Web Services and Service Discovery in Military Networks

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Outline

• Introducing service discovery
  – SOA and status
  – categories of discovery models
  – three topologies
  – hybrid model
• Operational network
  – complexity
  – our suggestion
• Summary
Service discovery

• The process of locating and identifying a service, known as service discovery, is an important part of any SOA.
  – Challenging in dynamic environments such as military tactical networks.
• We need to consider new solutions suitable for
  – mobile environments
  – low bandwidth networks
  – discovery with/without registry
Service Oriented Architecture

- Service discovery is an important part of any SOA.
- Service discovery in its simplest form can be a single centralized registry.
  - UDDI for Web services
Status

• Current Web service discovery is not sufficient for the NEC battlefield
  – Registries today:
    • (mostly) centralized solutions
    • stale data possible
    • designed for high bandwidth, wired networks
  – Registries should have
    • no single point of failure (distributed solution)
    • liveness information
    • functional equivalents in MANETs
  – What if a registry is unavailable?
    • registry-less discovery
Service discovery considerations

• A service discovery architecture should:
  – reduce the amount of manual configuration
  – enable automatic discovery and selection of relevant services
  – offer a complete and up-to-date picture of the services available
  – be robust in terms of partial failure
  – be bandwidth efficient, since nodes in dynamic environments may have wireless connections with low network capacity
The two main categories of service discovery models

1. The client-service model (*right*).
2. The client-service-directory model (*left*).
   - SOA / Web services
Three basic topologies

- In the *decentralized topology* (a), all nodes are equally important.
- The *centralized topology* (b) has one node with more responsibility than the others.
- The *distributed topology* (c) is a compromise between the centralized and the decentralized, where a group of nodes has more responsibility than the others.
Service discovery models and topology possibilities

- Client-service model
  - fully decentralized
- Client-directory-service model
  - centralized
  - distributed
  - Web services use this model today.
    - UDDI, ebXML
    - Experimental P2P
- We suggest a hybrid model
  - Use a registry (i.e. client-directory-service model) if available, and use a client-service model as fallback
Operational network

- An operational network is complex.
  - Different levels with different communication needs and solutions.
  - It is apparent that a single service discovery mechanism will not meet all demands.

(The figure is borrowed from MITRE technical report MTR 060175.)
Operational network complexity

- Strategic network
- Tactical network
  - Deployed
  - Mobile

Number of services vs. Dynamicity
Service discovery mechanisms per operational level

- **Registr**
  - **Peer-to-peer**
  - **Ad hoc discovery**

- **Tactical network**
  - Deployed
  - Mobile

- **Strategic network**
Service discovery mechanisms per operational level

- **Strategic network**
  - High bandwidth, static network
    - Technology: Federated UDDI and/or ebXML
    - Status: Standards available

- **Tactical deployed network**
  - Lower bandwidth than strategic level (radio) and some mobility, many nodes so fully decentralized does not scale
    - Technology: P2P?
    - Status: Experimental

- **Tactical mobile network**
  - Lowest bandwidth, few nodes per network, high mobility
    - Technology: Cross layer service discovery?
    - Status: Experimental
Challenges identified

1. Investigating registry solutions
2. Investigating peer-to-peer solutions
3. Investigating ad hoc discovery solutions
4. Investigating interaction and integration
   2. *Horizontal* integration for NATO coalition utilization and interoperability.
Challenges: current status

1. Investigating registry solutions
   • We are planning experiments using the ebXML reference implementation in cooperation with the NC3A.

2. Investigating peer-to-peer solutions
   • We are currently investigating a bandwidth efficient search algorithm for unstructured P2P networks.
Challenges: current status

3. Investigating ad hoc discovery solutions
   • We are evaluating several options:
     • Mercury – an experimental cross-layer solution for MANETs,
     • WS-Discovery – a multicast based service discovery solution for Web services (draft specification, to be standardized)
     • (and others...)

4. Investigating interaction and integration
   2. Horizontal integration for NATO coalition utilization and interoperability.
      - We focus on service discovery support across heterogeneous networks.
Summary

• We suggest a hybrid solution.
  – Different technologies for different needs
• “Registry”
  – Standardized
  – UDDI and/or ebXML
• “P2P”
  – Experimental
  – A hybrid solution that is scalable and handles mobility
• “Ad hoc discovery”
  – Experimental
  – Cross layer solution for minimum overhead
    • limited number of pre-defined services (bit pattern)
  – Distributed, client-service model
    • should be able to use registry if present