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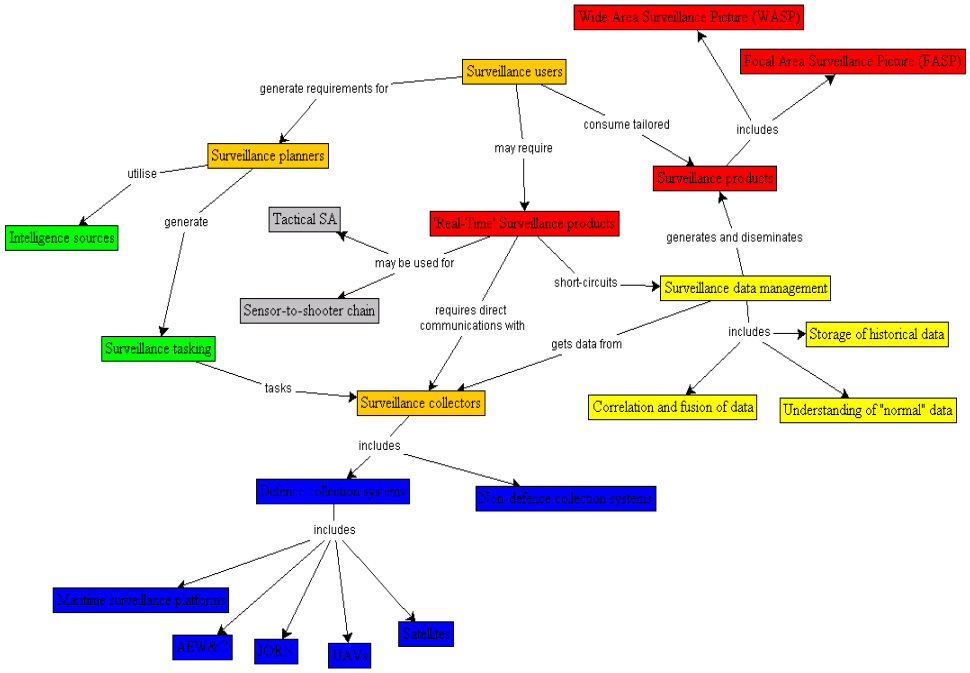
ICCRTS - C4ISR /C2 Architectures or Network Centric Applications

Networked Services



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Presented by Thea Clark at 9th ICCRTS Copenhagen, September 2004

Introduction

- The paper ‘Networked Services’ proposes the use of ‘services’ to model all interactions that occur between nodes within a force.
- The presentation will cover the following sections:
  - Limitations of existing modelling techniques (and how we think a services construct might improve on these).
  - Some definitions.
  - Service interactions – How services link together.
  - Issues associated with applying a services construct to a military domain.
  - ‘Where to from here?’ – The next tentative steps.

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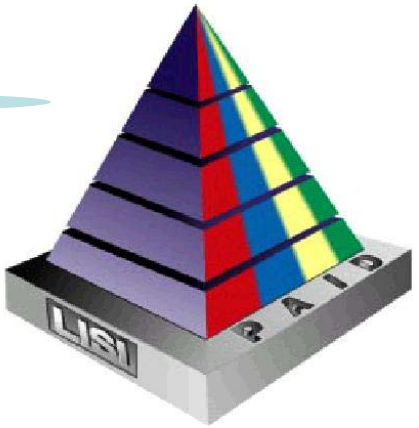
Limitations of Current Techniques



- Modelling of force interactions & interoperability often takes an information-centric approach:

Sources		Node 1				Node 2				Node 3				Node 4				Node 5				Node 6				Node 7				Node 8				Node 9			
		C2	MS	TD	SA	C2	MS	TD	SA	C2	MS	TD	SA	C2	MS	TD	SA	C2	MS	TD	SA	C2	MS	TD	SA	C2	MS	TD	SA	C2	MS	TD	SA	C2	MS	TD	SA
Node 1	Voice	✓	✓	✓	✓				✓				✓		✓		✓								✓						✓		✓				
	Data	✓	✓	✓	✓				✖				✖		✓		✓				✓				✓						✓		✓				
Node 2	Voice				✓	✓	✓	✓	✓				✓		✓		✓								✓						✓		✓				
	Data				✖	✖	✖	✖	✖				✖		✖		✖				✖				✖						✖		✖				
Node 3	Voice				✓				✓	✓	✓		✓		✓		✓								✓						✓		✓				
	Data				✖				✖	✖	✖		✖		✖		✖				✖				✖						✖		✖				
Node 4	Voice	✓			✓	✓			✓	✓			✓	✓	✓		✓					✓			✓	✓					✓		✓		✓		✓
	Data	✓			✓	✖			✖	✖			✖	✓	✓		✓	✓			✓	✓			✓	✓			✓		✓		✓		✓		✓
Node 5	Voice																																				
	Data			✓	✓			✖	✖				✖		✓		✓				✓				✓						✓		✓		✓		✓
Node 6	Voice				✓				✓				✓		✓		✓					✓	✓		✓						✓		✓				
	Data				✓				✖				✖		✓		✓				✓	✓	✓		✓						✓		✓				
Node 7	Voice																																				
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Node 8	Voice	✓		✓	✓	✓		✓	✓	✓			✓	✓			✓					✓			✓	✓				✓	✓		✓		✓		✓
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Node 9	Voice													✓												✓				✓							
	Data													✓				✓								✓				✓							

- This can provide many insights but it does not give the full picture:
  - Why did the information transfer take place?
  - How did it contribute to achieving an effect?

NATO Definition

Interoperability:

"The ability of systems, units and forces to provide ***services*** to and accept ***services*** from other systems, units or forces and to use the ***services*** so exchanged to enable them to operate effectively together"

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Services, NCW and EBO…

- What is the conceptual relationship between NCW, EBO and a Services construct?

"…network-centric operations are indeed a means to an end, and effects-based operations are that end."

– Edward Smith

The ADF needs to "…focus on improving our understanding of the way in which people, systems and platforms link with each other and contribute to achieving the effects that we require."

– Senator Robert Hill (Minister for Defence)

- Services focus on a breakdown of 'need' and 'effect' rather than concentrating on how each effect is achieved.
- Services potentially provide a better way of describing, or analysing, an effects based operation.

What is a Service?

- People intuitively know what a service is… but there are numerous definitions.
- Depends on the domain being discussed (e.g. commerce, economics, IT).

"Employment in duties or work for another."

"**Mechanism** for producing requested beneficial outcomes, using **resources independent of the requestor** (consumer)."

"...an economic activity that does not result in ownership."

"...a callable routine that is made available over a network."

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The Service – Some Assumptions

- Has a consumer, customer and a provider.
- Has deliverables:
  - Tangible deliverables (physical products, goods).
  - Less tangible deliverables (information, deterrence etc.).
  - Leads to a change of state.
- Satisfies some need of the consumer.

- The means of provision are decoupled from the satisfaction of the consumer's need.
  - i.e. the consumer doesn't care how the provider does their job as long as they deliver!

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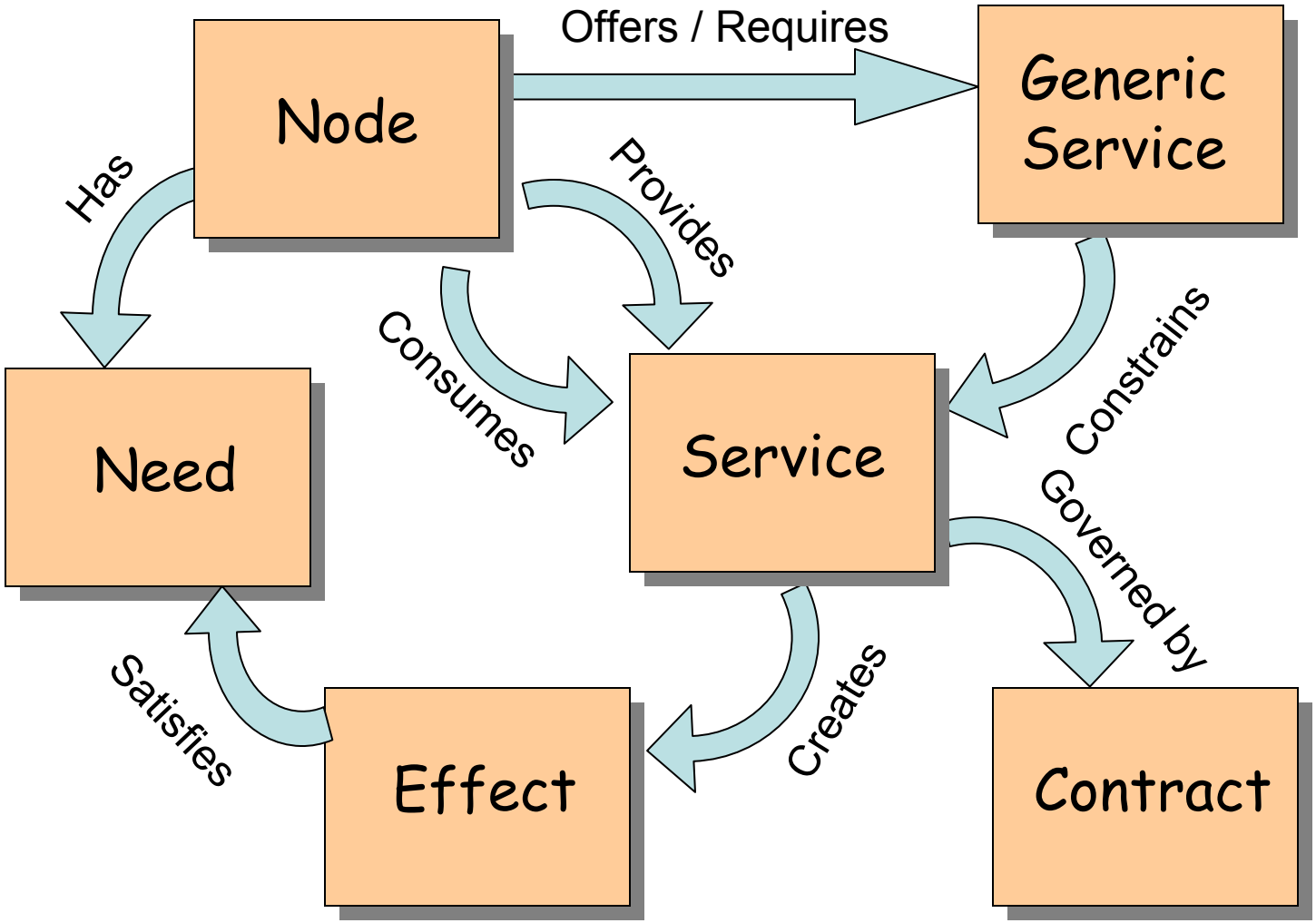
Related Concepts



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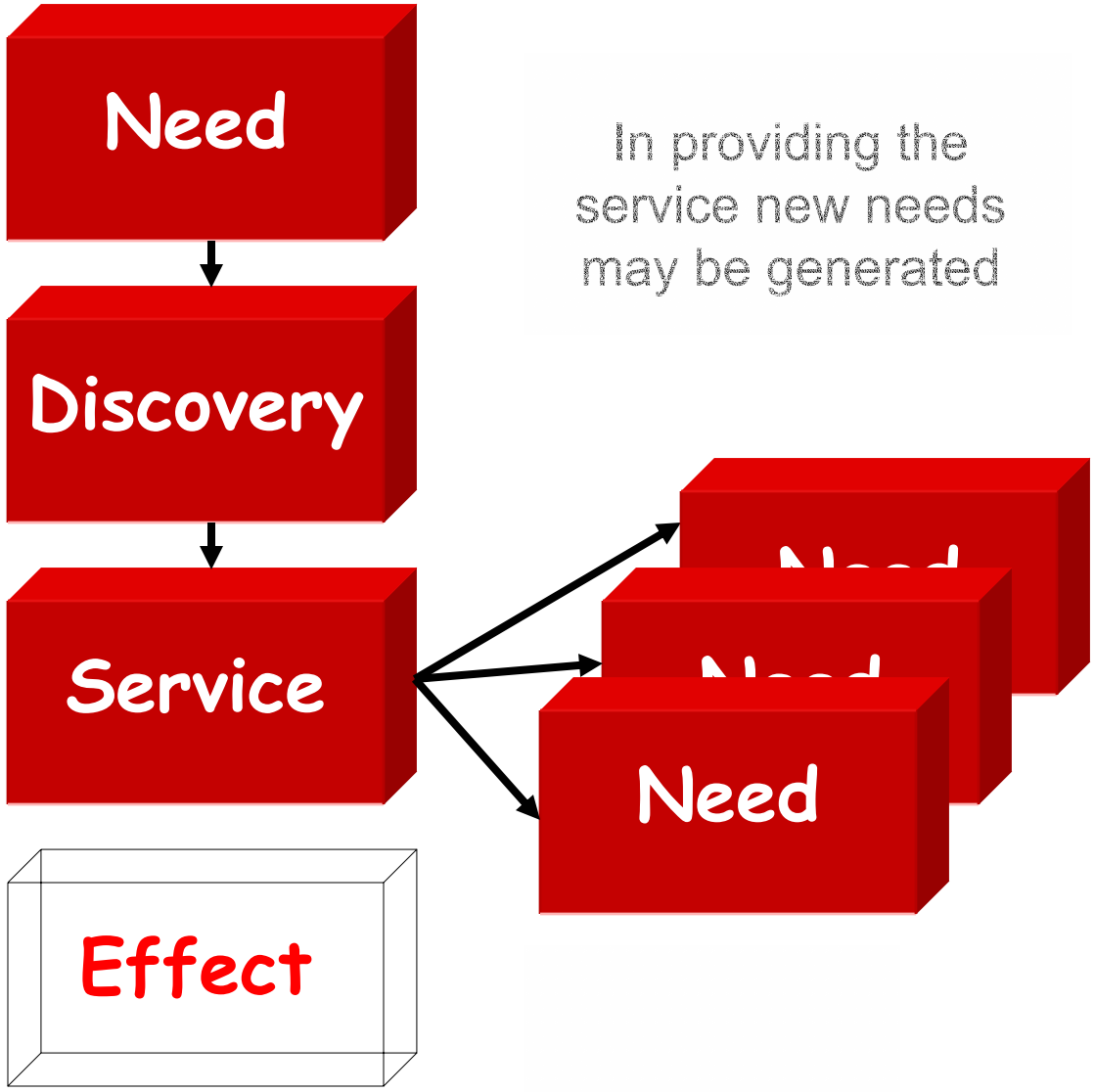
Service Interactions

A 'need' is identified by the customer.

A 'Discovery' process informs the customer about the 'generic services' and providers that exist.

A Service is spawned following negotiation between the service customer and the provider.

An effect which satisfies the initial need is not created until all of these 'sub needs' have also been satisfied.



In providing the service new needs may be generated

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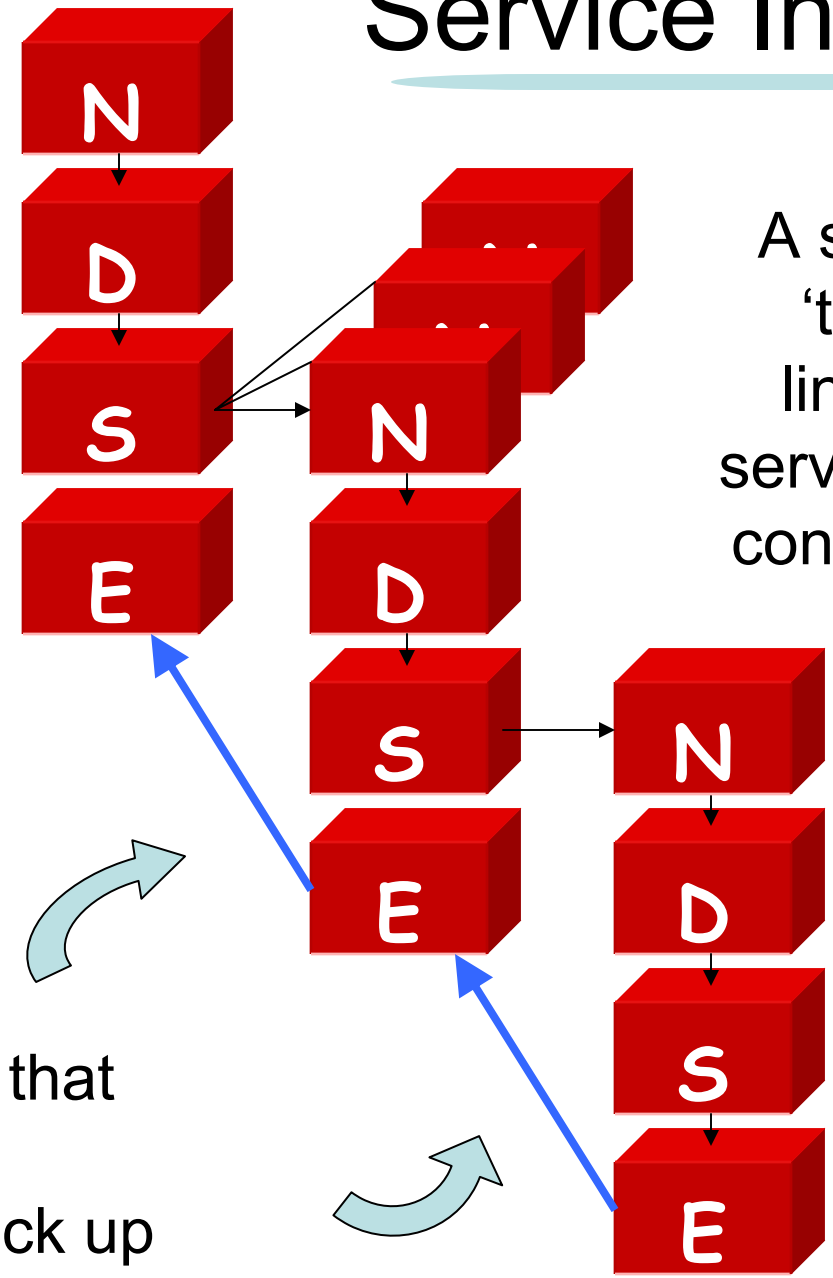
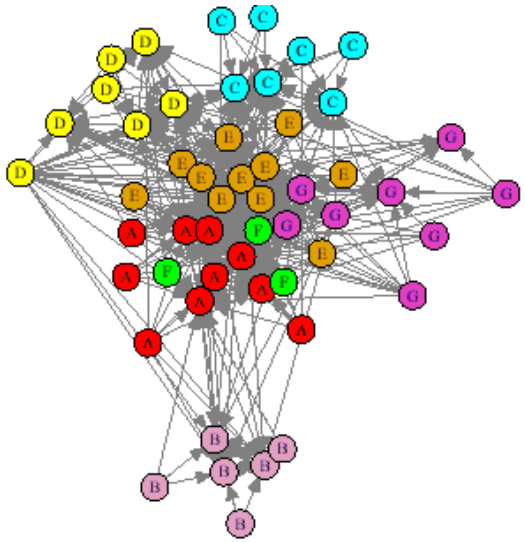
Service Interactions



A services ‘chain’ / ‘tree’ can form - linking numerous service providers and consumers together.

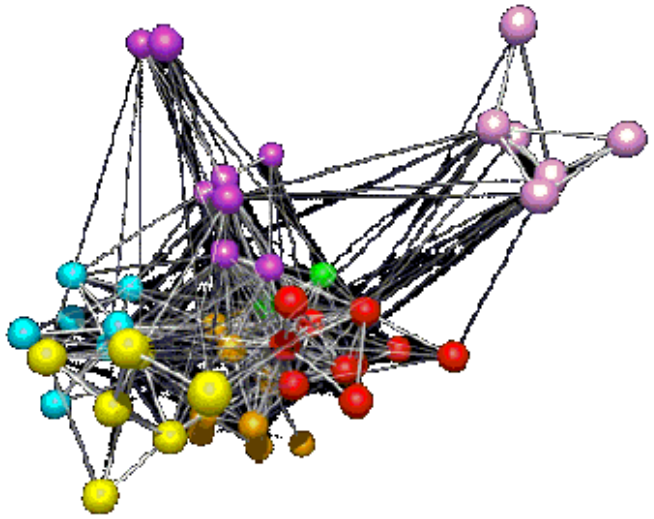
The effects that are created cascade back up the chain.

Service Networks



- A number of independently originating service ‘chains’ may be contained within a ‘network-of-services’.
- Services form the links between nodes within a network-of-services.

- At a lower level of abstraction, well defined interfaces and protocols must be in place to enable service discovery, delivery of effect etc.



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Services in the Military Domain

- Is it feasible to describe a military operation in terms of service requests and service provision?

	Military Domain	Other Domains
Service provider can be forced to accept a request.	✓	✗
Priority of service requests is imposed externally.	✓	✗
All consumers and providers share some overarching intent / goal.	✓	✗

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C2 Services

- Many of the unique aspects of the military domain stem from the existence of Command and Control and overarching intent.
- In other domains ‘nodes’ generally have more autonomy.
- Is it possible to use a services construct given these constraints?

Perhaps C2 can be modelled as a set of services:

1. Brokering
2. Prioritisation / Adjudication
3. Tasking

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C2 Services (continued)

- Prioritisation / Adjudication:

  In an environment where there are finite resources, decisions must be made about which need is greater – i.e. which need best supports the overall intent of the operation.

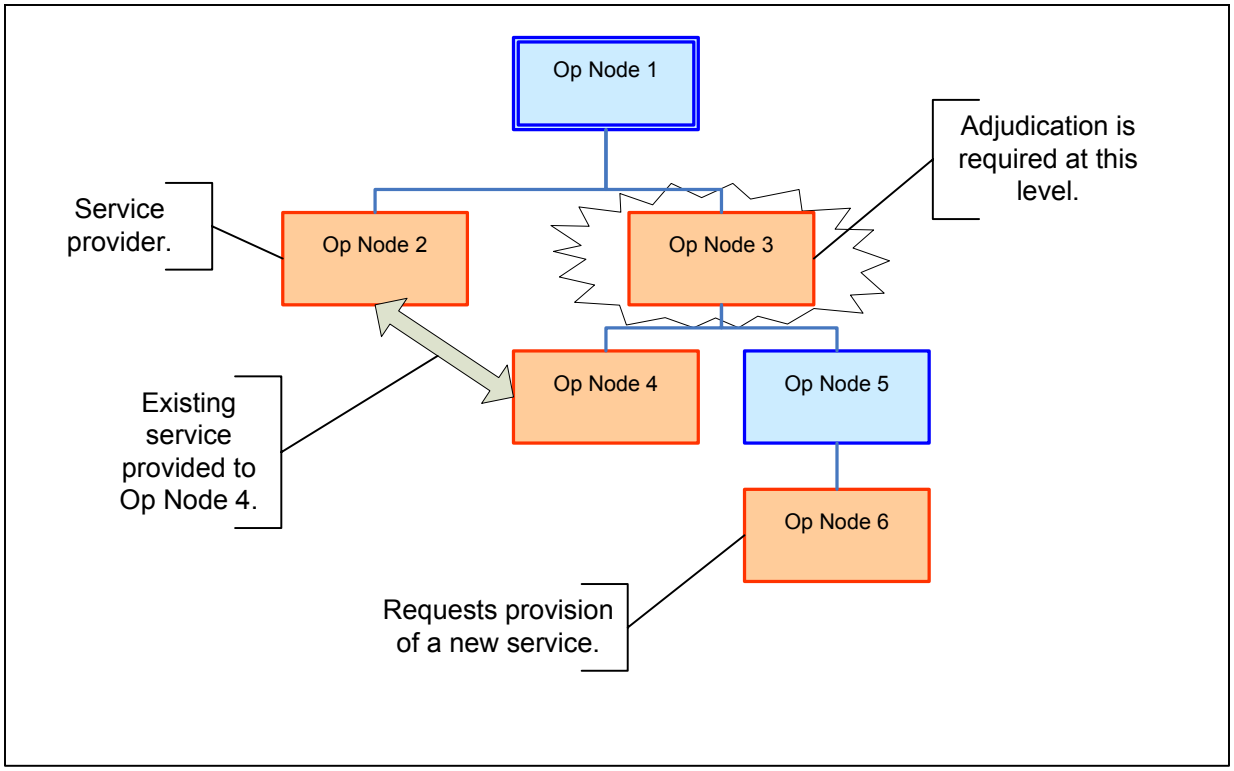
- Tasking:

  Compelling a subordinate node to provide services to a third party consumer.

- Brokering:

  Matching the need of a consumer to the most appropriate service provider.

C2 Services (continued)



- The paper discusses the operation of the C2 services within a command hierarchy.

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Future C2

- The discussion of C2 and services in the paper focuses on hierarchical / traditional C2 structures.
  - Would a services construct still be able to describe the interactions that occur between elements (nodes) within a network centric force?
    - Flatter C2 structures.
    - More dynamic C2.

- Perhaps a dynamic network centric force would require its nodes to have greater autonomy in conducting adjudication / prioritisation.

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A Services Framework

- In order to use a services construct to model forces, a framework is required.
  - A Services framework should outline:
    - How to formally describe what a service can do.
    - The interfaces used for: needs expression, service discovery and effect delivery.
    - Protocols to support inter-service communication, negotiation and coordination.
    - Rules for determining the level of service granularity that is required for a given force and a given level of analysis.

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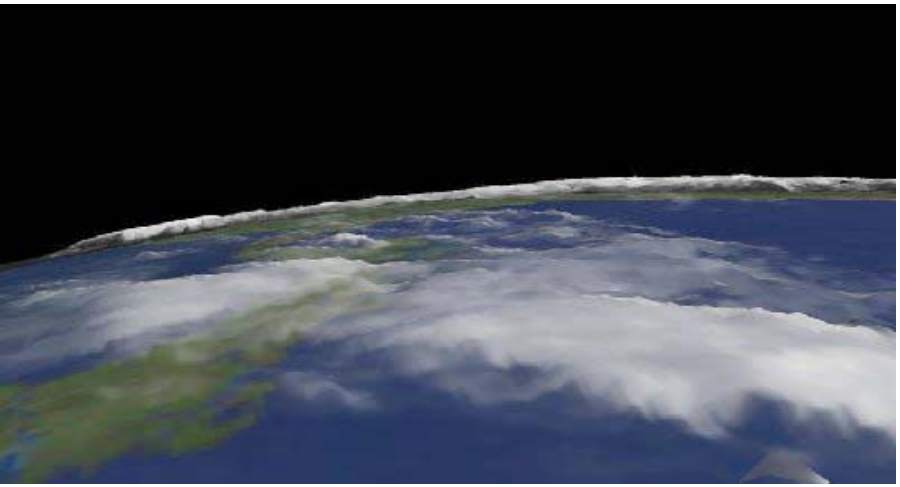
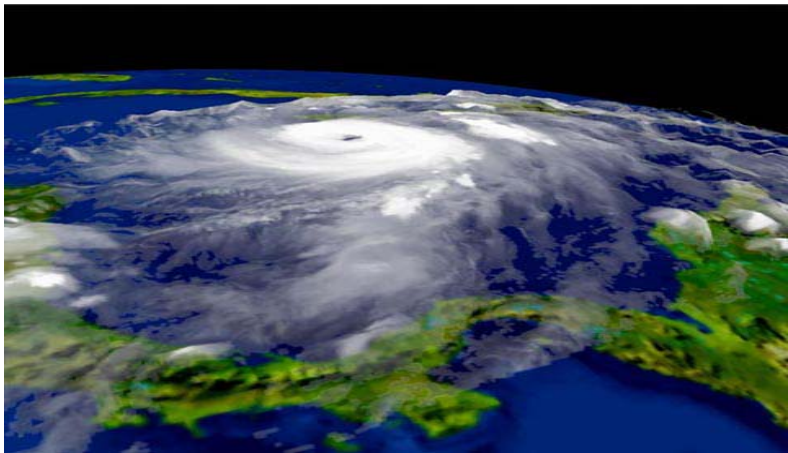
Where to from here?



- Need to apply a services-based modelling technique to a larger real-world case study and…
- Demonstrate that this approach has tangible benefits over other approaches.

- This cannot happen without a services framework.
- Visualisation of services still an issue.
- Can a services construct aid the capability development process?
  - Some work is being conducted in this area.



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