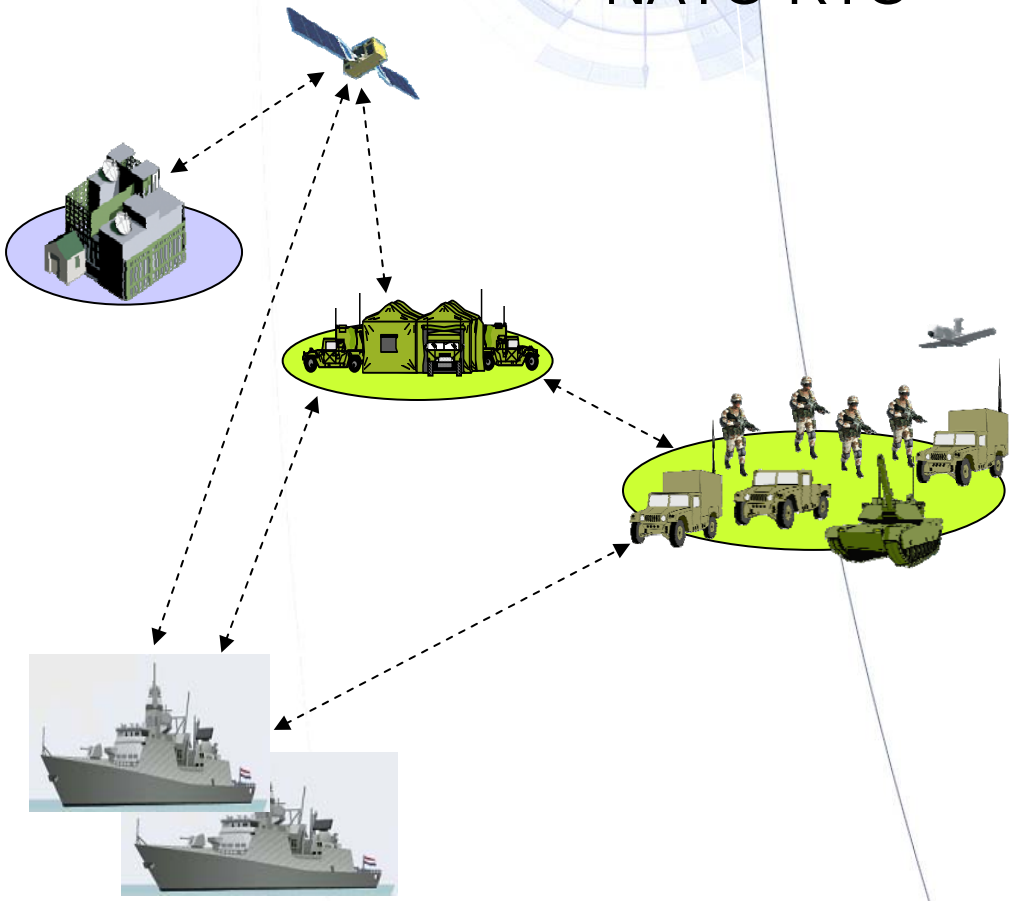
SOA Challenges for Disadvantaged Grids

IST-090
NATO-RTO



Members:
DEU, DNK, ESP, FRA, GBR,
ITA, NLD, NOR, POL, TUR

Chair: NLD

Start: January 2009 – End: December 2011

External presentation

High level goals of NATO RTO IST-090 - 1

- Identify solutions to make SOA applicable on battlefield disadvantaged grids;

- Investigate:
  - Communication Paradigms;
  - Mechanisms to reduce needed bandwidth;
  - Mechanisms to improve reliability (deal with intermittent connectivity, link instability and latency);
  - Mechanisms to improve Security (limited to investigating how security solutions discussed in other groups perform with respect to bandwidth requirements etceteras).

High level goals of NATO RTO IST-090 - 2

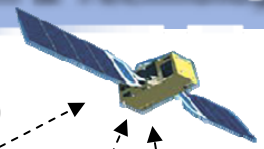
- Don’t impose interoperability restrictions and limit changes to client applications to benefit the most of web services: provide interoperability in a heterogeneous environment;

- Provide requirements for use of SOA over Disadvantaged Grids and provide demonstrations that show how the challenges, provided by disadvantaged grids, for the implementation of SOA can be mitigated.

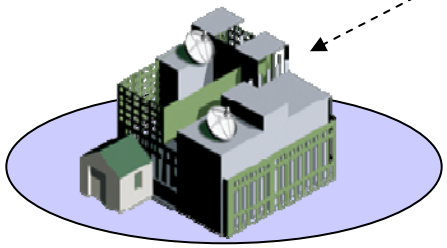
- SOA advantages and disadvantages
- Scenario
- Objectives and Deliverables
- Working groups
- Schedule and Programme of work
- IST-090 Members

Scenario (Overview)

Mobility for deployed units
Security
Real-time aspects

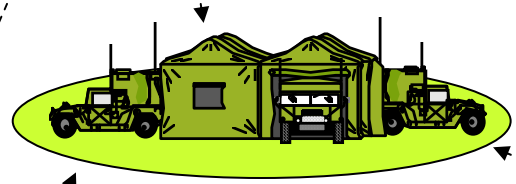


Satcom Link
(High bandwidth)



Operational Experts
(Not Deployed)

Available services:
- Chat
- VoIP
- Video Conference



HQ (Deployed)

Available services:
- Chat
- VoIP
- Video Conference
- COP Management

Regular SOA Implementation

Tactical Link
(Low bandwidth)

Adapted SOA implementation

Units (Deployed)

Available services:
- Chat
- VoIP
- Observation Report
- Real-time status
- CFF request
- . . . . .

Tactical Link
(Low bandwidth)

Adapted SOA implementation

Tactical Link
(Low bandwidth)

(Multiple ships)

Subject understanding – SOA Advantages (Web services) - 1

The Web services realization of the SOA approach has demonstrated many advantages for the development and implementation of C4ISR systems:

- Asynchronous mode of exchanges through SOAP protocol:
  - Simple way to build interoperability;
  - Good level of decoupling between presentation and transportation of information;
- Common use of XML as a basis for the different description languages of the different levels of abstraction:
  - SOAP for exchanges;
  - WSDL for services description;
  - UDDI for directories.

Subject understanding – SOA Advantages (Web services) - 2

- Allows the use of a wide offer of COTS for definition and management of schemas;
- Most of the commercial programming environments offer tools to easily realize “wrappers” of legacy application into Web services;
- SOA, and thus this study, is not limited to these technologies.

Subject understanding – SOA Disadvantages (Web services) - 1

These advantages have some counterparts which are underlined in a military network based on a constrained network:

- The higher level of abstraction, which facilitates interoperability, increases the latency. Especially for the discovery and invocation of service;

- The existing products, mainly driven by the commercial market of WAN enterprise information systems, are not robust in case of disadvantaged grids with significant probability of unanticipated disconnections;

Subject understanding – SOA Disadvantages (Web services) - 2

- Trust in delocalized services if network is not itself trustworthy;

- XML documents are verbose and need high bandwidth to exchange SOAP messages and to allow interaction in a distributed environment:
  - Compression technologies need to be improved;
  - Other protocols than SOAP may be used: e.g. REST Web services or no Web services at all (in disadvantaged networks).
    Remark: SOA does not enforce the use of Web services (e.g. DDS in tactical networks).

Subject understanding – Current SOA-based C2 functionalities

- NATO concept is being developed based on the SOA concept (Core G, FFT, NMMR, IEG, NIRIS, MCCIS, BRITE – BWS;
- Other countries have their SOA – based implementations:
  - Germany – SPC SOA;
  - France – FoCCs-SOA;
  - Finland – Mevat;
  - SOA-based implementation of Web Services in a NEC environment has been shown in many international experiments;
- Many military exercices take SOA as the main subject of tests:
  - CWIX (formerly CWID);
  - CE (Combined Endeavour).

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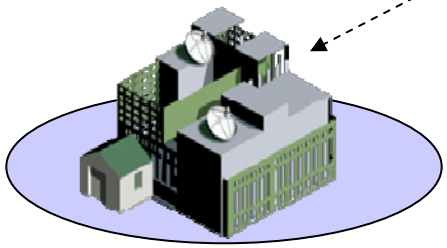
Scenario

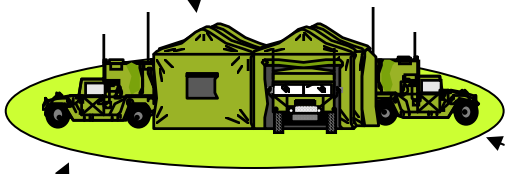
Satcom Link
(High bandwidth)



Operational Experts
(Not Deployed)

Available services:
- Chat
- VoIP
- Video Conference

Includes following aspects:
- Mobility for deployed units:
loss of connection, communication switch, bandwidth limitations, ...
- Security: data sharing with different levels of classification, ...
- Real-time: CFF, status, ammunition availability



HQ (Deployed)

Available services:
- Chat
- VoIP
- Video Conference
- COP Management

Regular SOA Implementation

Adapted SOA implementation

Tactical Link
(Low bandwidth)

Units (Deployed)

Available services:
- Chat
- VoIP
- Observation Report
- Real-time status
  - Weapons
  - Communications
- CFF request
- BFT
- COP (Contrib + distrib)
- ISR Video streaming (ie. UAV sensor)
- Alert
- Data Base Search
- Notification

Tactical Link
(Low bandwidth)

Tactical Link
(Low bandwidth)

(Multiple ships)

COI (Community Of Interest)
(include some people from Experts, NATO HQ, and deployed units)

cenario Services Description - 1

COP – Common Operational Picture

– Compilation, distribution and contribution of relevant information;

BFT – Blue Force Tracking

– Provide information about own forces location;

ISR Feed– Intelligence Surveillance Recognition

– Ability to access ISR Sensor information;

CFF – Call For Fire

– Fire support requests containing all information needed to determine the method of target attack. For the scenario the CFF comes from an observer;

Alert Service

– High priority instant advertising of incoming emergencies and contingences;

cenario Services Description - 2

Observation Report

– Distribution of information collected on the battlefield through observation by deployed soldiers and a variety of electronic sensors;

Database Search

– Remote requests of information relevant to the operation by deployed units;

Online Status

– Availability status monitoring of deployed units;

Notification

– Ability to be notified when a subscribed data changed. It is linked to a data subscription approach;

Others: Chat, VoIP, Video

ventory of Capabilities of Communication Equipment

Communications equipment considered:

- SATCOM;
- Link;
- Radio;
- WiFi;
- Other equipment.

Netwerknaam	Orbit	Datarate[3](s)	Frequentie (band)	Round trip Delay [msec]	LOS / BLOS / Range	Availability	Voice	Data (IP support)	Voice & Data simultaneously
MILSATCOM	Zeer uitgebreide mogelijkheden http://www.milsatcom.net/								
Milstar [3]	(41,200 km) geosynchronous	Low data rate communications (voice, data, teletype and facsimile) at 75 bit/s to 2,400 bit/s Medium data rate communications (voice, data, teletype and facsimile) at 4.8 kbit/s to 1.544 Mbit/s Frequency plan: Q-Band uplink, Ka-Band downlink	Q-Band uplink, Ka-Band downlink	0.5 seconds	LOS	Anti-jam, low probability of intercept and detect, Nuclear survivable	Yes	Yes	Yes
Iridium [3]	low Earth orbit at a height of approximately 780 km	2.2 to 3.8 kbit/s,	L-band spectrum between 1616 and 1626.5 MHz. Iridium exclusively controls 7.775 MHz of this and shares a further 0.95 MHz.	Latency for data connections is around 1800 ms round-trip, using small packets	LOS	Earth coverage	Yes	Web/e-mail to SMS gateway	?

SOA advantages and disadvantages

Scenario

Objectives and Deliverables

Working groups

Schedule and Programme of work

IST-090 Members

bjectives and Deliverables

Objectives:

- Identify improvements to make SOA applicable on battlefield disadvantaged grids.
- Investigate Communication Paradigms, Mechanisms to reduce needed bandwidth, Mechanisms to improve reliability (deal with intermittent connectivity / link instability and high latency), security (not a main focus).

eliverables:

- Technical Report
- Requirements for the use of SOA over Disadvantaged Grids (desired)
- Demonstrations (desired)

SOA advantages and disadvantages

Scenario

Objectives and Deliverables

Working groups

Schedule and Programme of work

IST-090 Members

Working groups - Introduction (1 of 3)

Web services

- Web services is the most common technology used for implementation of SOAs.

- Web services is designed for use in fixed infrastructure networks, such as the Internet, and the technology needs to be ***adapted*** if it is to be used in tactical networks.

Working groups - Introduction (2 of 3)

DDS

DDS is a standards-based middleware that shows promise for use in low capacity networks and could be considered as an alternative for implementing SOA in tactical communications networks.

If one chooses to base a tactical SOA implementation on a non Web service solution such as DDS, it is important to consider how such a solution will co-exist with Web service solutions used on higher levels.

We would like to present DDS as a real alternative in tactical communications.

To reach this goal, we have defined some tactical services which can be used as a first step of a future Tactical Data Interface.

Working groups - Introduction (3 of 3)

Service Discovery

- Service Discovery is an important part of any SOA, as service consumers must be able to find the available services before they can be used.

Simulated and synthetic environment

- The simulated and synthetic environment is something we need to look at to help us establish relevant use cases and also give us a framework for demonstrating/testing the technological solutions we come up with.

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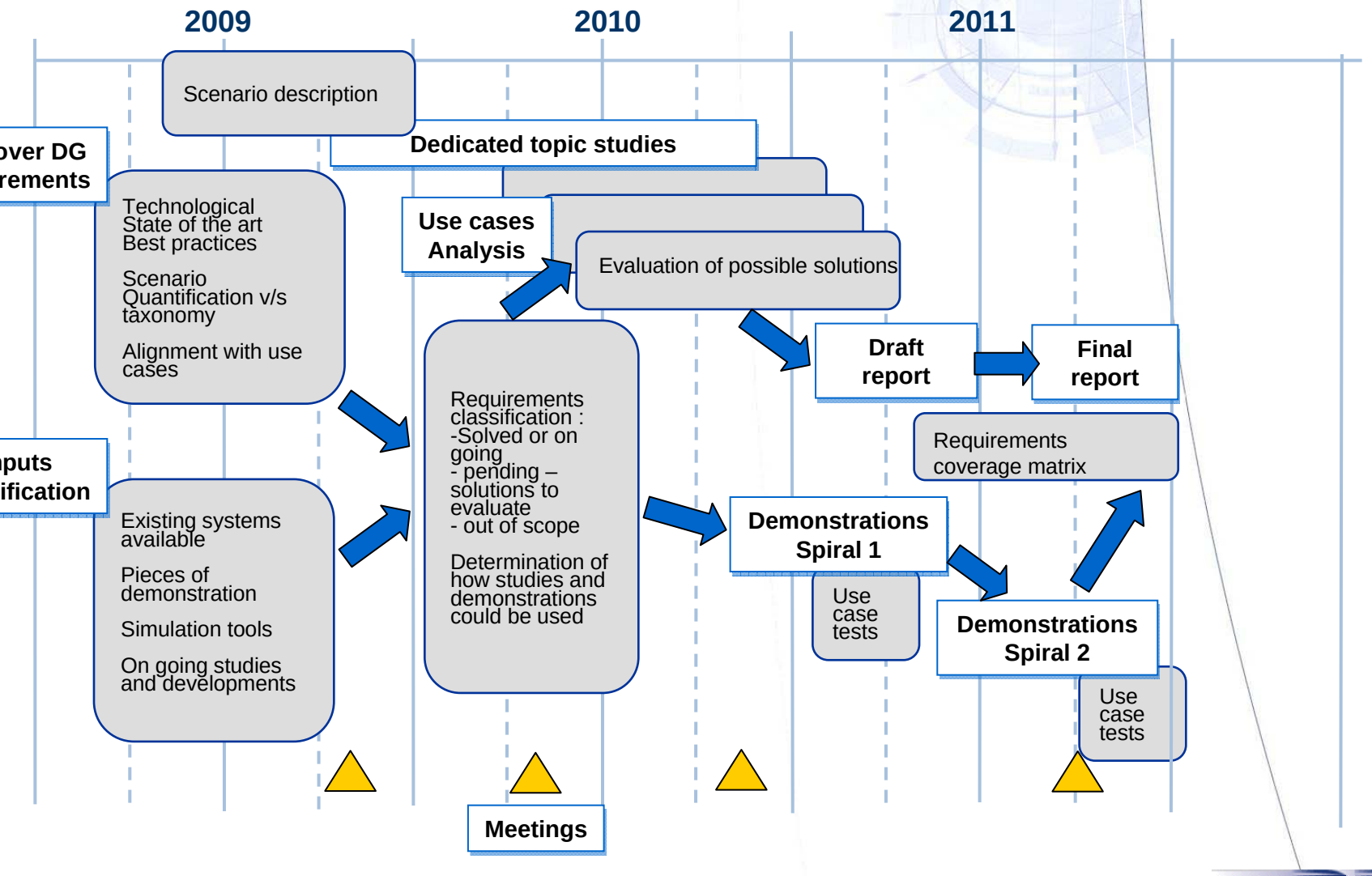
G Schedule (Preliminary and dynamic)



SOA advantages and disadvantages

Scenario

Objectives and Deliverables

Working groups

Schedule and Programme of work

IST-090 Members

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onclusions => Benefits for military domain

Results of tests carried out among group participants

– Advantages and disadvantages of used solutions

– Limitations for their utilization in disadvantaged networks

Best practices for SOA implementation in a tactical disadvantaged environment

Directions for further development in terms of SOA for disadvantged grids