Using XML-based Web Services to Implement a Prototype C2 System

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Outline

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Background

- Most of C2 systems were independently developed to reflect service needs rather than joint focused.
- Stovepipe systems have an adverse impact on joint or coalition operations.
- The integration of distributed and heterogeneous C2 systems is first priority to enhance inter-service interoperability and meet joint operation needs.
Background

The traditional component based technologies like CORBA, DCOM and RMI has the following weaknesses:

- Use non-standard communication protocol and are too complex to implement
- Difficult to achieve inter-language interoperability
- Only apply for intranet rather than internet
- The cost of integration is high

XML-based Web Services technology provides a solution to improve the weaknesses of CORBA, DCOM and RMI
Background

- XML-based Web Services technology has the following strengths:
  - Use standard internet protocol like HTTP to send message in a XML format
  - Easy to implement
  - Provide interoperability across different platforms and languages
  - Apply for internet network
  - The cost of integration is cheaper than the traditional approach
Purpose

- Using XML technology for C2 data exchange
- Using web services to integrate the C2 systems distributed in the network
- Implement a prototype C2 system to demonstrate the application of Web services
System Architecture

Web Services
- SetMTF()
- GetMTF()
- Query()

C2 center
- Invoke (SOAP)

Radar
- Invoke (SOAP)
- XML-MTF

GPS
- XML-GPRMC
- (Track generator)

Web Server
- Pull current tracks
- Up-link current tracks

Display Screen

SQL Server
(Intelligence Database)
Assumptions

- The radar can provide the target tracks periodically.
- The radar track formats are US MTF and stored in a text file.
- GPS system can receive the positioning data periodically.
- GPS positioning formats are GPRMC and stored in a text file.
- The agreement on the tag or element names in XML formats has been reached.
System Implementation Steps

1. Implement track simulation generator
2. Implement track web services
3. Implement intelligence web services
4. Implement client (C2 operation center) application
System Implementation Steps

1. Track simulation generator

   ✤ Air tracks: USMTF
     AIROP/020200Z/6/US/FTR/F15/TN:401/LM:2300N1
     2300E/CRS:180/SPD:600KPH/ALT:12000FT//

   ✤ Analyze the definition of USMTF

   ✤ Define the XML schema

   ✤ Generate simulation tracks

[USMTF] MIL-STD-6040 and CJCSM 6120.05
System Implementation Steps

Air tracks : XML-USMTF transfer

```xml
<?xml version="1.0"?>
<Operation>
  <op_type type="Air Operation">
    <DateTime>020200Z</DateTime>
    <Quantity>6</Quantity>
    <Country>US</Country>
    <Catalog>FTR</Catalog>
    <Type>F15</Type>
    <TrackNumber>401</TrackNumber>
    <Axis>2300N12300E</Axis>
    <CRS>180</CRS>
    <Speed>600</Speed>
    <Altitude>12000</Altitude>
  </op_type>
</Operation>
```
Track simulation generator

- Land tracks: GPS data format
  $GPRMC,161229.487,A,25.0377,N,121.3366,E,0.13,309.62,120598,1.2,E,*10$

- Analyze the definition of GPS format
- Define the XML schema
- Generate simulation tracks
Land tracks : XML-GPS transfer

```xml
<?xml version="1.0"?>
<Operation>
  <op_type type="GPRMC">
    <UTC>161229.487</UTC>
    <Status>A</Status>
    <latitude>25.0377</latitude>
    <dir_of_lat>N</dir_of_lat>
    <longitude>121.3366</longitude>
    <dir_of_long>E</dir_of_long>
    <TrackDegree>0.13</TrackDegree>
    <UT_Date>120598</UT_Date>
    <MVG>1.2</MVG>
    <dir_of_MVG>E</dir_of_MVG>
  </op_type>
  <Checksum></Checksum>
</Operation>
```
2. Track web services:
   - Track web services can be dynamically interfaced and invoked by consumers for their own mission needs.

3. Intelligence web services:
   - Provide consumers to query the static intelligence data such as OOB from common intelligence database.
Client Application

- Integrate all the web services distributed in a network and redesign them for their own mission requirements.

- C2 operation center can have common operation pictures to support situation awareness.
Results and Analysis
Results and Analysis

C2 operation center

Radar Coverage

Static intell
Results and Analysis

- XML is fairly simple, the most difficult part is to reach an agreement on the tag or element names.
- This is often a painful and time-consuming process and has to be done.
- The organization owning the battlefield information can become web services provider.
- The legacy system is easily integrated
- The consumers can make their own value-added applications
Conclusions

- XML can promote the data exchange capability no matter what its original format is.
- C2 operation centers can dynamically integrate the various sensors and intelligence web services distributed in a network to meet their mission needs.
Conclusions

- Web Services not only facilitate the integration of new and legacy systems but also enhance interoperability.
- Web services technology in system development and integration aspects will become the mainstream in the foreseeable future.
Q&A