religion":"Low"}</FieldValue>
</Field>
</Metadata>

```

Below is an example XML Schema for processing the JavaScript Object Notation (JSON) Data in the “Application Metadata” field once the message is received.

```

{
  "$schema": "http://json-schema.org/draft-04/schema#",
  "title": "VoI Person",
  "description": "Attributes Gathered by HDPT VoI Mobile App",
  "type": "object",
  "properties": {
    "Name": {
      "description": "Name of the person",
      "type": "string"
    },
    "Nationality": {
      "description": "Nationality of the person",

```

```

        "type": "string"
    },
    "Tribal Affiliation": {
        "description": "Tribe of the person",
        "type": "string"
    },
    "Age": {
        "description": "Age of the person",
        "type": "integer"
    },
    "Criminal Record": {
        "description": "Criminal Record of the person",
        "type": "string"
    },
    "Education": {
        "description": "Education Level of the person",
        "type": "string"
    },
    "Employment": {
        "description": "Job of the person",
        "type": "string"
    },
    "Religion": {
        "description": "Religion of the person",
        "type": "string"
    }
},
"required": ["Name"]
}

```

Below is the corresponding example JSON data that will be parsed by the XML Schema detailed above.

```

{"Name": "Hashim Ahmad",
 "Nationality": "Afghan",
 "Ethnicity": "Baloch",
 "Age": 45,
 "Criminal Record": "No Record",
 "Education": "Medium",
 "Employment": "Cleric",
 "Religion": "Low"}

```

4. Conclusions

ARL's HDPT smartphone application allows Soldiers to enter tactical information from the field into the DCGS-A Global Graph as well as into DSPro for dissemination to edge nodes for near-real-time analysis. ARL was able to take the lessons learned from previous field exercises and new collaborations and successfully build upon them. This is the first step in promoting the rapid sharing of information between tactical-maneuver Soldiers and military-intelligence analysts in the COIST. In the future, additional features and refinements will be added to further enhance ARL's smartphone technology.

Notes

1. The Institute for Human and Machine Cognition is a not-for-profit institute of the Florida University System that frequently collaborates with ARL. <http://www.ihmc.us/>.
2. Getting Started with DisServicePro, Giacomo Benincasa/Niranjan Suri, 2015.

References

- Hanratty T, Heilman E, Richardson J, Mittrick M. Concept evaluation of the heterogeneous data proximity tool at the C4ISR network modernization event FY12. Aberdeen Proving Ground (MD): Army Research Laboratory (US); 2014 Jan. Report No.: ARL-TR-6783. Also available at https://www.arl.army.mil/www/default.cfm?technical_report=7027.
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List of Symbols, Abbreviations, and Acronyms

ARL	US Army Research Laboratory
COIST	Company Intelligence Support Team
DCGS-A	Distributed Common Ground System–Army
DSPro	Proactive Dissemination Service
FY	fiscal year
GUI	graphical user interface
HDPT	heterogeneous data proximity tool
IHMC	Institute for Human and Machine Cognition
JSON	JavaScript Object Notation
OTM	On the Move
VoI	Value of Information

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