Outline

1. Information and Network Environments: Strategic/Corporate and Battlespace/Warfighter
2. Defence Journey in EA/RA: Information and Network Services Architectures
3. Understanding Reference Architecture: Common Data Models/Information Elements
4. Tactical Edge Constraints and Architectural Considerations
5. Technologies influencing Future Tactical Edge Networks
6. Need for a Coherent Framework
7. Tactical Edge Design Patterns: Example
8. Summary and Conclusion
### Information Environment: Strategic/Corporate and Battlespace

<table>
<thead>
<tr>
<th></th>
<th>Strategic/ Corporate</th>
<th>Battlespace/War-fighter</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industry Support</strong></td>
<td>Commercial-Off-the-Shelf (COTS) Main Stream ICT</td>
<td>Military-Off-the-Shelf (MOTS) Main Steam CIS</td>
</tr>
<tr>
<td><strong>Resources Availability</strong></td>
<td>Relative Abundance</td>
<td>Constrained</td>
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<tr>
<td>(Bandwidth, Data Store)</td>
<td></td>
<td></td>
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<tr>
<td><strong>Network Configuration</strong></td>
<td>Prominently Wired, Fixed</td>
<td>Prominently Wireless, and more Heterogeneous</td>
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<tr>
<td><strong>Network Topology</strong></td>
<td>Infrastructure-centric and Centralised</td>
<td>Infrastructure-less, Self-organisation</td>
</tr>
<tr>
<td><strong>Information Management</strong></td>
<td>Persistent and centralised - more tilted towards centralising information storage</td>
<td>Non-persistent, Federated, and Distributed</td>
</tr>
<tr>
<td>(Information is scattered)</td>
<td></td>
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<tr>
<td><strong>Application/Service</strong></td>
<td>Service-orientation, centralised</td>
<td>Platform-orientation</td>
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<tr>
<td>Integration</td>
<td></td>
<td></td>
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<tr>
<td><strong>Interoperability</strong></td>
<td>Well established Standards, Open Interfaces</td>
<td>Federated, Heterogeneous, Proprietary Interfaces</td>
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<tr>
<td><strong>Technology Change</strong></td>
<td>Rapid – 3 to 5 years</td>
<td>Slow / Evolving – 10+ years (This will change. Beersheba)</td>
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<tr>
<td>Management</td>
<td></td>
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<tr>
<td><strong>Service Management</strong></td>
<td>Vendors centric end-to-end service provisioning</td>
<td>Military Operated system integration &amp; support</td>
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</table>
Defence EA/RA: Information and Network Service Architectures

DEFENCE ENTERPRISE ARCHITECTURES (BUSINESS, INFORMATION, NETWORK, and COMMUNICATION)

2008

NETWORKED BATTLEFIELD ARCHITECTURE (NBA)

2011

BATTLEFIELD TACTICAL INFORMATION ARCHITECTURE (BTIA)

2011

JOINT BATTLEFIELD NETWORK ENVIRONMENT (JBNE)

2014

LAND INFORMATION NETWORK (LIN)

2012

LAND NETWORK CONCEPTS (LNC)

2014

DEFENCE ARCHITECTURE ENGAGEMENT FRAMEWORK (DAEF)

2012

DEPLOYED NETWORK SERVICES ARCHITECTURE (DNA)

2011

TACTICAL MOBILE NETWORK SERVICES ARCHITECTURE (TMNSA)

2014

COMMON COMMUNICATIONS SERVICES (CCSA)

2011

BATTLE SPACE COMMUNICATIONS ARCHITECTURE (BCS-L)

2012

MARITIME COMMUNICATIONS ARCHITECTURE (MCA)

2012
Understanding RA

- **Reference Architecture (RA):** guides and constrains the development of solution architectures,
- **Usage:** RA is an authoritative source of information about a specific subject area,
- RA constrains instantiations of multiple architectures and solutions,
- **Common Vocabulary** for the various stakeholders,
- **Consistency of Data Models** for Reuse, Interoperability and Joint Integration,
- **Composition of Customised but Fit-for-Purpose Views,**
- Validation of solutions against RA,
- **Standard Design Patterns.**

Networked Battlespace Architecture 2020+

Networked Battlespace Architecture 2020+
Joint Operations Concept Master Graphic

Adaptive, Agile, Assured Networking of the Joint Force

Networked Land Operations

Networked Maritime Operations

Networked Air Operations

Coalition Networks

Conventional & Unconventional Operations

Networked Special Operations

Sea Control

Sea Denial

Maritime Power Projection

Sea Lines of Communication

Cyber & Information Security

Network Defence Against Adversary Exploitation & Cyber Attacks

Targeting Exploitation & Attack Against Adversary Networks

Environment & Terrain

A secure Australia focused on the Defence of Australia against direct armed attack. This captures Australia’s fundamental interest in preserving the security, stability and cohesion of Australia’s immediate neighbourhood, and maintaining a strategic stability in the Asia-Pacific region focused on the security, stability & resilience of the homeland/new Pacific.

A stable, rules-based global order focused on promoting an international order that respects aggression and effectively manages risks and threats.

IDEP 23/07, Page 4 "Networked Battlespace Architecture 2020+"
LAND INFORMATION NETWORK

Defence Architecture Engagement Framework

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Reference
Tactical Edge Constraints

- Tactical Edge Information Environment (DIL)
  - Disconnected
  - Intermittent
  - Limited

- Delay and Disruption Tolerant Network (DTN) Architecture
  - Are we there yet?
  - When will Military Network Transport adopt siblings? (TCP/IP and DTN)

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Tactical Edge Considerations

Design Patterns and Corresponding Attributes

• **Network Access**
  – Connectivity, Bandwidth and Latency.

• **Resource Availability**
  – Processing Power, Storage Capacity, System Weight, System Space, and Power Requirements.

• **Data Exchange**
  – Amount of Data, Type of Data, Priority, Update Rate, Traffic Pattern, Exchange Pattern, No. of Exchange Partners.

• **Information Assurance**
  – Availability, Confidentiality, Integrity, Traceability, Authorisation, Authentication, Accreditation, Certification and Defence in Depth.

• **User Interface**

Reference: Dr. Fatma Dandashi, Tactical Edge Characterisation Framework, 08-0037, 2007
Key Network and ICT Technologies for adoption and/or adaptation

**PLATFORMS and SENSORS**
- Sensor Networking
- Large distributed M2M Configuration

**APPLICATIONS**

**SERVICES**
- Service-orientation, SOA for Tactical Environment
- Delay and Disruption Tolerant Services
- Virtualisation

**TRANSPORT**
- Network Topology Variants, Self-organisation and Mobility Support
- IPv6, Gateways, and Delay & Disruption Tolerant Network
- Long Term Evolution (LTE) 4G Network Elements and NFV

**SECURITY and INFORMATION MANAGEMENT**
- Security: Perimeter Protection and Hierarchical/Distributed Key Management

**MONITORING, MANAGEMENT & CONTROL**
- Distributed Net-ops & Spectrum Management
- Situational Awareness
Need for a Coherent Approach

A Tactical Edge RA Framework

- Common Vocabulary and Data Definitions,
- Design Patterns and Standardised Template,
- Infrastructure Requirements based on Use case environment,
- Reference implementation to validate the Design Guidance,
- System Design is influenced by two factors
  - Requirements placed on the system to provide a given function
  - Constraining placed by the environment in which the system operates
- Implementations for Sharing Information at the tactical edge.

Reference: Dr. Fatma Dandashi, Tactical Edge Characterisation Framework, 08-0037, 2007
• Why Service-Orientation and **SOA practices**
  – Intrinsic interoperability,
  – increased federation,
  – and business centric alignment.

• **SOA in tactical edge** environments
  – SOA approaches in majority of cases presume the availability of reliable, consistently available networks that provide limited bandwidth and little or no latency.
  – **Design guidance** to support SOA-based tactical systems is required.
• **Example Pattern - Resource Availability Dimension**
  – Reliable Asynchronous Messaging
  – Store and Forward
  – Caching
  – Compression
  – Publish and Subscribe

• Such Design Patterns need to be scalable for the generic classes of tactical environments: **Fixed Centre**, **Deployable/Mobile Centre**, **Mobile Swarm** and **Dismounted User**.

• Each class of these tactical nodes have different attribute sets for other tactical edge dimensions such as **Network Access**, **Resource Availability**, **Data Exchange**, **Information Assurance** and **UI**.

Reference: Dr. Fatma Dandashi, Tactical Edge Characterisation Framework, 08-0037, 2007
Summary and Conclusion

- There are some **additional considerations on ICT architectures for tactical edges** as compared to Strategic/Corporate Networks.
- Reference Architecture and Design Patterns require **common data models for Reuse, Interoperability, and Joint Integration**.
- In order to meet the long term Defence RA architectural objectives for Battlespace Communications Networks, **consistent and co-ordinated efforts are required**.
- **Rapid adaptation and tailoring of some Network and Information technologies is essential**; (Such technology elements will not be readily available from the conventional and commercial ICT sources).