Providing a Tactical Domain For an Independent Nations Task Force

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Research Questions

- How can a small nation build an independent tactical information domain from soldier/platform level to independent task force (upper tactical echelon) that integrates all stake holders within armed forces?
- Could Software Defined Radio and Semantic web technologies accelerate the development of this domain?
- What aquisition approach will allow technologies to transition to service when mature?

Introduction

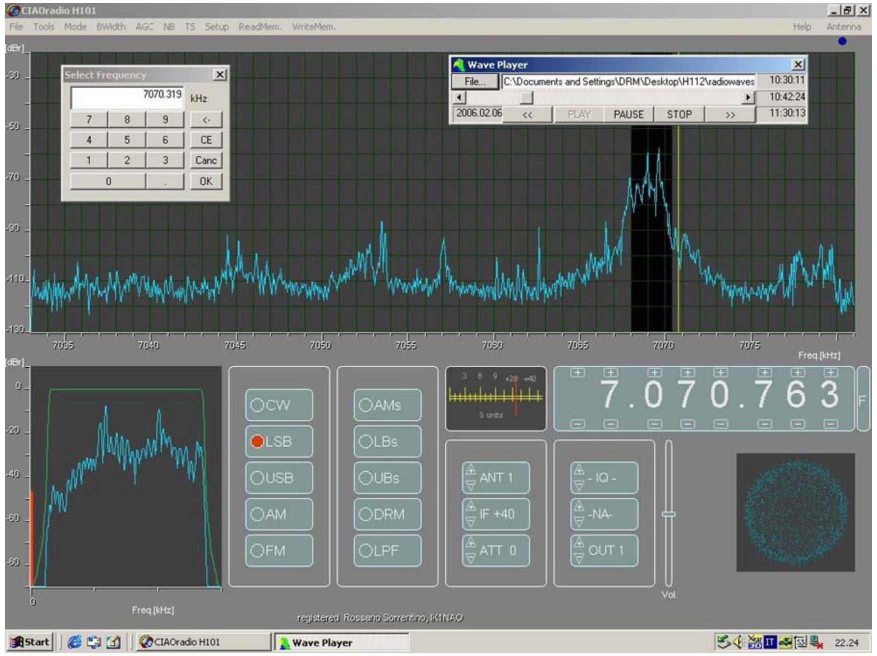
- Look towards future military communications equipment
- Focus on the Land Tactical Domain
- Must not forget non equipment lines of development
- In context of independent nation acting alone or unknown coalition
- Land manoeuvre Bde with attached air and naval assets
- Home base or expeditionary
- Future up to 2035

Communications

- Software Defined Radio (SDR).
- Mobile Ad-hoc Networks (MANET).
- Cognitive Radios.
- Software Defined Networks (SDN).
- Software Defined Voice Networks (SDVN).
- Physical limits and laws will still apply

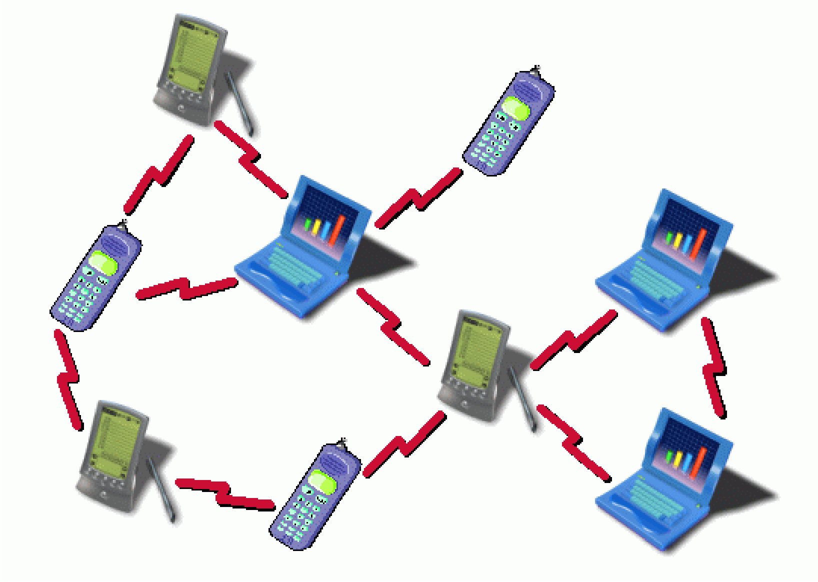
Software Defined Radio

- Flexible and useful standards (Software Communications Architecture)
- SDR only beneficial if have access and need for other waveforms
- Not future proof as some like to advertise
- Useful for suite of waveforms (satellite, terrestrial, …)
- Waveforms proprietary and subject to International Traffic in Arms Regulations (ITAR)



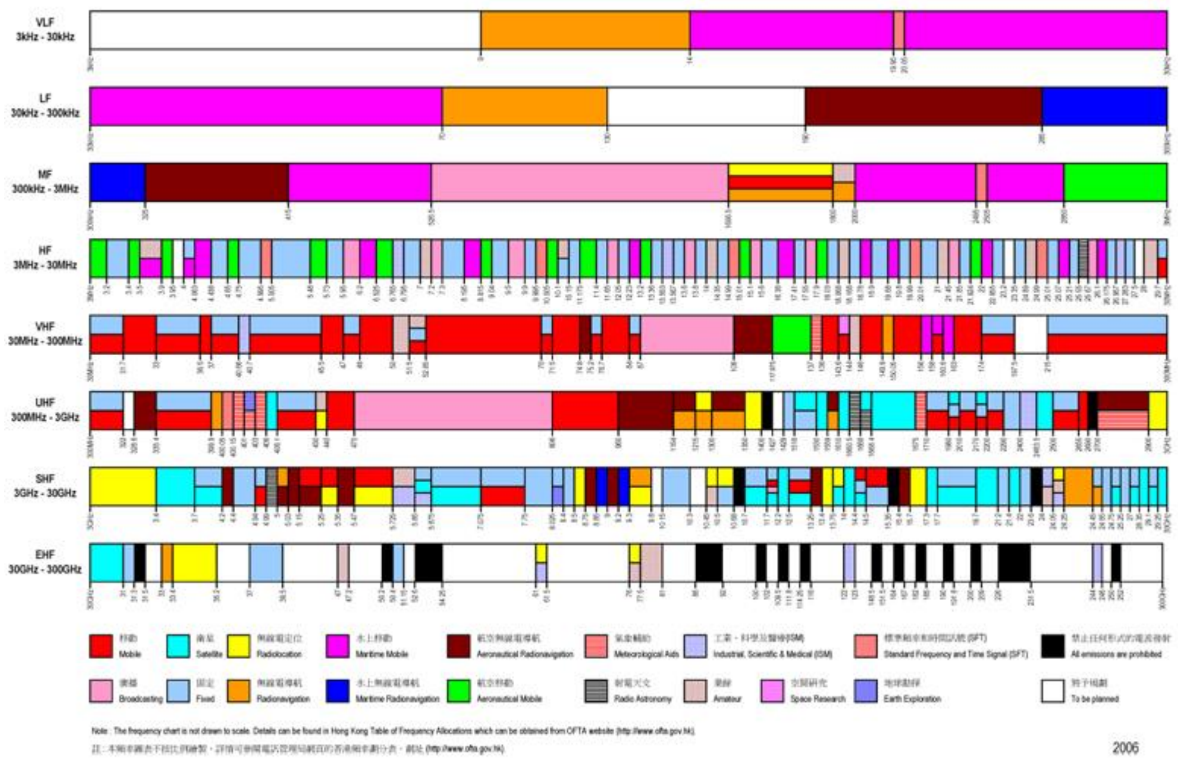
MANET

- In service but still mostly at the platform level
- Highly suited to tactical domain due to low user training
- Soldier worn possible but need to have viable backhaul
- Mothership concept may be required



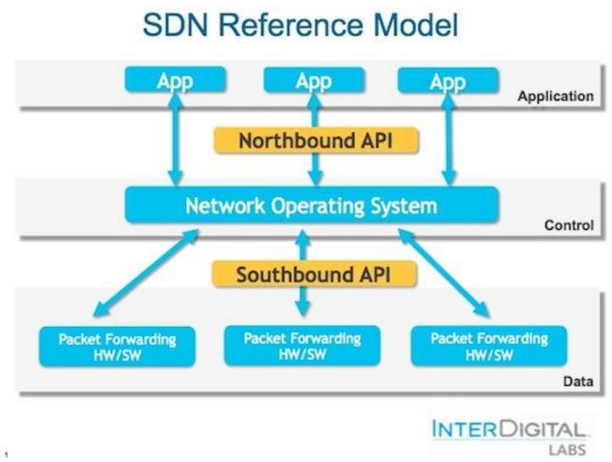
Cognitive Radio

- Addresses lack of available spectrum
- Can achieve maximum spectral efficiency
- Simplify spectrum management
- Still procedural barriers



Software Defined Networks

- Plan, deploying and maintaining a complex heterogeneous network is tough
- Military networks are dynamic and constrained
- At the lowest levels not network engineers
- Openflow is a possible standard but has additional overhead



Software Defined Voice Networks

- Fundamental all informed voice network is a little changed concept.
- Having voice in the Radio Frequency (RF) modulation can be restrictive
- Putting it across Internet Protocol (IP) makes sense
- Voice over IP (VoIP) can be used for all informed voice
- Understanding needed on latency and throughput in the tactical domain
- Standard needed (my PhD topic)

Commercial Off The Shelf (COTS)

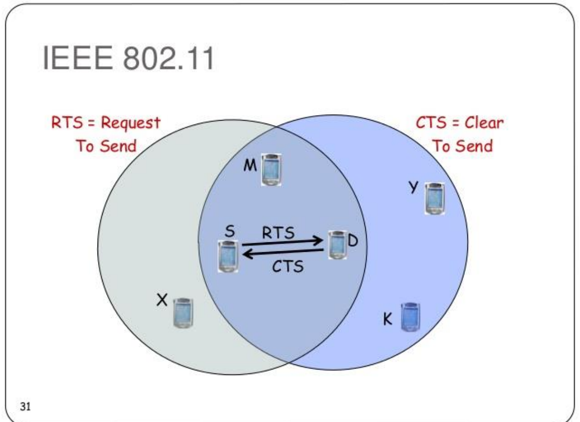
- Civilian communications now lead the way
- A military system should use these but be aware of the limitations
- Security requirements are different
- Throughput increases in future need to rely on shrinking cell sizes. Not always possible in this environment
- Spectrum access an issue
- Femtocells linked to a MANET backhaul possible

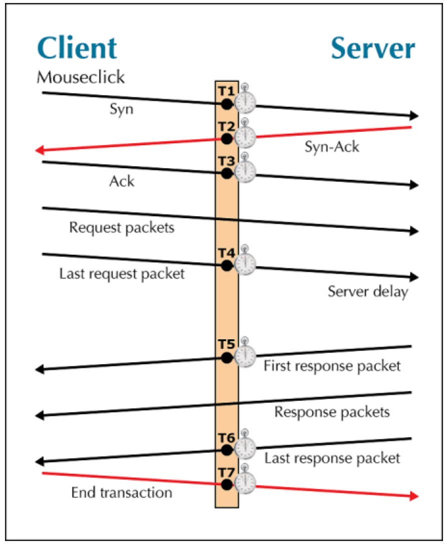
Application Layer and Software Infrastructure

- Support battle management, messaging, chat , Intelligence Surveillance Target Acquisition and Reconnaissance (ISTAR), ..
- Cannot always predict a campaigns information exchange requirements
- Assess:
  - Protocols
  - Service Oriented Architecture
  - Semantic Web
  - Applications

Protocols

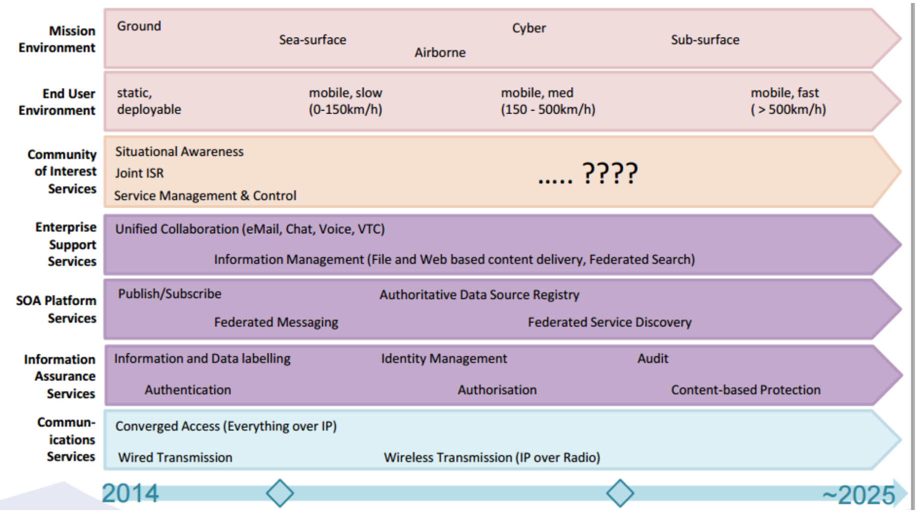
- Transport Control Protocol (TCP) vs UDP (User Datagram)
- Proprietary solutions: General Dynamics Adaptive Tactical Internet Services (ATIS), Bubblephone
- Alternatives such as Stream Control Transmission Protocol (SCTP)
- Hypertext Transfer Protocol (HTTP) used by many applications
- Quick UDP Internet Connections (QUIC) is new protocol built on top of UDP does same as HTTP





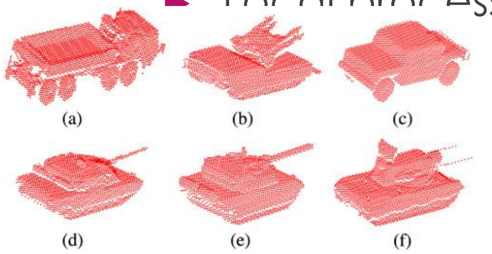
Service Oriented Architecture (SOA)

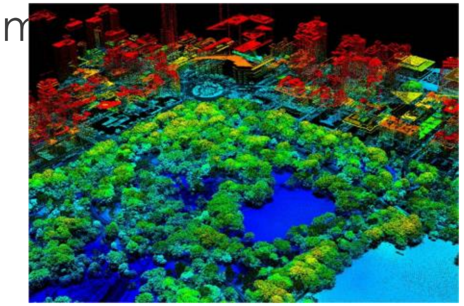
- Common interface has been used at strategic but not tactical level
- Simple Object Access Protocol (SOAP) can describe transactions but often wraps other formats Geographic Markup Language, Keyhole Markup Language etc
- Enterprise Service Bus (ESB) fordata normalisation and publish and subscribe
- Seen in the Afghan mission network and the Federated Mission Network
- For tactical space must be distributed

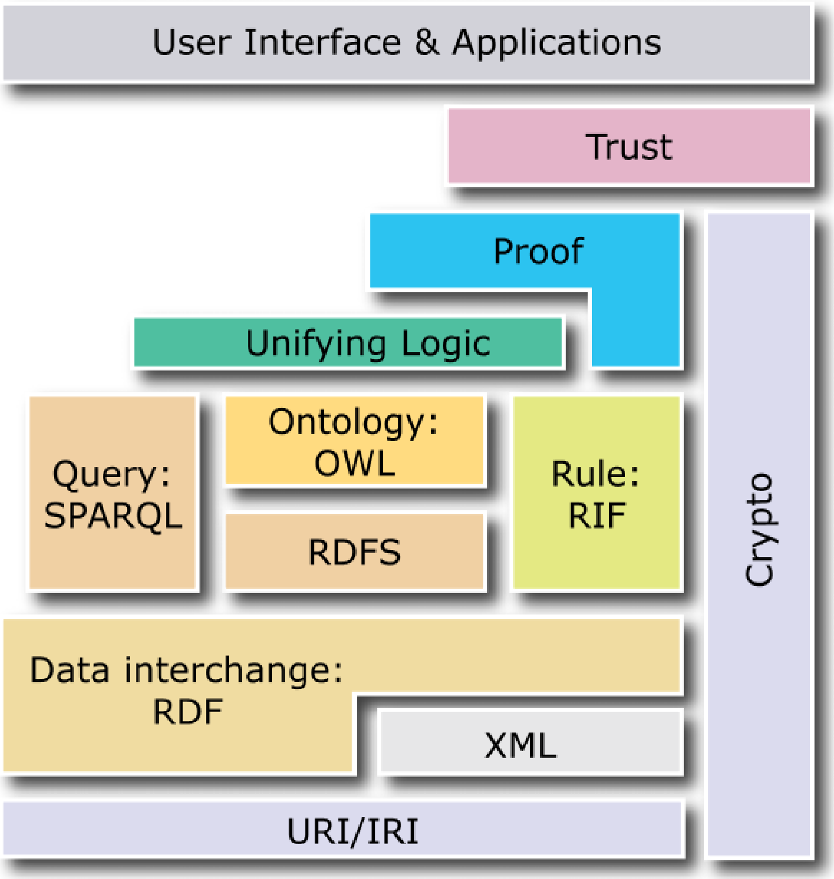


Semantic Web

- Information overload at all levels
- Semantic web can help extract the meaning from data
- Use Resource Description Framework (RDF) and SPARQL Protocol and RDF Query Language (SPARQL) avoid ambiguity
- SOA and ESB can facilitate extracting semantic data
- Big Data?:
  - LIght Detection And Ranging (LIDAR), Point Clouds, Imagery, Sensors
  - Local processing and dissem







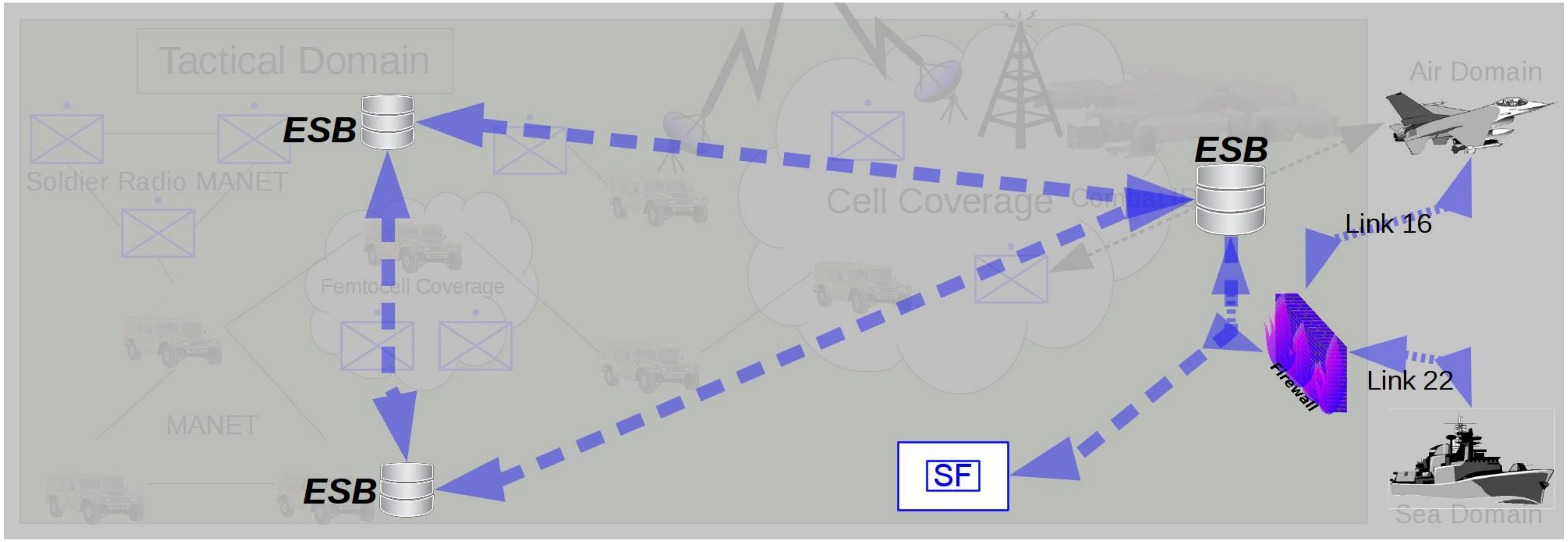
Applications

- Current monolithic Command, Control, Communications, Computers, and Intelligence (C4I) systems do not allow flexibility in application use
- Containerisation:
  - This is a growing way to package, isolate and distribute applications and services
  - Isolates applications and reduces integration risks
- Open Source:
  - Reduced cost
  - Freedom to switch vendor
  - Can improve and extend

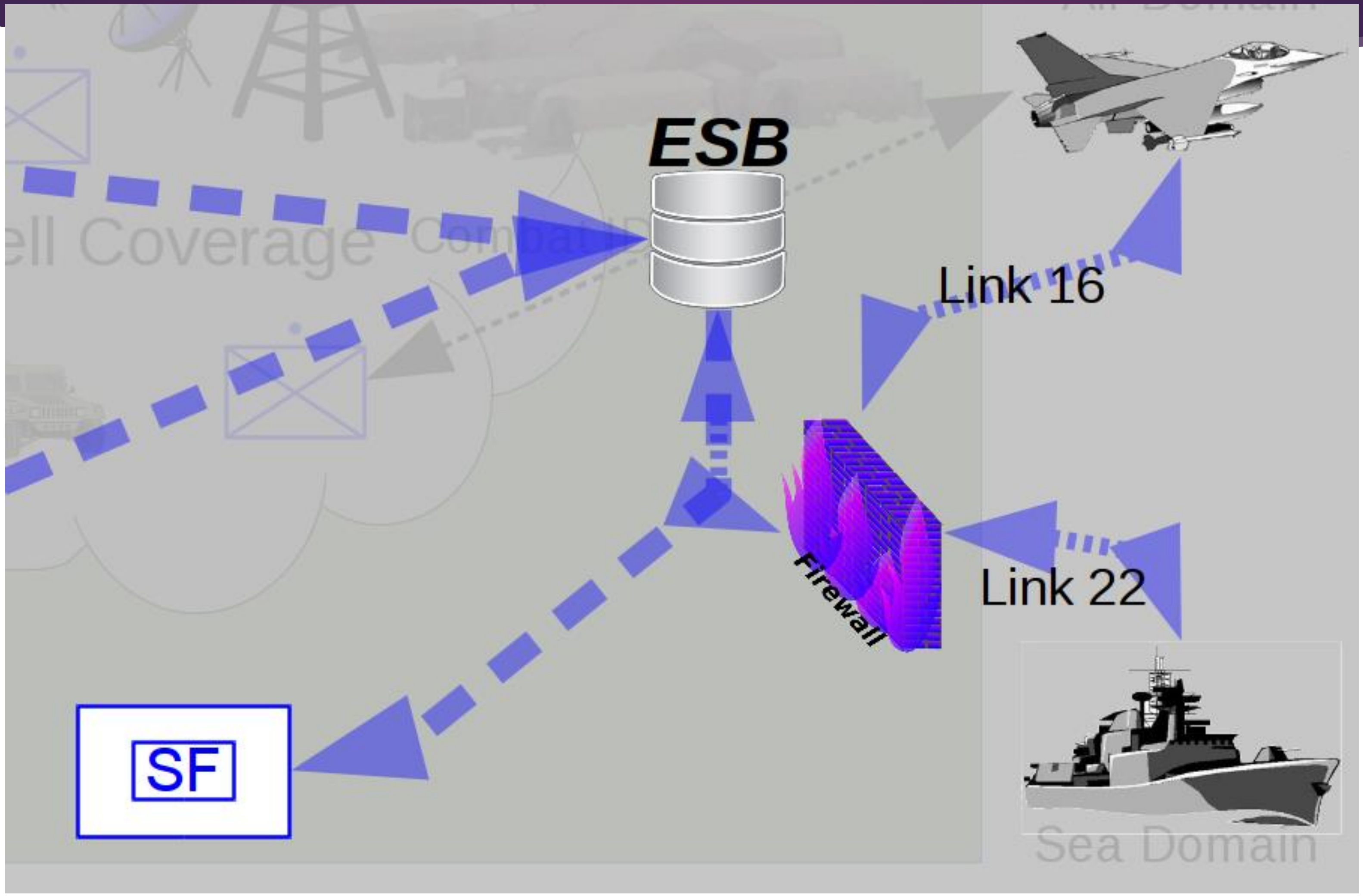
Architectural approach

- Combine technologies (golf bag approach)
- COTS where the environment allows
- Fixed infrastructure if possible
- The ability to deploy Military Off The Shelf (MOTS) when the environ requires

Candidate Architectures
Software Architecture

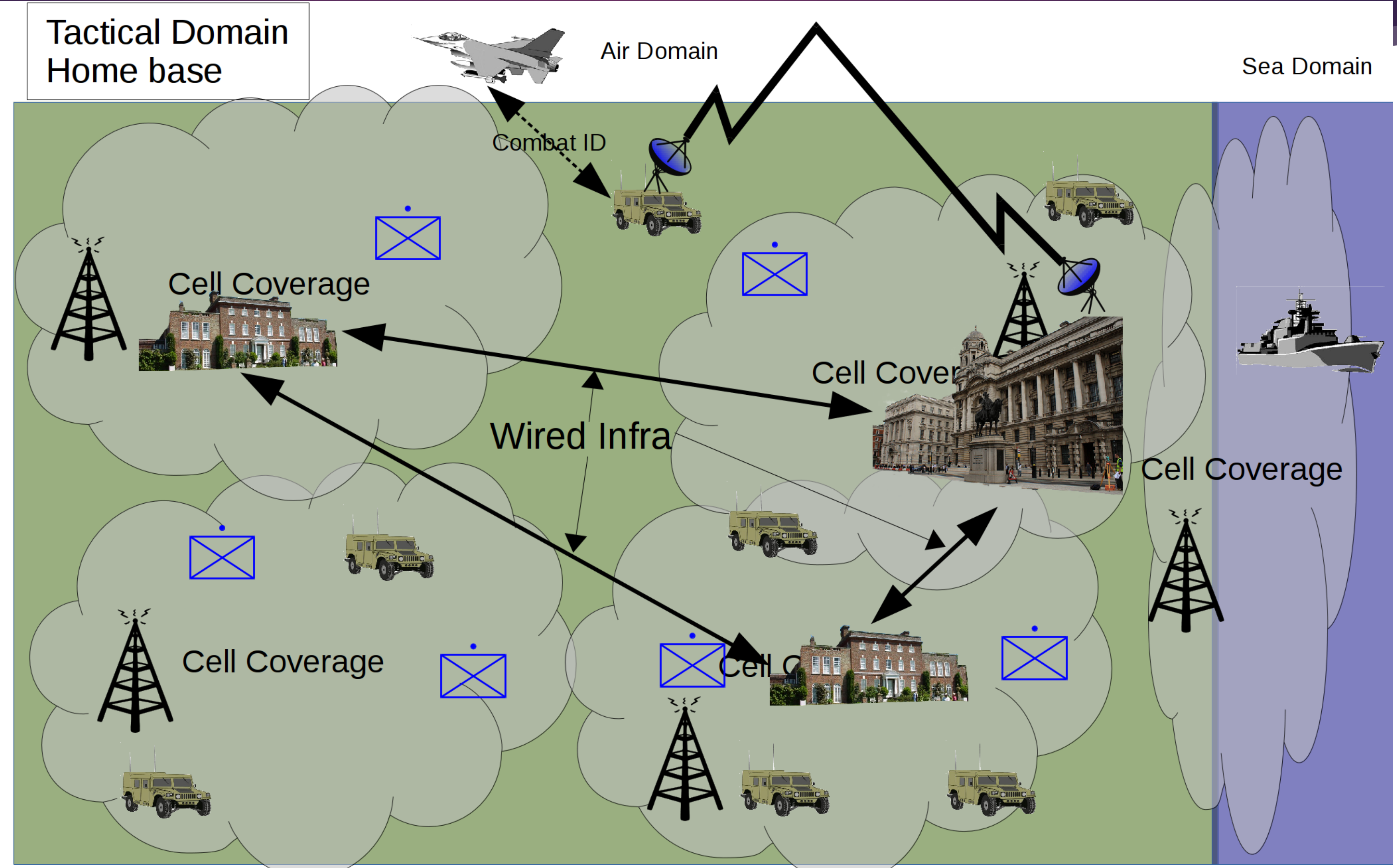


Candidate Architectures Interoperability



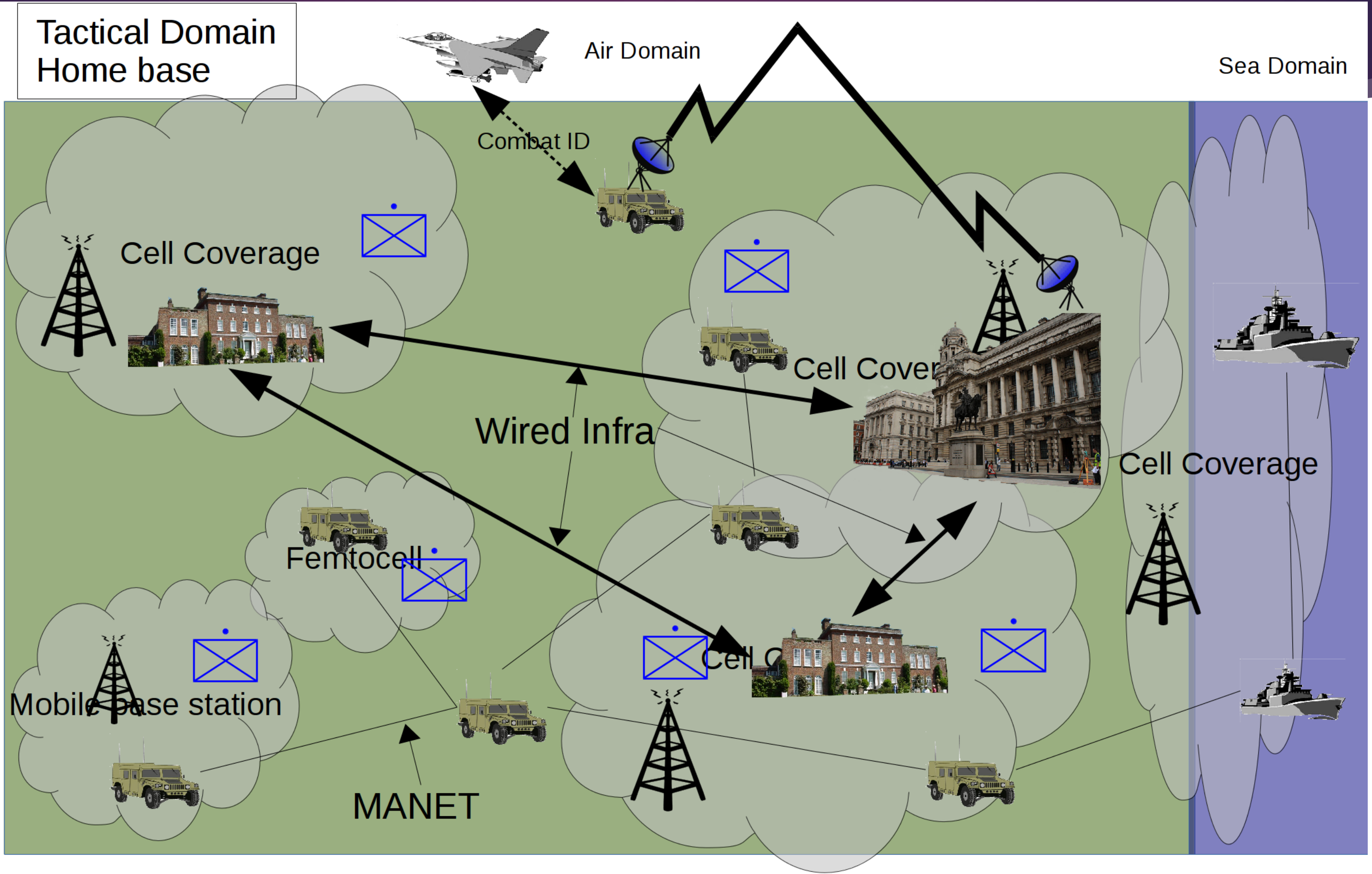
Candidate Architectures

Protection of the home base from undeveloped adversaries



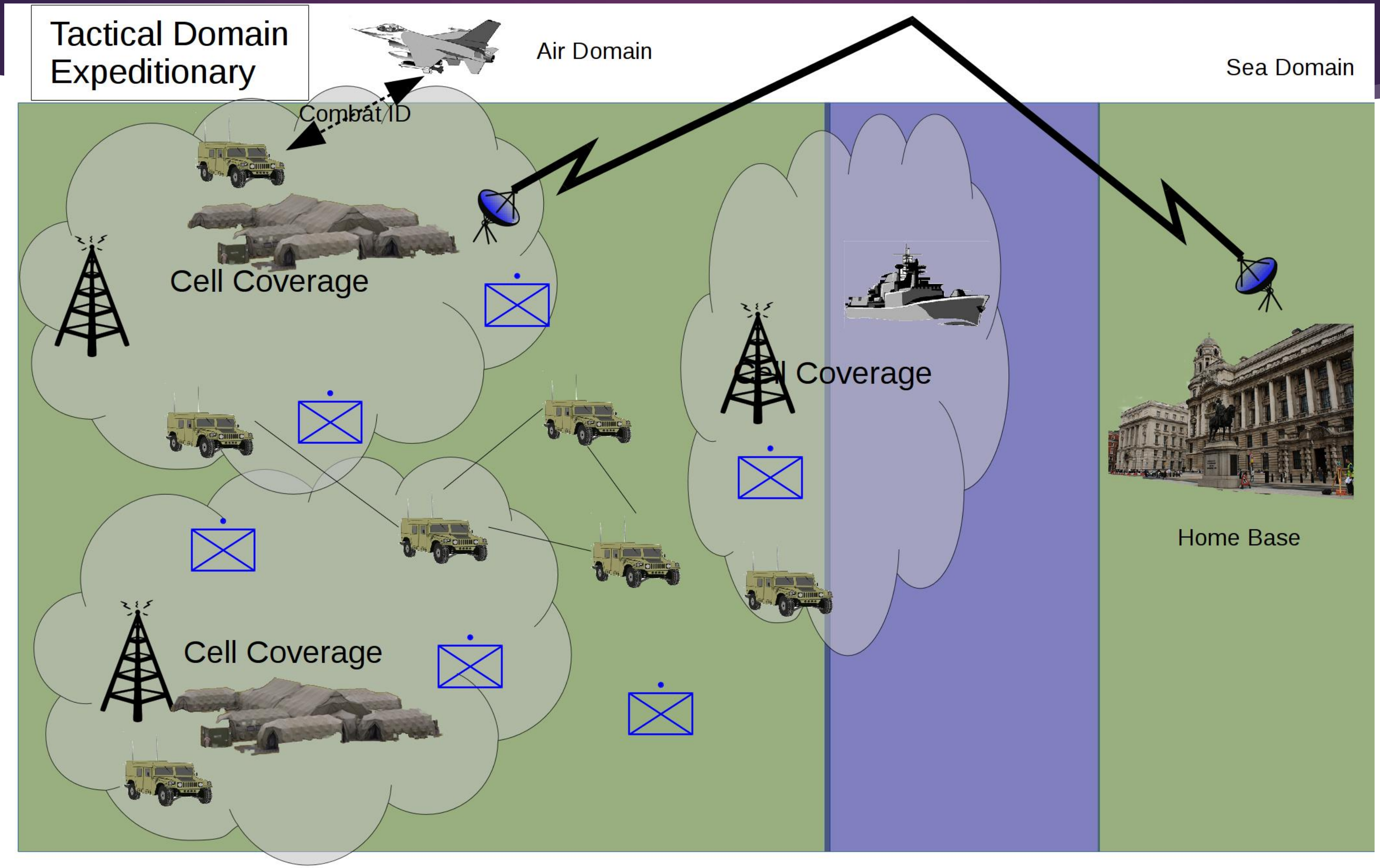
Candidate Architectures

Protection of the home base from advanced adversaries



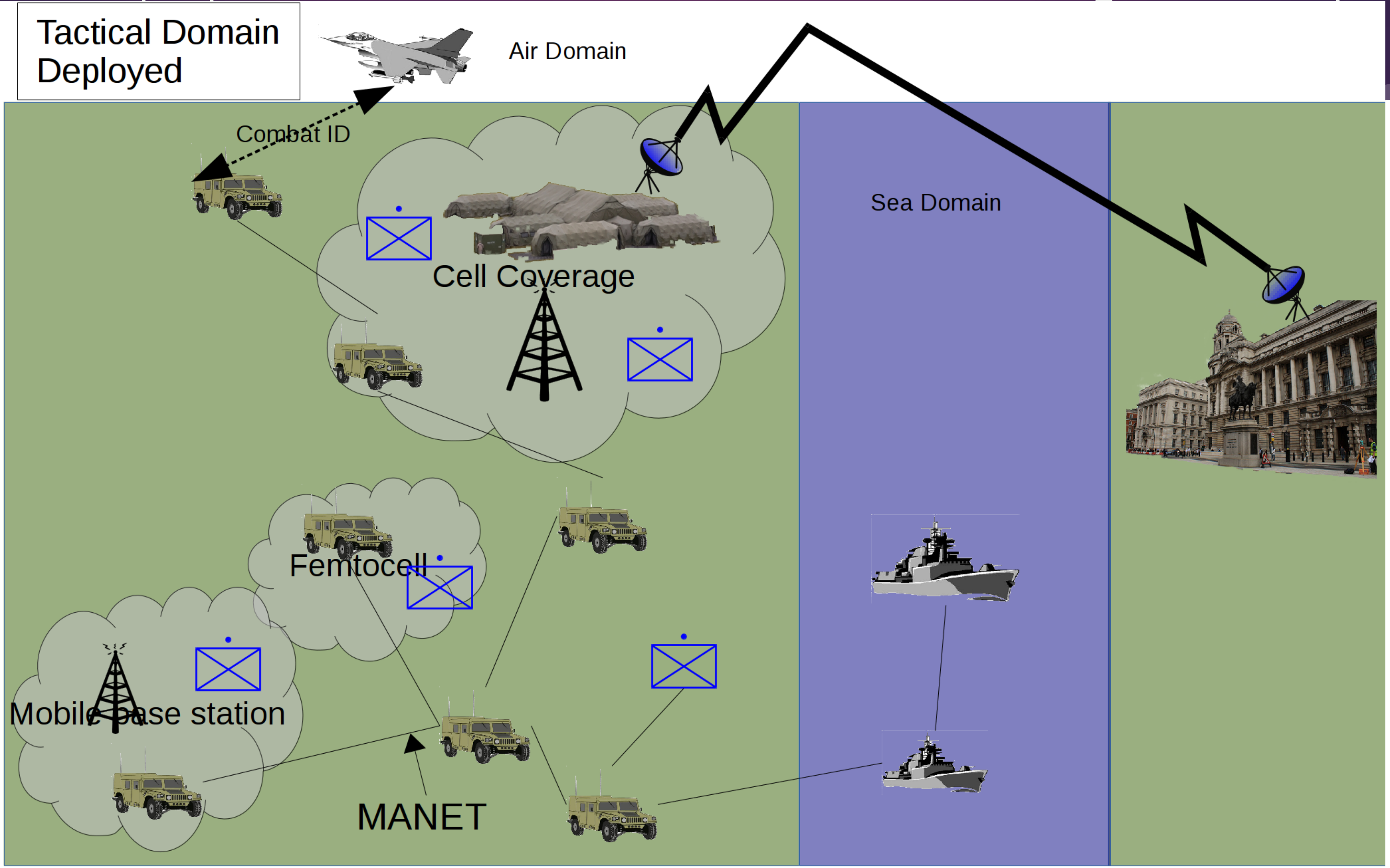
Candidate Architectures

Military operations outside the home base – low intensity



Candidate Architectures

Military operations outside the home base – high intensity



Other Lines of Development

- Doctrine and Training
- Support strategy
- Transition to service
- Avoid vendor lock in

Conclusions and future work

- Some key technology enablers discussed
- Tried to apply military reality
- Flexibility is key
- Some candidate architectures are presented
- Future work to look at efficiency of proposed solution
- Particular focus on the distributed architecture

Questions?

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