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

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Outline

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- Web Services Overview
- System Architecture
- System Implementation Steps
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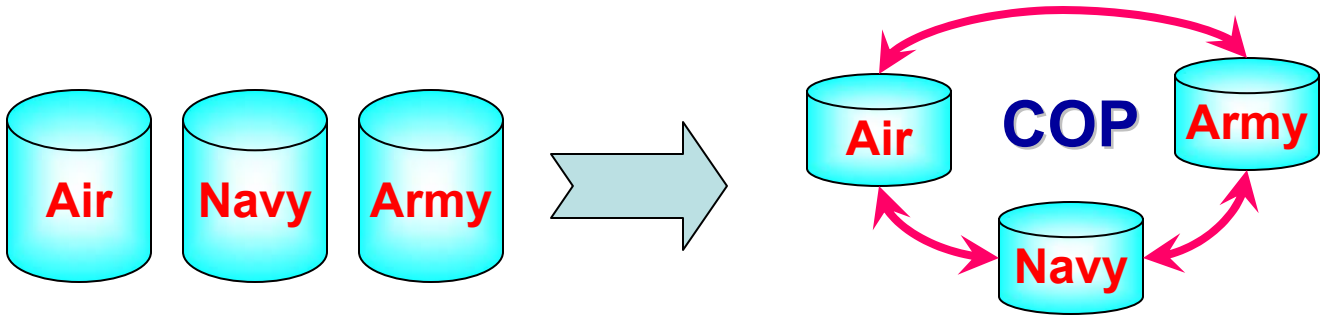
- Conclusions

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

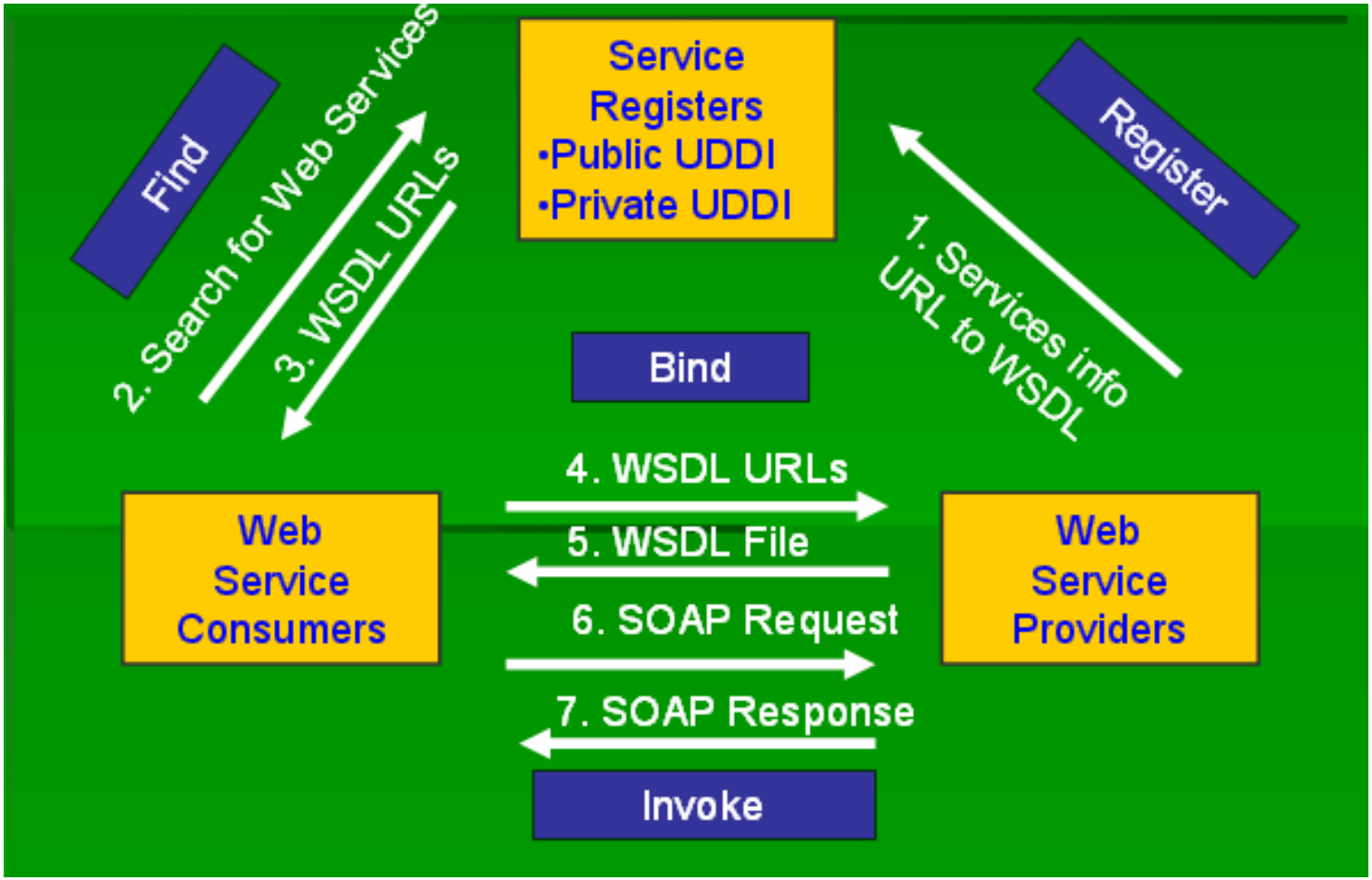
Background

- 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

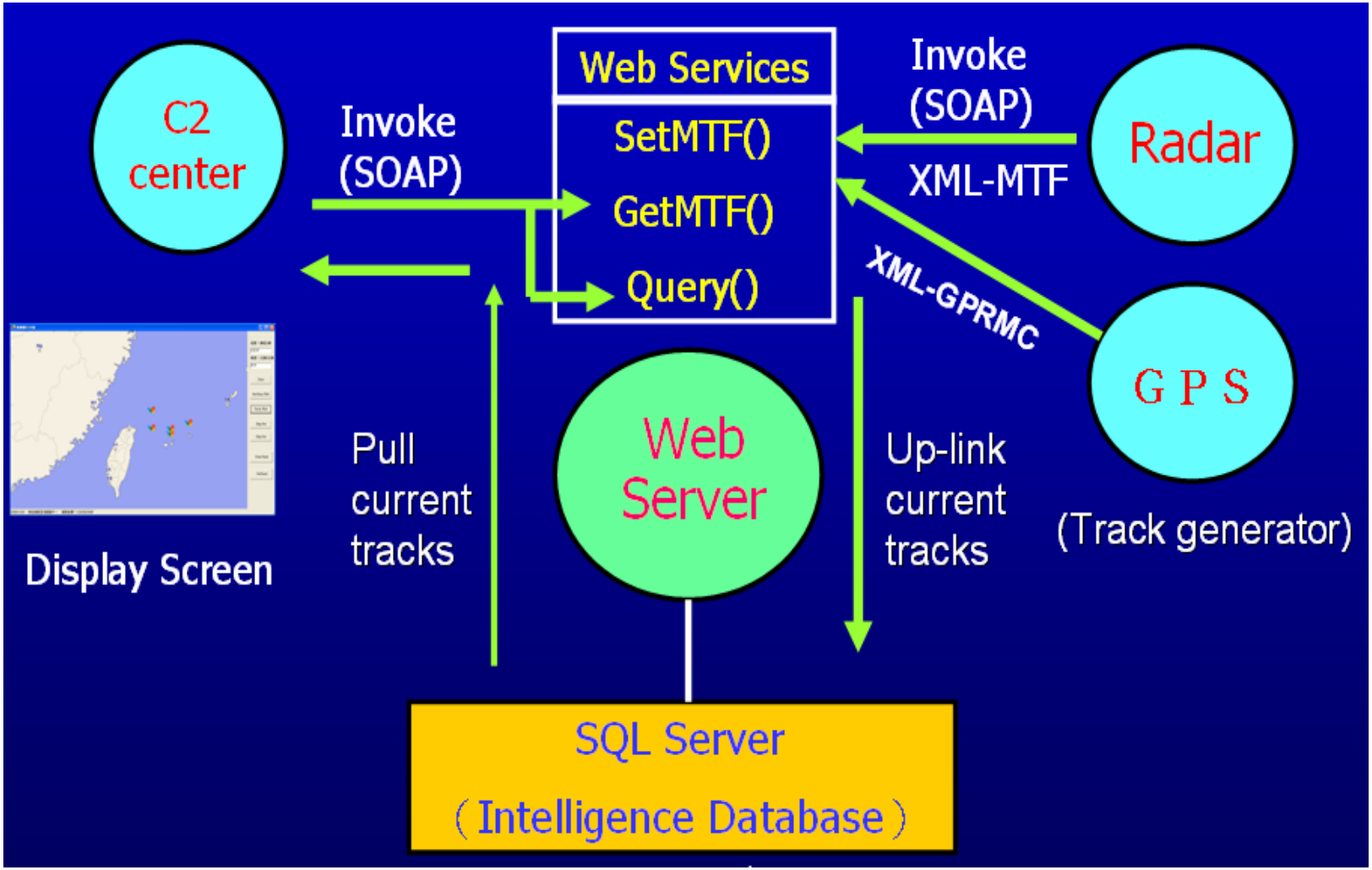
Purpose

- 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

Web Services Overview



System Architecture



System Implementation Steps

- 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

❶ Implement **track simulation generator**

❷ Implement **track web services**

❸ Implement **intelligence web services**

❹ 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//

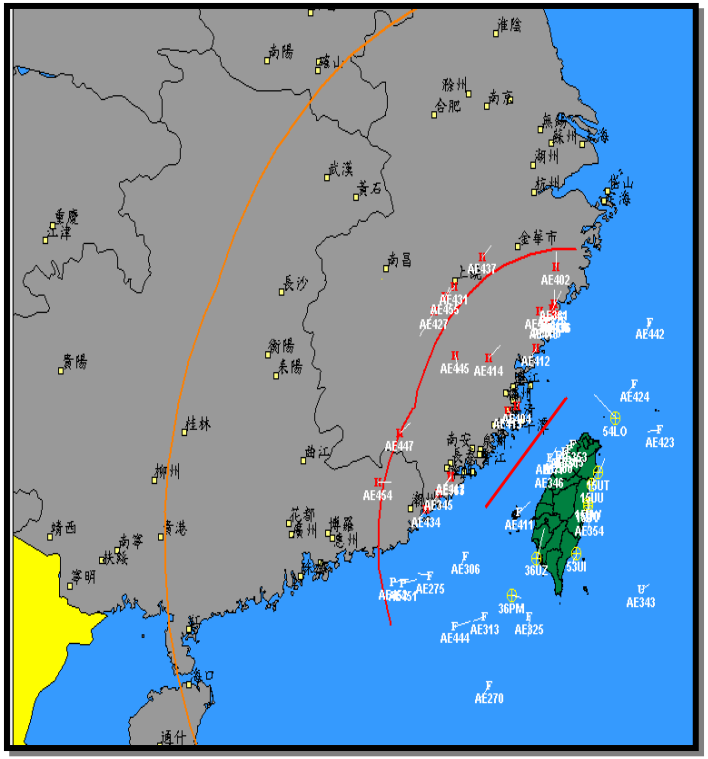
- Analyze the definition of USMTF
- Define the XML schema
- Generate simulation tracks

[USMTF] MIL-STD-6040 and CJCSM 6120.05

System Implementation Steps

1

- Air tracks : XML-USMTF transfer



```
<?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>
```

System Implementation Steps

1 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

System Implementation Steps

1

- Land tracks : XML-GPS transfer


```
<?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>
    <Checksum></Checksum>
  </op_type>
</Operation>
```

System Implementation Steps

2 Track web services：

- Track web services can be dynamically interfaced and invoked by consumers for their own mission needs

3 Intelligence web services：

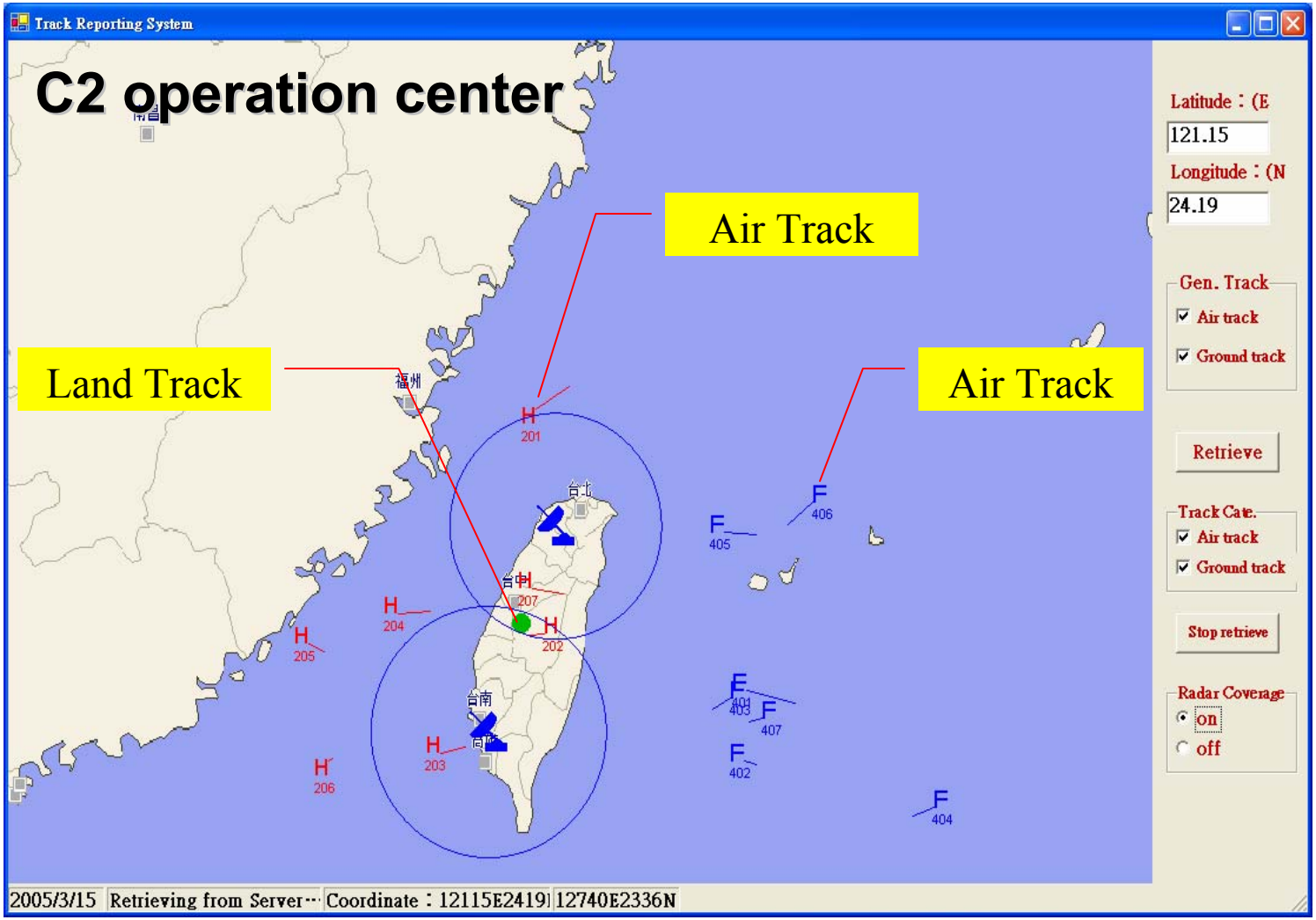
- Provide consumers to query the static intelligence data such as OOB from common intelligence database

System Implementation Steps

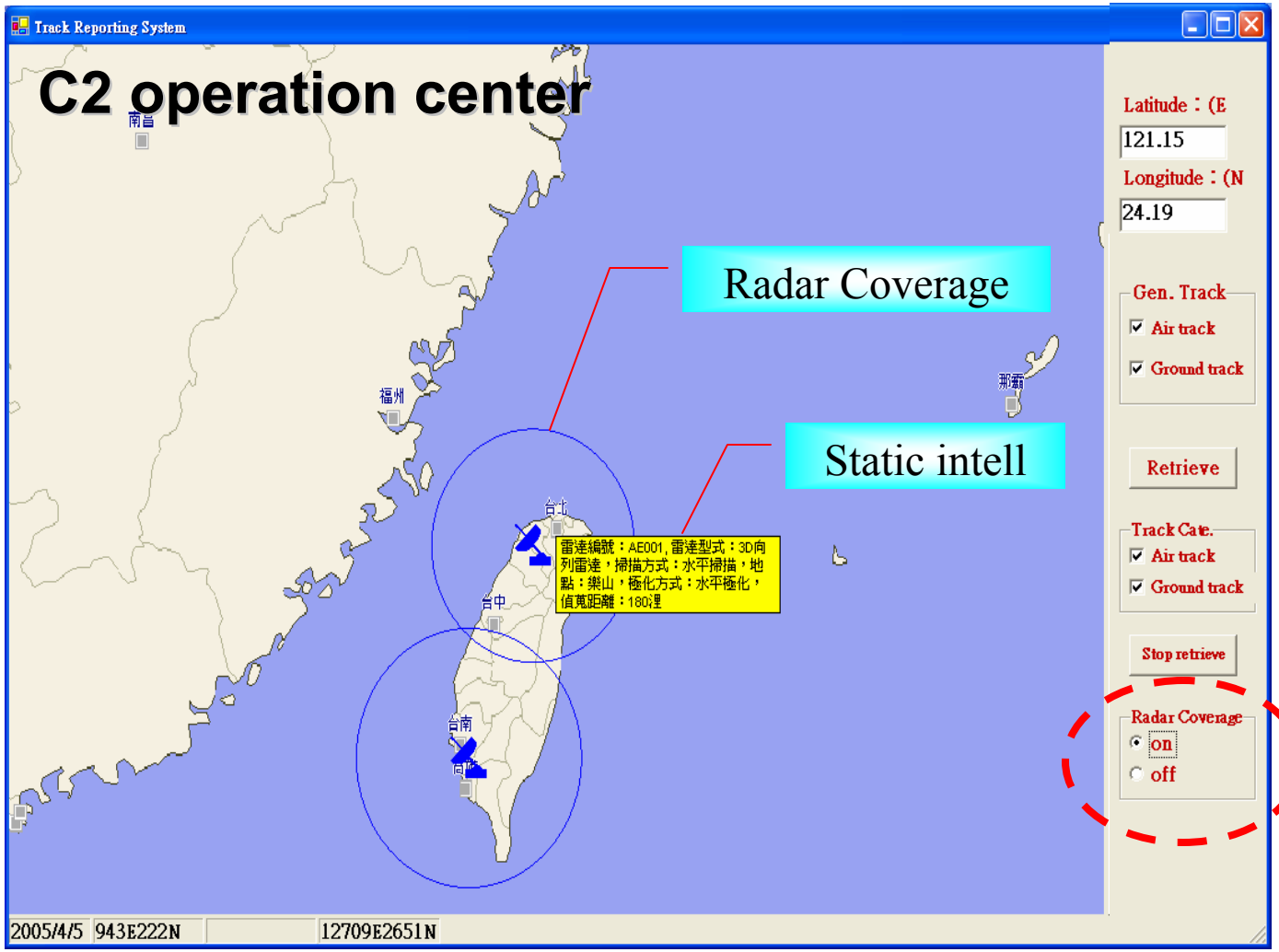
4 Client Application

- 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



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