

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

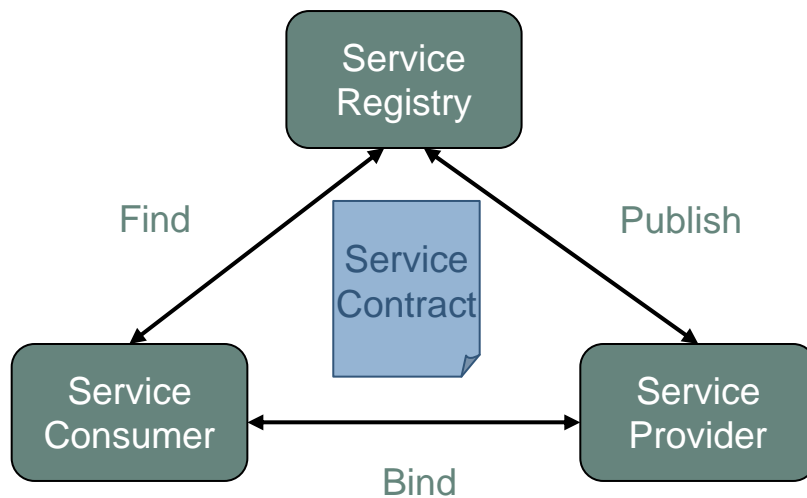


Service discovery

- 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

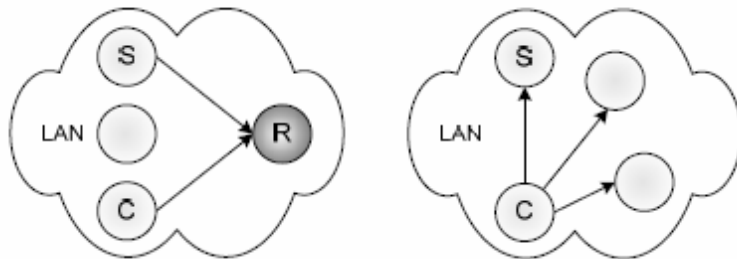


Service discovery considerations

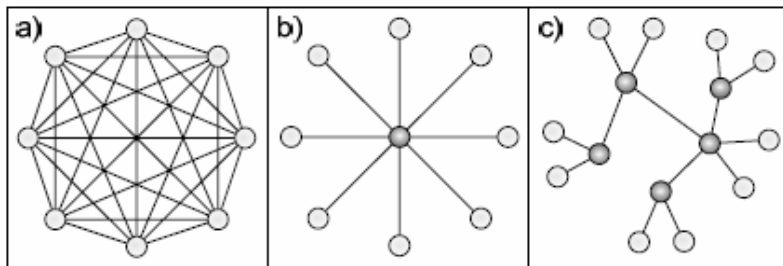
- A service discovery architecture should:
 - reduce the amount of manual configuration
 - enable automatic discovery and selection of relevant services
 - offer a complete and up-to-date picture of the services available
 - be robust in terms of partial failure
 - be bandwidth efficient, since nodes 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.

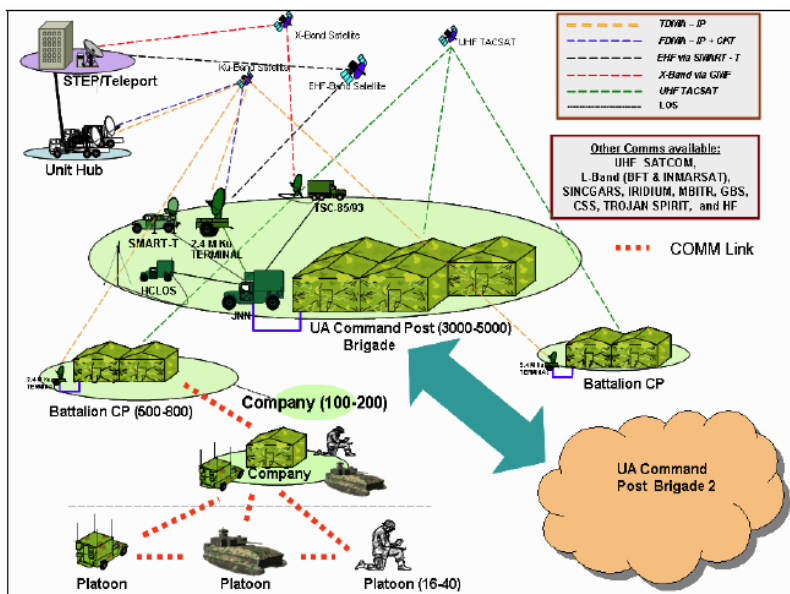


Service discovery models and topology possibilities

- 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

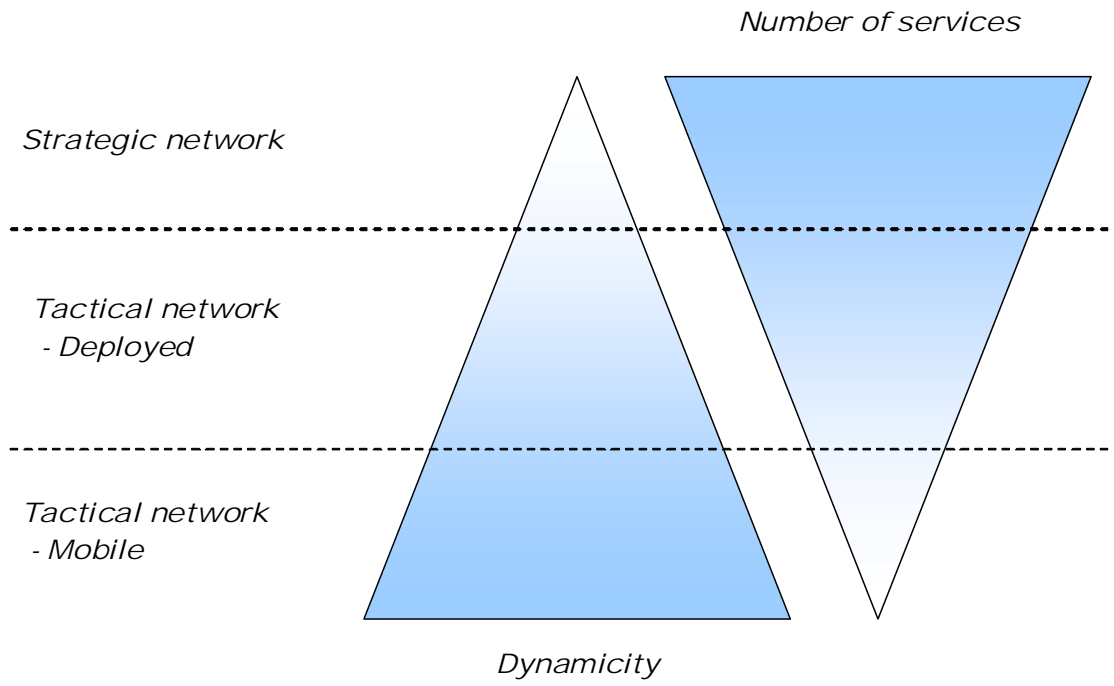
- An operational network is complex.
 - Different levels with different communication needs and solutions.
 - It is apparent that a single service discovery mechanism will not meet all demands.



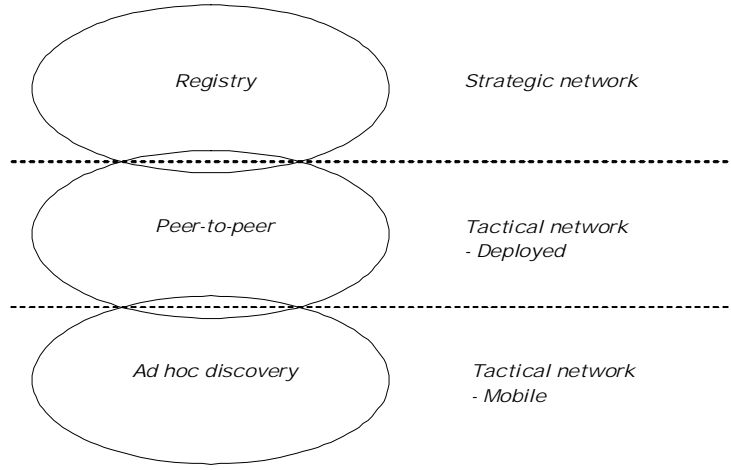
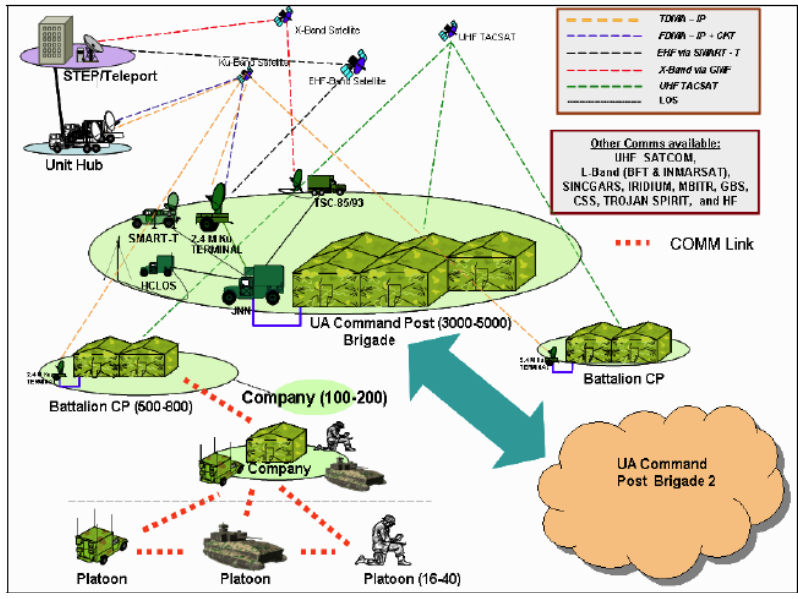
(The figure is borrowed from MITRE technical report MTR 060175.)



Operational network complexity



Service discovery mechanisms per operational level





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
 1. *Vertical* integration for nation wide utilization.
 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

1. Vertical integration for nation wide utilization.
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