Agility through Automated Negotiation for C2 Services

Bernardo Neto, George Mason University (C4I Center/ITA)
Michael Hieb, George Mason University (C4I Center)
Paulo Costa, George Mason University (C4I Center)
Celso Hirata, Technological Institute Of Aeronautics
Outline

- Methodology
- Application
  - Scenario
  - C2 Testbed Framework
- Practical Example and Analysis
- Conclusion
Interoperability via E-contracts

- We are developing an innovative method using E-contract Web Services inspired by E-business (Amazon, Google, etc.)

- The specific problem is how to best respond to an incident given many Organizations with many Resources

- We use E-contracts to represent agreements between the Organizations in the CICC-RJ for how they will use their Resources (e.g. Helicopters, UAVs, Trucks) to respond to incidents

- By consulting the E-contracts, organizations can respond *dynamically* to evolving situations, using the C2 systems they currently have, through a new layer of web services
The Lifecycle has 6 sequential phases:

- Each phase has an input (requirement) and produces an output, which is the input for the next phase.
- The solid arrows connect the phases in the regular workflow.
- The broken lines represent an update of the draft or signed e-contract, requiring new signatures.

Phases:
1 - Proposal
2 - Configuration
3 - Publication
4 - Negotiation
5 - Operation
6 - Closure
E-contracts contain Services to be Performed in the Future

Contract

**Partnership Agreement**

THIS PARTNERSHIP AGREEMENT is entered into and effective as of this [enter day of month] day of [enter year], 2009, by

[enter partner name 1] of [enter partner full address] (first party)

and by

[enter partner name 2] of [enter partner full address] (second party)

hereinafter referred to as "Partners".

THE PARTNERS desire to form a general partnership under the laws of the [state where formed] for the purposes and on the terms and conditions stated in this agreement. Therefore, the parties agree to become partners and to form a partnership and further acknowledge and agree as follows:

1. **NAME AND PLACE OF BUSINESS.**
   The name of the partnership shall be [insert name of business].
   The principal place of business shall be [insert business address] until changed by agreement of the Partners, but the partnership may carry on business in any and all other places as may from time to time be agreed upon by the Partners.

2. **TERM**
   The term of this agreement shall be for [number] years, commencing on [date], and terminating on [date], unless sooner terminated by mutual consent of the parties or by operation of the provisions of this agreement.

3. **PURPOSE**
   The purpose of the partnership is:

   (1)

   (2)
Types of E-contracts

- Template
- Draft
- Pre-contract
- E-contract

POST/PUT (data)
PUT (signature)
PUT (signature)
The Provider (P) has Services to offer and builds a Draft e-contract (D) by using a Template (T), stored in the Broker.

The Broker (B) is a filter and responsible for formatting agreements, validating signatures, and saving the e-contracts in use.

The Client (C) wishes to purchase and use Services.
The Provider (P) talks to the Broker (B) about what Services it has to offer.

The Provider (P) searches for a Template (T) to build a Draft E-contract (D) that has the right constraints for the Services it has.
Configuration Phase (2)

- The Draft E-Contract (D) is linked to the provider's services
The Draft E-contract (D) is signed, turned into a Pre-contract (P) and sent to the Broker (B)

The Pre-contract (P) is available to search
Negotiation Phase (4.1)

- The Client (C) searches and discovers the Pre-contract (P)
- Client (C) negotiates the clauses (cx) and fields
- Client (C) signs the Pre-contract (P) which becomes an E-contract (E)
Negotiation Phase (4.2)

**Phases**
1-Proposal
2-Configuration
3-Publication
4-Negotiation
5-Operation
6-Closure

**Diagram**
- **C** (Search (pre-contract), Discover (pre-contract), PUT(cx), http 200 “ok”, POST(signature))
- **B** (Pre-contract)
- **P** (Services)
- **E-contract** (Services)

**Links**
- PUT(cx)
- http 400 “cx”
- PUT(cx)
Client (C) accesses the Provider’s (P) Services directly

- The Broker (B) still holds the E-contract (E)
When the Client (C) is finished the obligation between the parties ends.

There is then no link between the E-contract (E) and the Provider’s (P) Services.

The E-contract (E) can be renewed if all parties agree.
Problem

- **Public Safety**
  - The number of homicides decreased but continues to be high by the first world standards

- **Transport**
  - Infrastructure highways and airports

- **Telecommunications**
  - Maintenance of communication links during events

- **Infrastructure in general**
  - Availability in Hotels
Rio de Janeiro Center of Command and Control (CICC-RJ)

- Created for World Cup and Olympics
- Meant to support daily operations in the city of Rio de Janeiro
- Integrate eight different agencies

CICC-RJ Includes:
- Ministry of Defense
- Federal Police
- National Force
- Civil Defense
<table>
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<th>Branch</th>
<th>System</th>
<th>C2 System</th>
<th>Central Command</th>
<th>Network</th>
<th>Operational System</th>
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<td>CCTOM</td>
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<td>CC²FTer</td>
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CICC-RJ Current Connection Schema
E-contracts in a C2 Environment

E-contract CI-CCRJ / AF

- Identification CI-CCRJ and BAF
- Signature CI-CCRJ $@@@@!!!!
- Signature BAF &**!!!!!

- Numbers of helicopters 4
- Description HH 9250 CH-13 2B43 AH-64 9249 link for current information [link]

- Clauses
  1. Must be used for military operation only
  2. Must monitoring, rescue and relief operation
  3. Must Brazilian air force pilots only
  4. Can for transporting of authorities
  5. Don’t shall use more than number of hours available SROMS application

- Important informations
  Validation: September 18, 2013
  Operation: Spider in Rio de Janeiro
  Airport based: Santos Dumont
  Minimum Altitude: 2000ft
  Autonomy: 3 hours

- Testbed current Date and time: Thu Aug 29 15:25:13 PDT 2013
  empty form link

http://192.168.0.4:8080/Testbed/users/Af01
Scenario

http://192.168.1.4:8080/TESTBED/AF1
Soccer World Cup In Rio De Janeiro

Area to monitor

CICC-RJ

Airports
Overview of Simulation Scenario
Rio de Janeiro Scenario
Architecture

VR-Forces

E-contract Module

WS API

CI-CCRJ Module

EXata+Cyber

ZoneMinder

Sensor API

Sensor

Agency

Commercial
Open source
Interface
Module
Implementation of the Testbed
Practical Schema

GET(http://192.168.0.1/H3)
response:
Owner: BAF
Order: 34
Speed: $140 \, O_x, \, 10 \, O_y, \, .5 \, O_z$
Altitude: 120
Autonomy: 2.5
E-contract: 5631

POST(http://192.168.0.1/EVENT)
Parameters:
Latitude: 38.8060
Longitude: -77.3001
Type: Bomb Blast

GET(http://192.168.0.1/H2)
response:
Owner: BAF
Order: 31
Speed: $3.5 \, O_x, \, 2 \, O_y, \, .15 \, O_z$
Altitude: 240
Autonomy: 1.5
E-contract: 5631
3D View of the Resources in the Simulation Testbed

Civil Aircraft

Military Helicopters

Civilians

UAV
Analysis

Axis Y = Number of messages
Axis X = Time
* log scale (base 10)
** Ethereal analysis

Lifecycle phases
- proposal
- configuration
- publication
- negotiation
- operation

REST methods
- GET
- PUT
- POST
- DELETE
Conclusions

- We have presented an innovative approach to both Interoperability and Integration of C2 Services.
- The E-contract approach using RESTful web services allowed the team to share data to more efficiently manage tasks dynamically in the simulation.
- Web Service technology is useful for integration because each agency involved in the combined operation has a different Information Technology Environment.
- We believe that using E-contracts and Automated Negotiation would result in more agile and flexible C2, but this remains to be examined in more detail.
Thanks, Any Questions?

For any additional questions, please contact Bernardo Neto or Michael Hieb
jneto@c4i.gmu.edu
mhieb@c4i.gmu.edu
C2 Testbed Project (2010-2013)

- Joint Use Cases running on Commercial Simulations in both Brazil (ITA) and the US (George Mason / C4I Center)
- Facilitates collaborative C2 research by University Faculty, PhD/Masters Students and Industry. The end product of this research is:
  - Conference and Journal Publications,
  - Research Demonstrations, and
  - Research Prototypes
- The Testbed simulates a complex endeavor involving different agencies through the Simulation of Physical Environments, Sensors and Networks
Publications to Date

LTC Marques

Major Barreto

LTC Bernardo