14th ICCRTS

International Command and Control Research and Technology Symposium

C2 and Agility

June 15-17, 2009
Omni Shoreham Hotel
Washington, D.C.

Department of Defense
Office of the Assistant Secretary of Defense
Networks and Information Integration
DoD Chief Information Officer

CCRP
Focus
& Convergence
for Complex Endeavors
www.dodccrp.org

SAS-065

NATO Network Enabled Capability (NNEC) C2 Maturity Model -- Overview

SAS Exploratory Team

C2 Agility

June 16, 2009

CCRP
Focus & Convergence for Complex Endeavors

Agenda

- Overview of N2C2M2
  - Context: complex endeavors
  - Why a maturity model?
  - NNEC Capability Levels
  - C2 Approaches
  - C2 Capability Levels
- Validation Case Studies
- Uses of the Maturity Model
- Challenges of C2 Agility
  - Need for requisite agility
  - Way-ahead

The Problem

There is a fundamental disconnect between

the state of the art and practice of

Command and Control

&

21st Century

Mission challenges

21st Century Missions

21st Century Missions are ***Complex Endeavors***

Complexity in the Task and Environment

+

Complexity of 'Self'

=

Complex Endeavor

Complexity of Task and Environment

Humanitarian Assistance

Peace Operations

Counter Terrorism

- The success of 21st Century Missions requires a multi-dimensional effects space
  - *political, social, economic, military*

- The complexity of the mission is a result of the interactions between and among the effects particularly across dimensions and the uncertainties associated with a network of cascading effects.

Disaster Relief

Stability Operations

Complexity of Self

• Self = A large number of heterogeneous, independent, and interdependent entities that differ significantly with respect to:

- Culture, values and norms
- Laws, policies, rules, and regulations
- Practices and processes
- Levels of trust
- Language
- Information and communications capabilities
- Approach to organization and management

• The complexity of 'Self' comes from the nature of the interactions between and among the participating entities and the dynamics of the situation that affect entity willingness, constraints, perceptions, and capabilities.

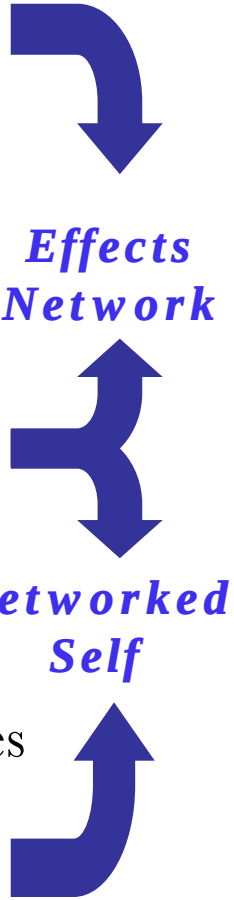
Complex Endeavors: Implications for Command and Control

- There will not be a unified chain of command.
- Entities will each have their own intent.
- The situation will be, in part, unfamiliar to all entities.
- There will be multiple planning processes.
- Critical information and expertise necessary to understand the situation will be non-organic.
- Actions, to be effective, will require developing synergies between and among entity actions.

There is a difference between <u>Entity</u> Command and Control and <u>Collective</u> Command and Control

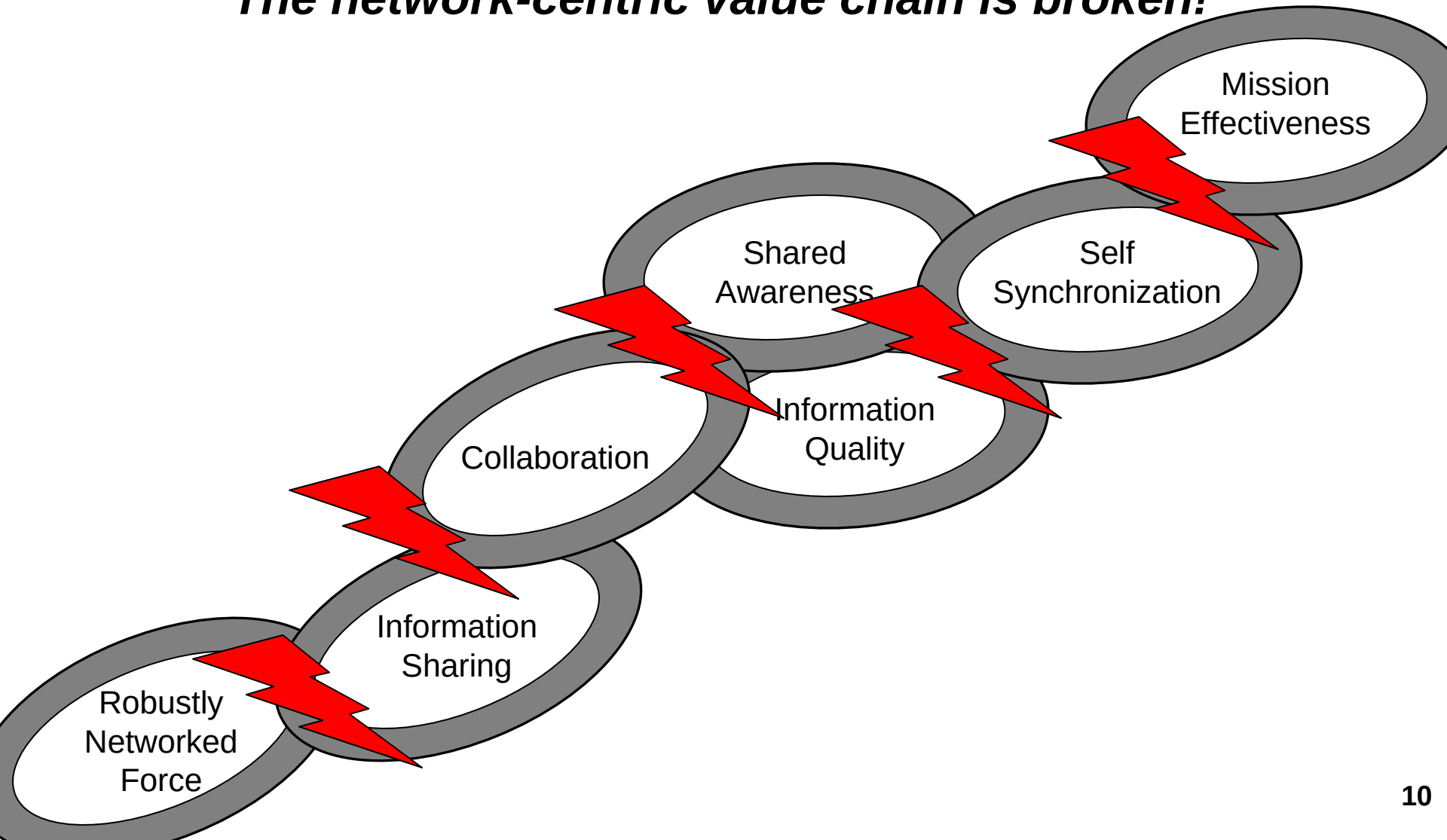
It's all about Networks and Network Enabled C2

- Complex Endeavors are now the business of DoD
- Complex Effects Space
  - More than just military effects
  - Interactions in effects space significant
  - Lack of understanding of cross-domain cause-effects
  - Inability to predict
- Operating in a Network-Centric Environment
  - Many v. Few
  - Unfamiliar v. Familiar
- Complex "Self"
  - "Self" is composed of large number of heterogeneous entities
  - Different objectives, values, constraints
  - No single entity in charge
  - Entities have significantly different perceptions



However

The network-centric value chain is broken!



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What is a Maturity Model?

- A Maturity Model identifies different levels of capability that are achievable and what is required to move from one level to the next.
- It is usually assumed that entities, as they mature, will be able to achieve higher levels of capability.
- Some Maturity Models map capability levels to a measure of value and/or to the specific characteristics of a number of key value-related variables.
- The capability levels must be empirically measurable.

Why a Maturity Model?

- Network Centric Value Chain assumes a mature C2 capability
- NATO and the nations need to assess where they are and where they want to be (capability gap)
- NATO and the nations need to figure out how to get from where they are to where they want to be (roadmap)
- A Maturity Model identifies different levels of capability that are achievable and what is required to move from one level to the next.

NEC C2 Maturity Model

- The NNEC C2 Maturity Model (N2C2M2) was developed specifically for operations that can be characterized as Complex Endeavors
- Nevertheless N2C2M2 can be applied to the lesser included case of more traditional operations
- Thus, N2C2M2 can be applied to entities and/or collections of entities
- For collections of entities, the term C2 should be read as "Collective C2"
- C2 Maturity Levels are associated with the degree to which a collective or entity is able to conduct network-centric operations (NEC capability levels)
- C2 Maturity Levels are defined in terms of specific regions of the C2 Approach Space

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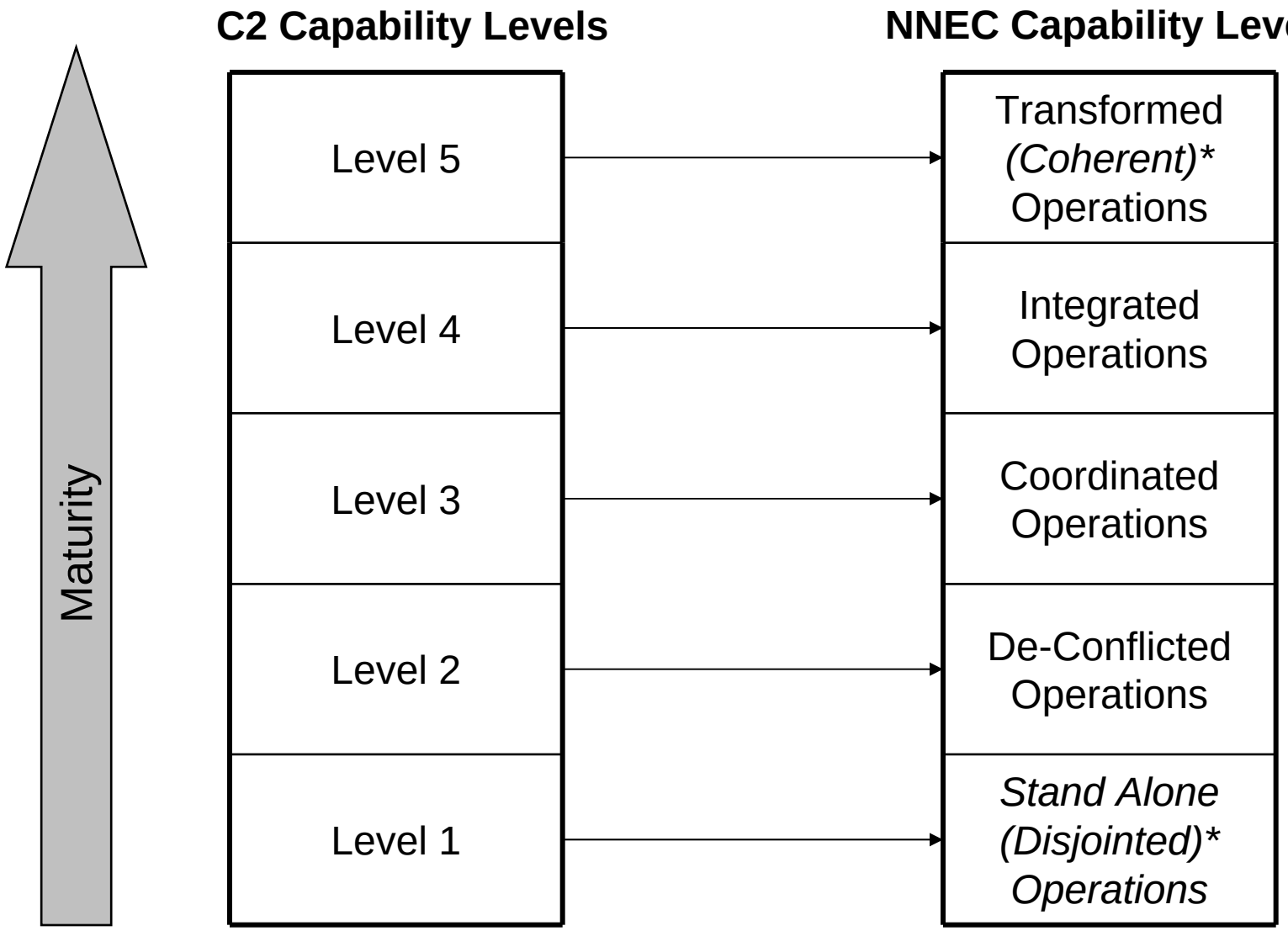
NATO NEC Capability Levels

Capability Level	Distinguishing Characteristics
Transformed (Level 5)	Self-synchronized actions of participating entities Robustly networked entities interacting continuously Unprecedented effectiveness
Integrated (Level 4)	Symbiotic relationships between participating entities Interdependent actions and based on a single shared plan Significant synergies
Coordinated (Level 3)	Linking plans and operations of participating entities Initial pooling of non-organic resources Enhancing effects of and avoiding conflict between entities
De-Conflicted (Level 2)	Geographical, functional, timely separation of operations Avoidance of adverse cross-impacts
Stand Alone (Level 1)	Independent Operations Potential interference and adverse cross-impacts

C2 and NNEC Capability Levels



* The NNEC Feasibility Study used the terms Coherent and Disjointed rather than Transformed and Stand Alone

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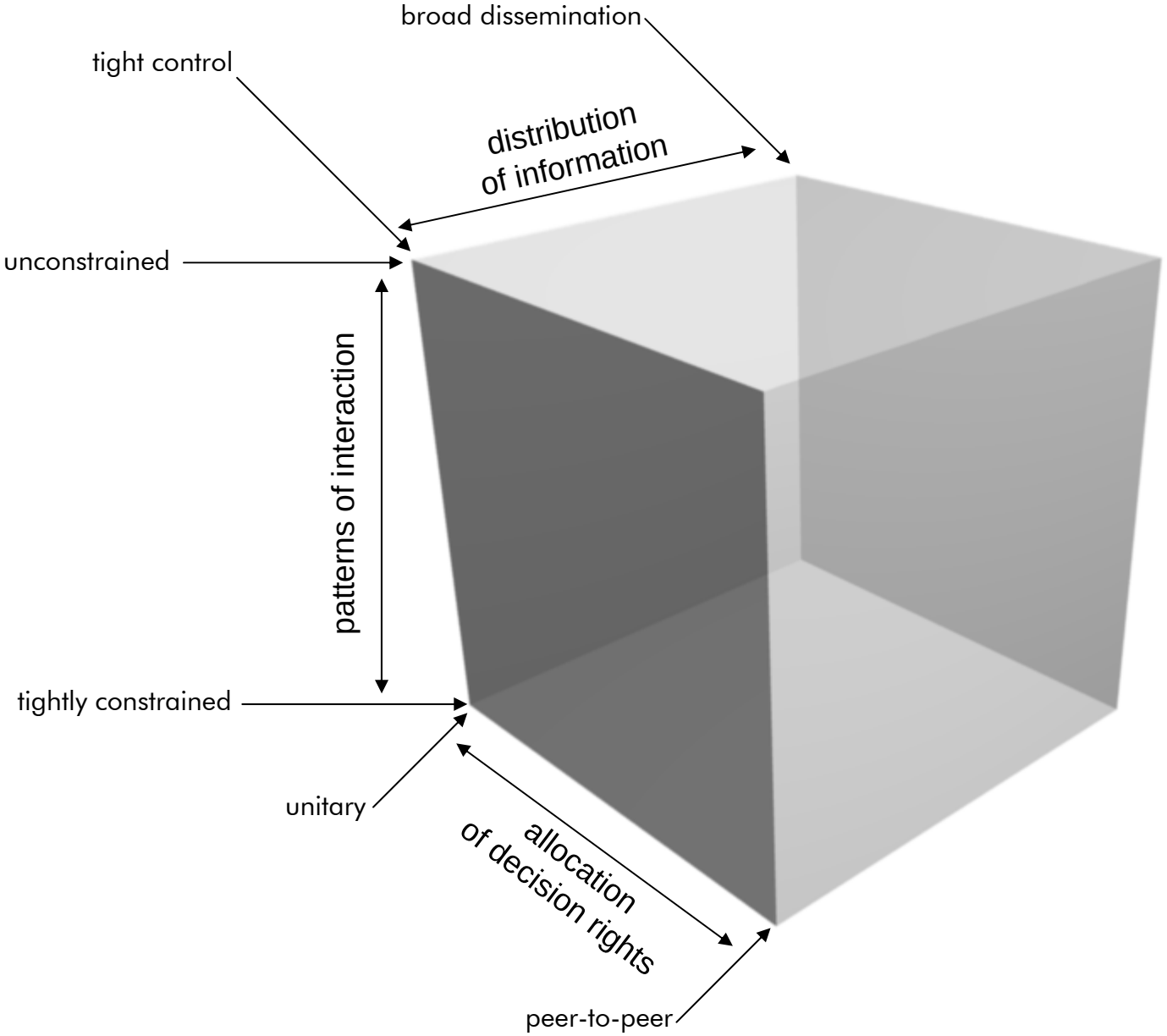
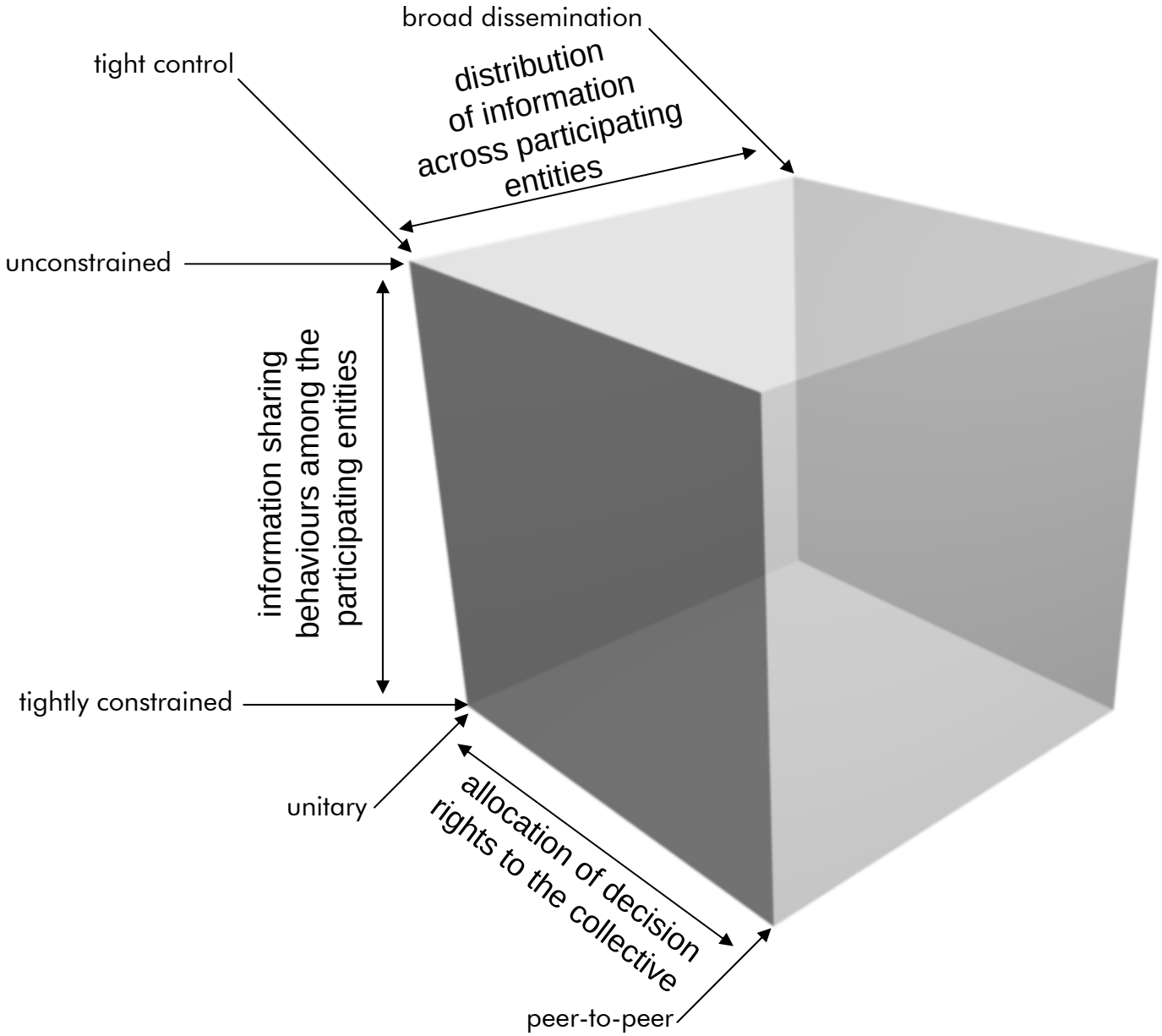
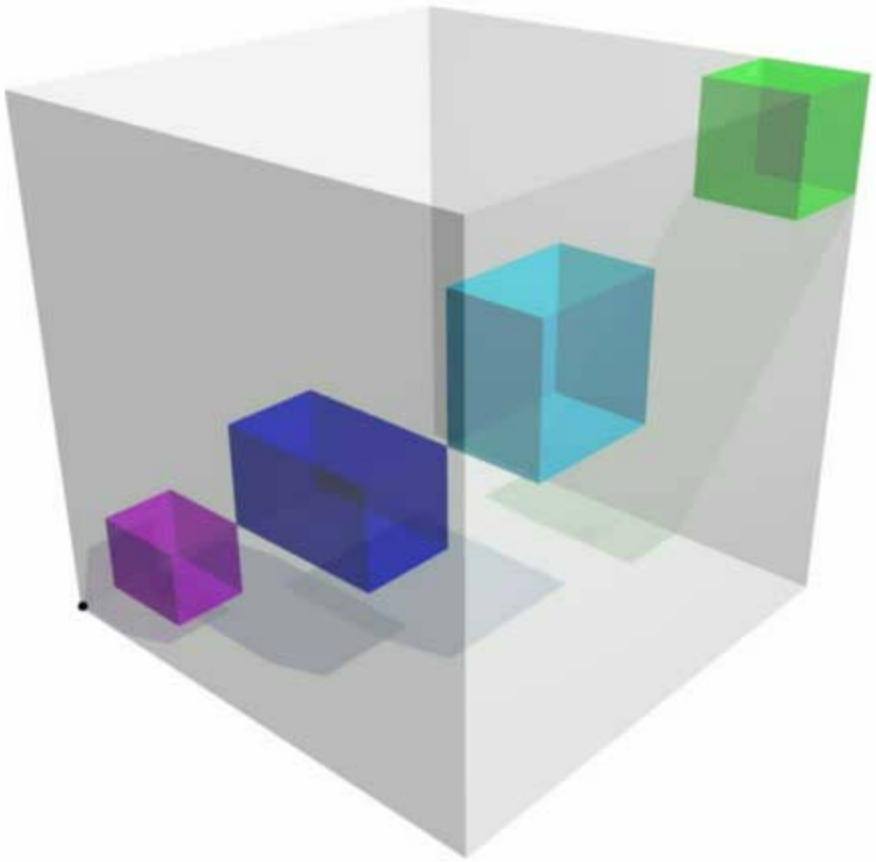
C2 Approach Space



Collective C2 Approach Space



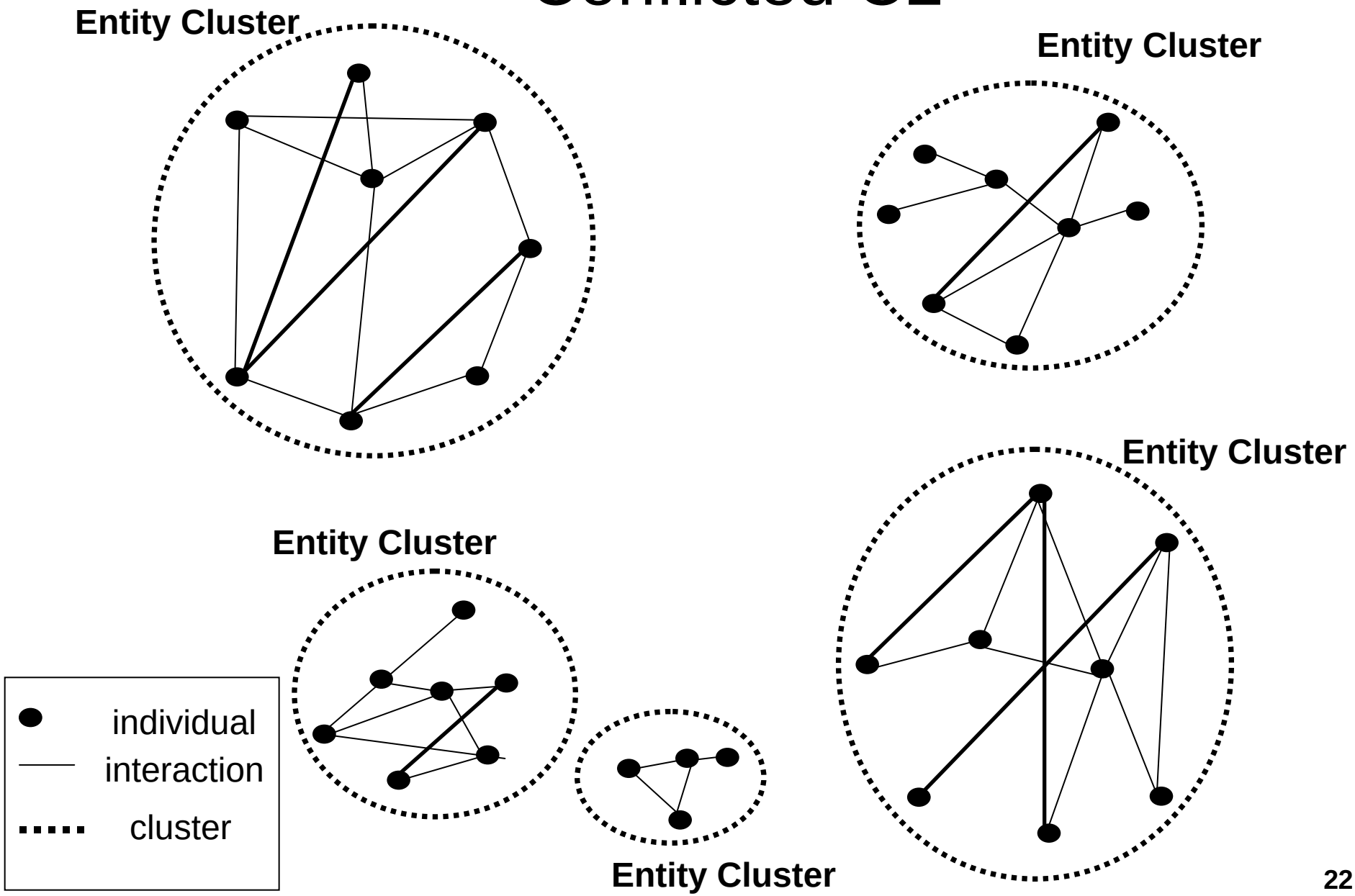
C2 Approach Space



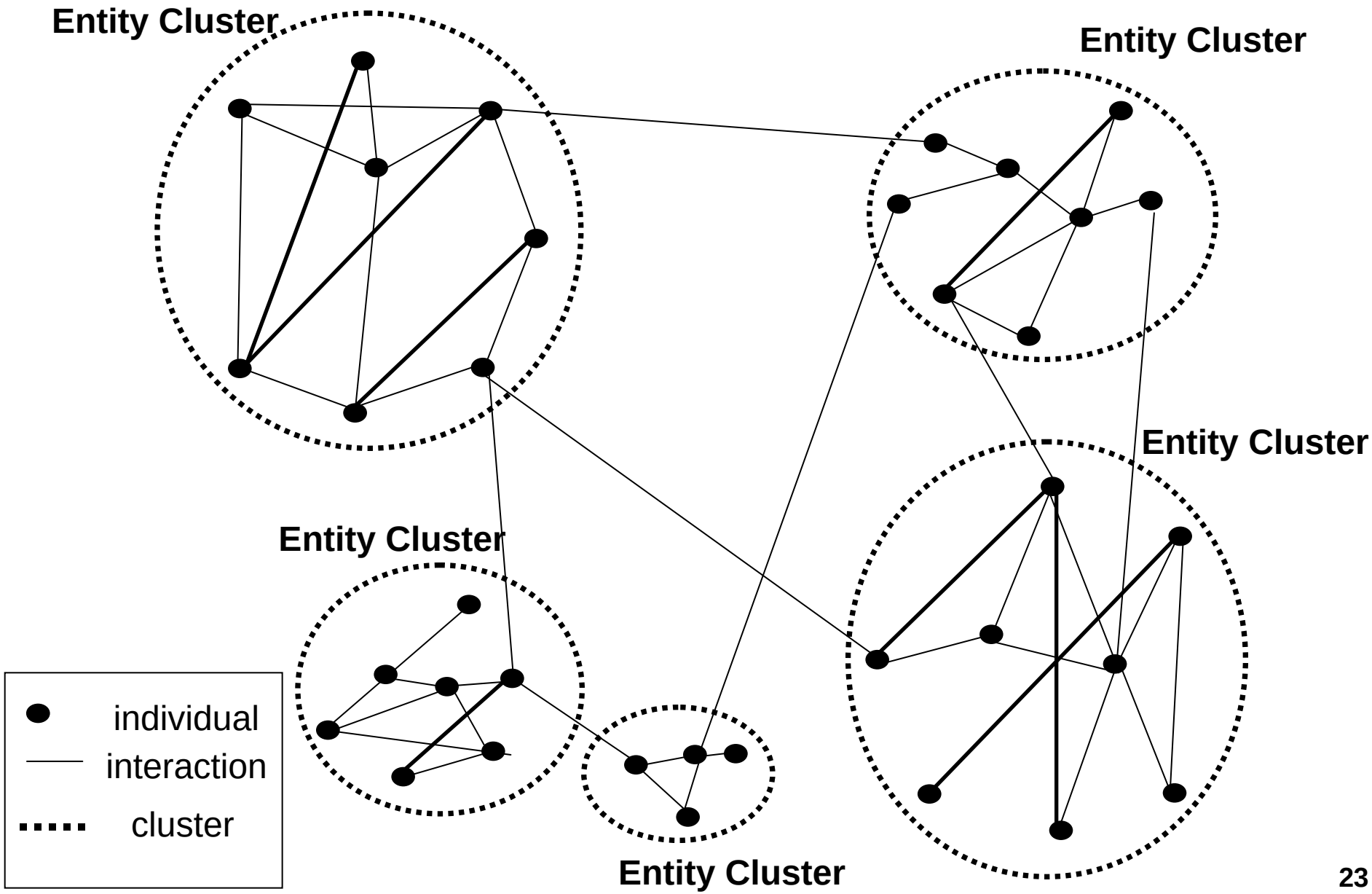
C2 Approaches

- Edge C2
- Collaborative C2
- Coordinated C2
- De-Conflicted C2
- Conflicted C2

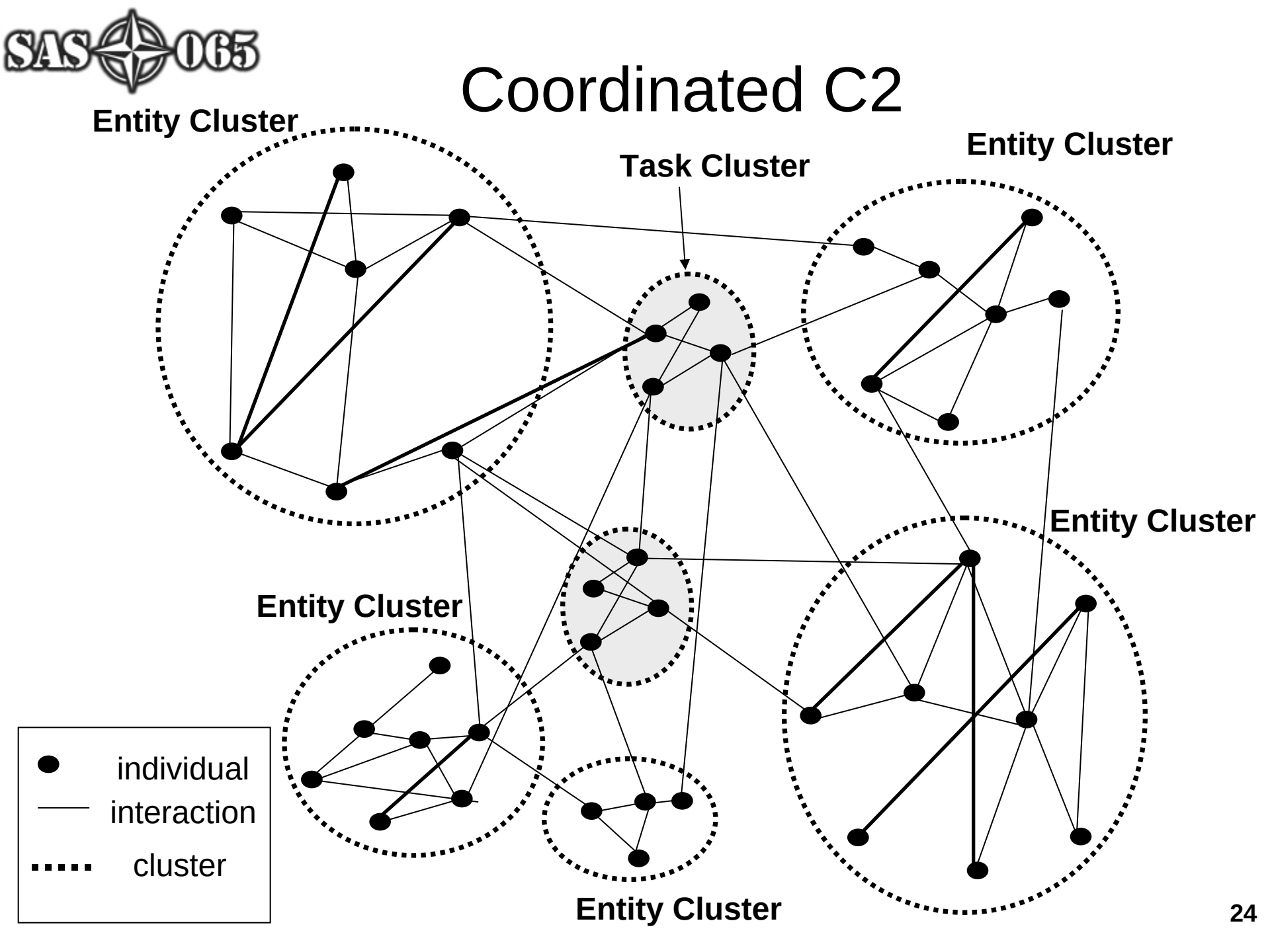
Conflicted C2



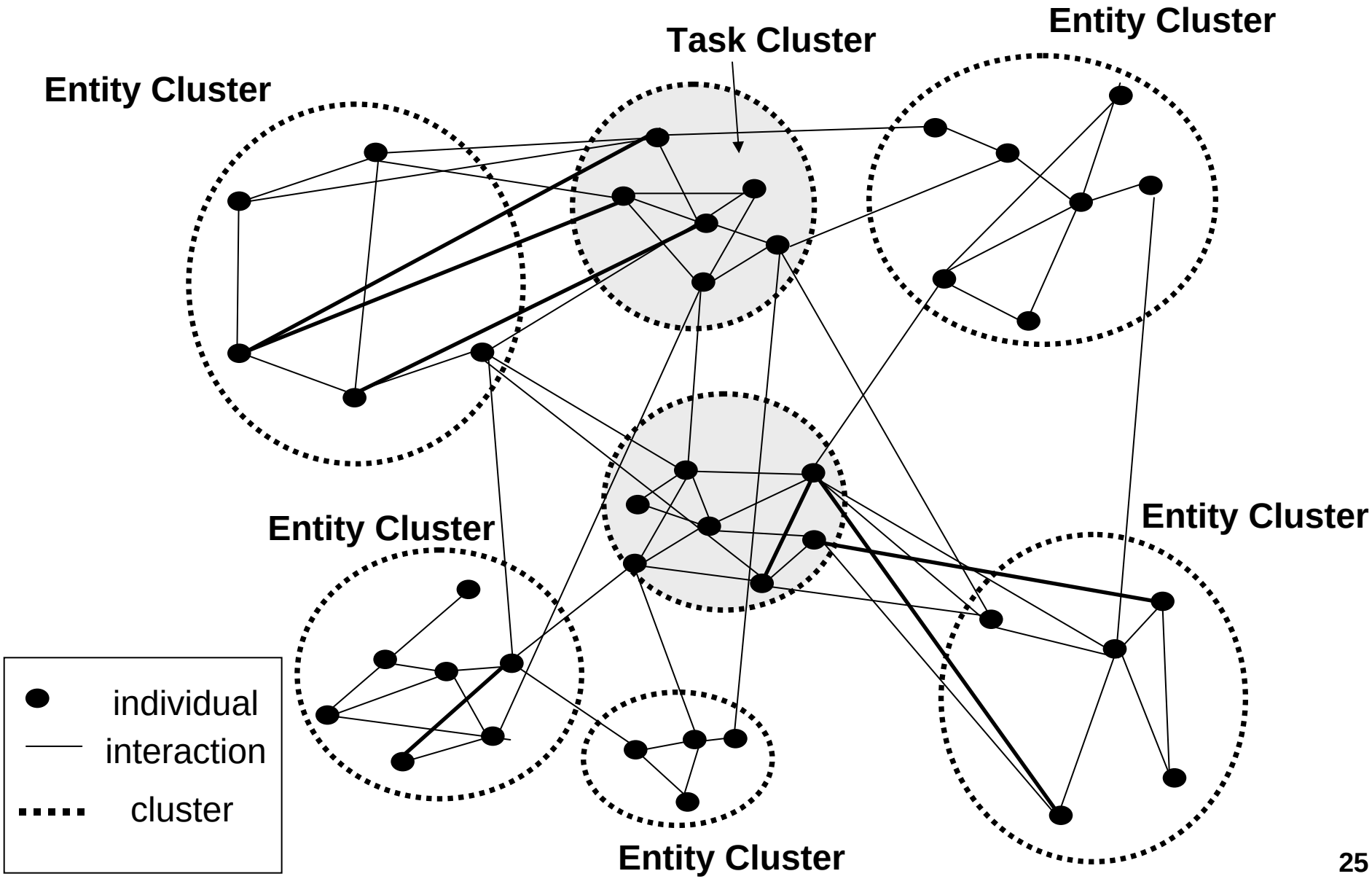
De-conflicted C2



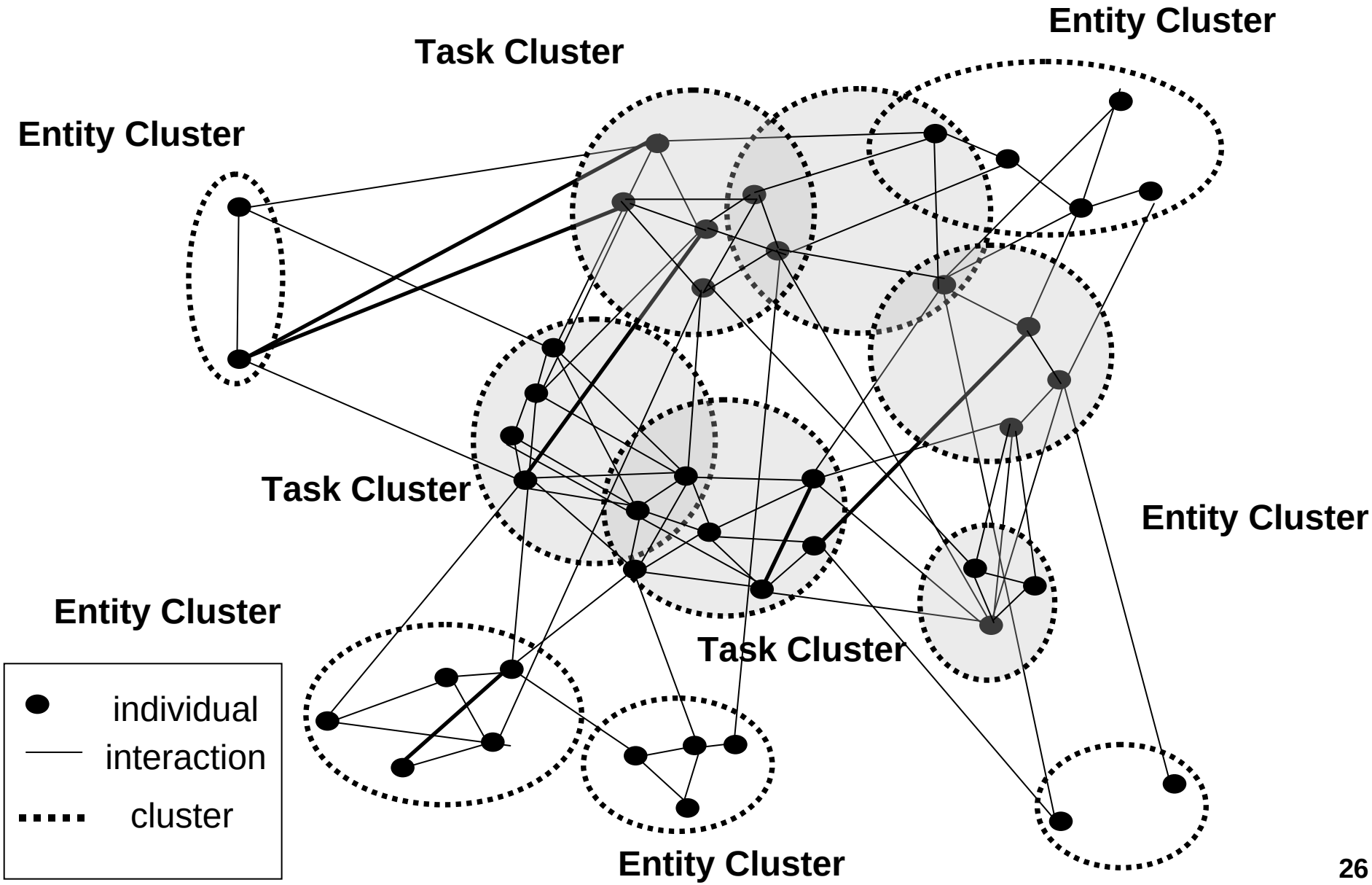
Coordinated C2



Collaborative C2



Edge C2


Entity Cluster
Task Cluster
Entity Cluster
Task Cluster
Entity Cluster
Entity Cluster
Task Cluster
Entity Cluster
individual
interaction
cluster

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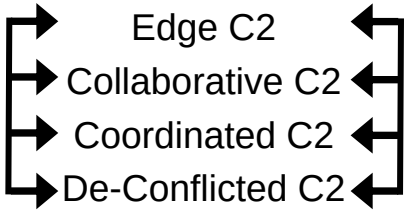
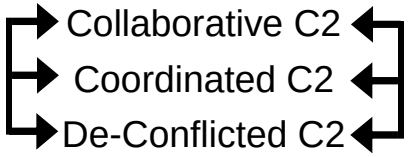
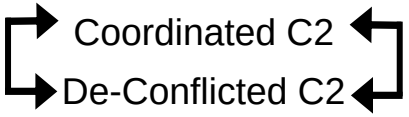
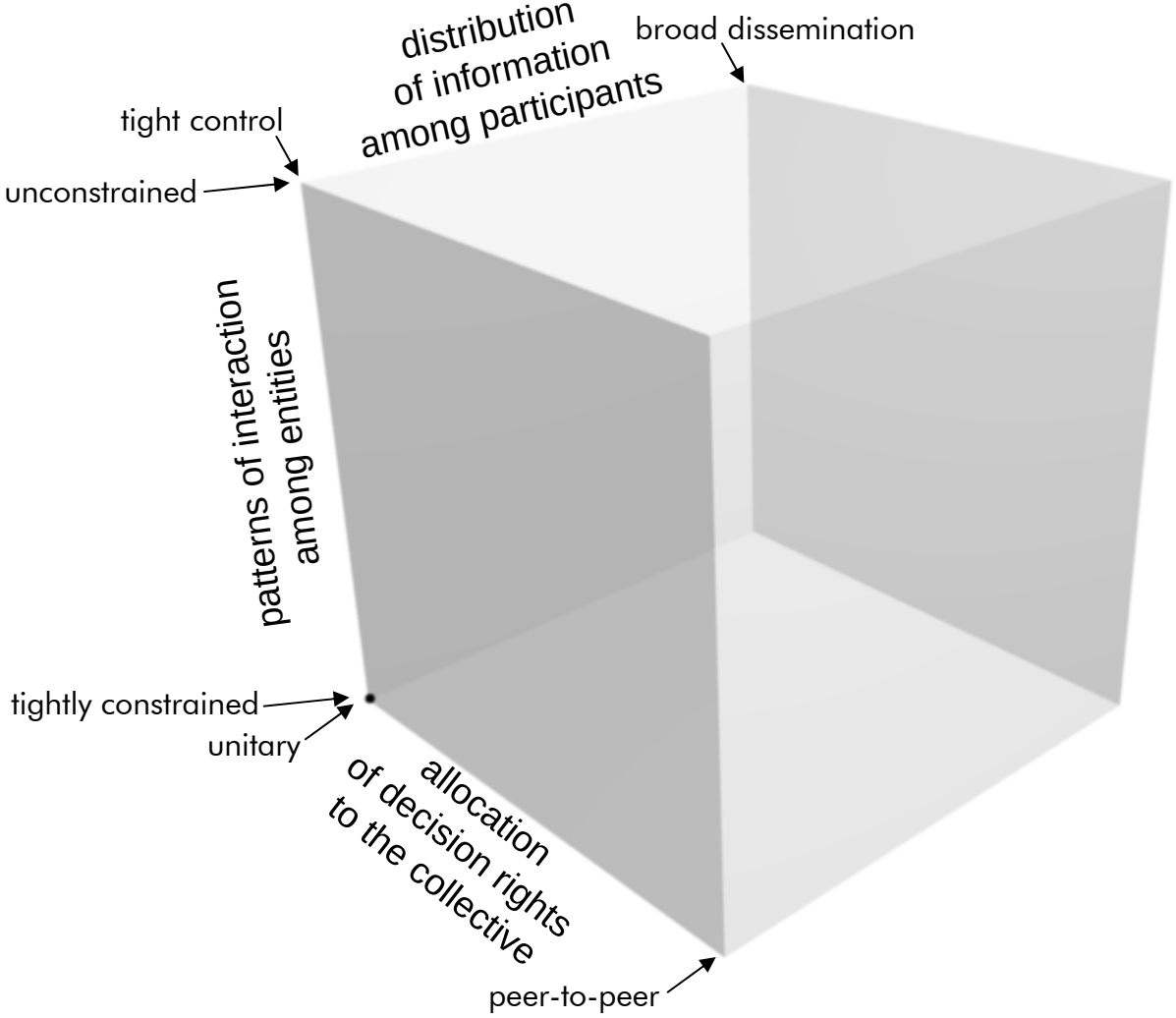
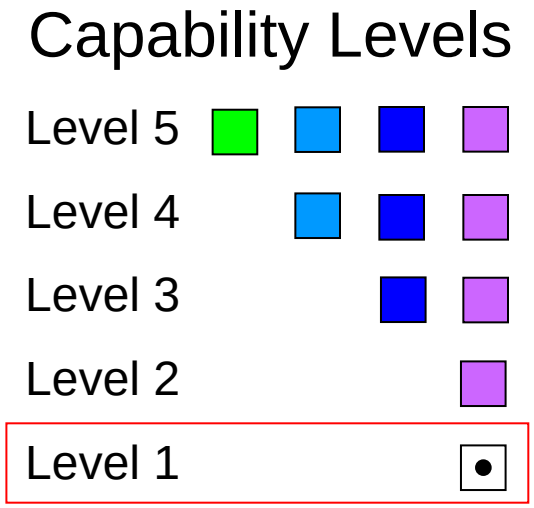
C2 Capability Levels

C2 Capability Levels	Contents of C2 Toolkit	C2 Approach Decision Requirement	Transition Requirements
Level 5	Edge C2 Collaborative C2 Coordinated C2 De-Conflicted C2	Emergent	
Level 4	Collaborative C2 Coordinated C2 De-Conflicted C2	Recognize 3 situations and match to appropriate C2 approach	
Level 3	Coordinated C2 De-Conflicted C2	Recognize 2 situations and match to appropriate C2 approach	
Level 2	De-Conflicted C2	N/A	None
Level 1	Conflicted C2	N/A	None

C2 Capability Levels





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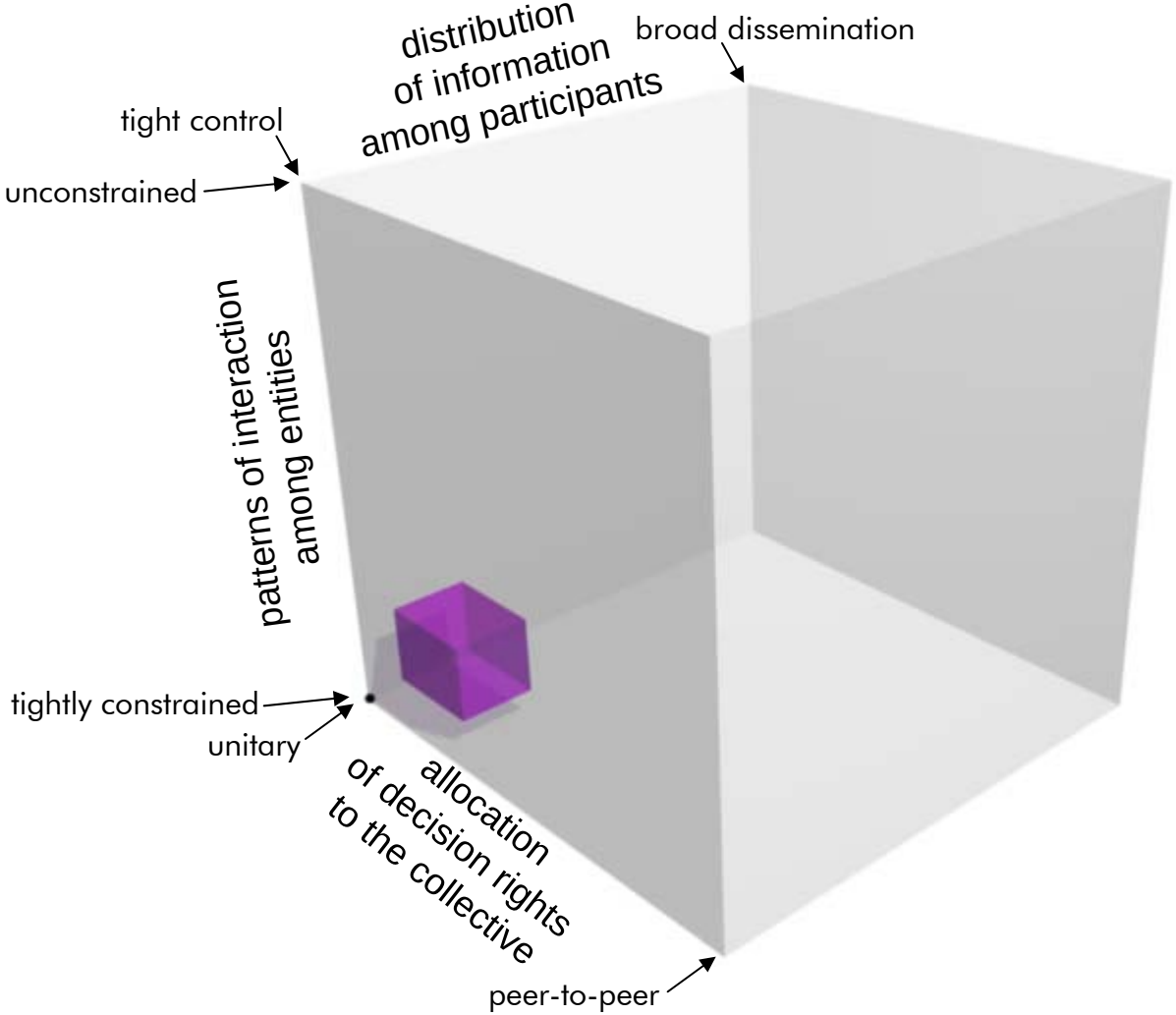

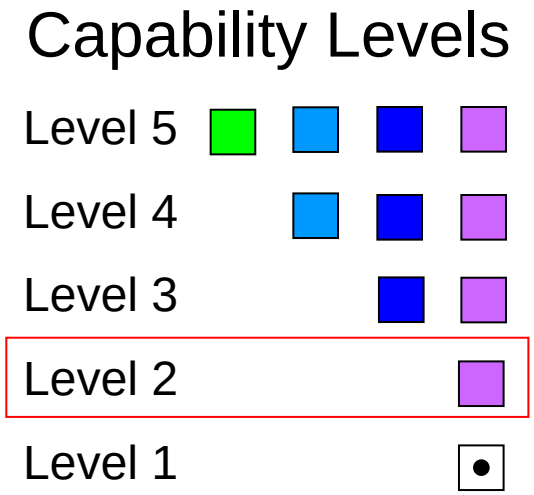

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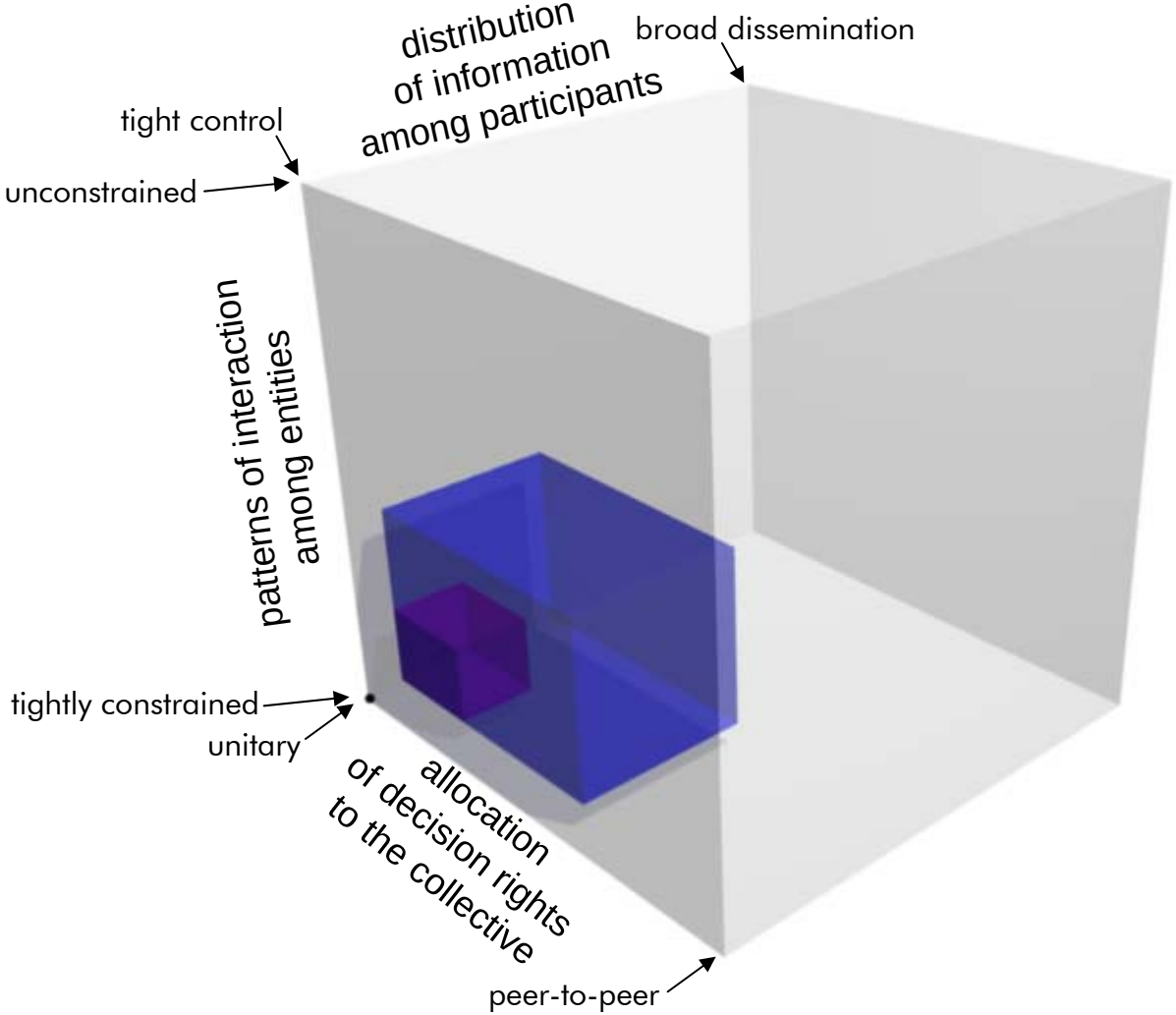

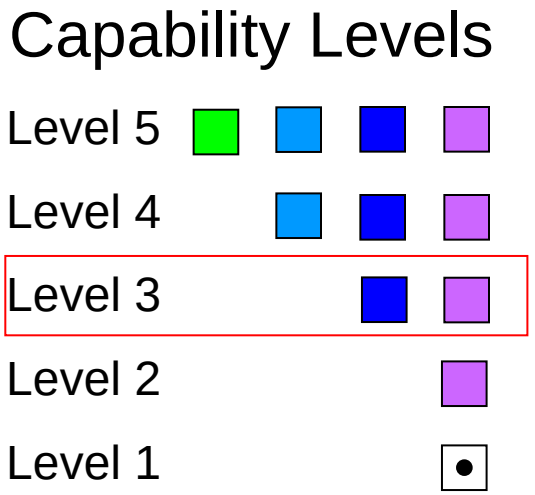

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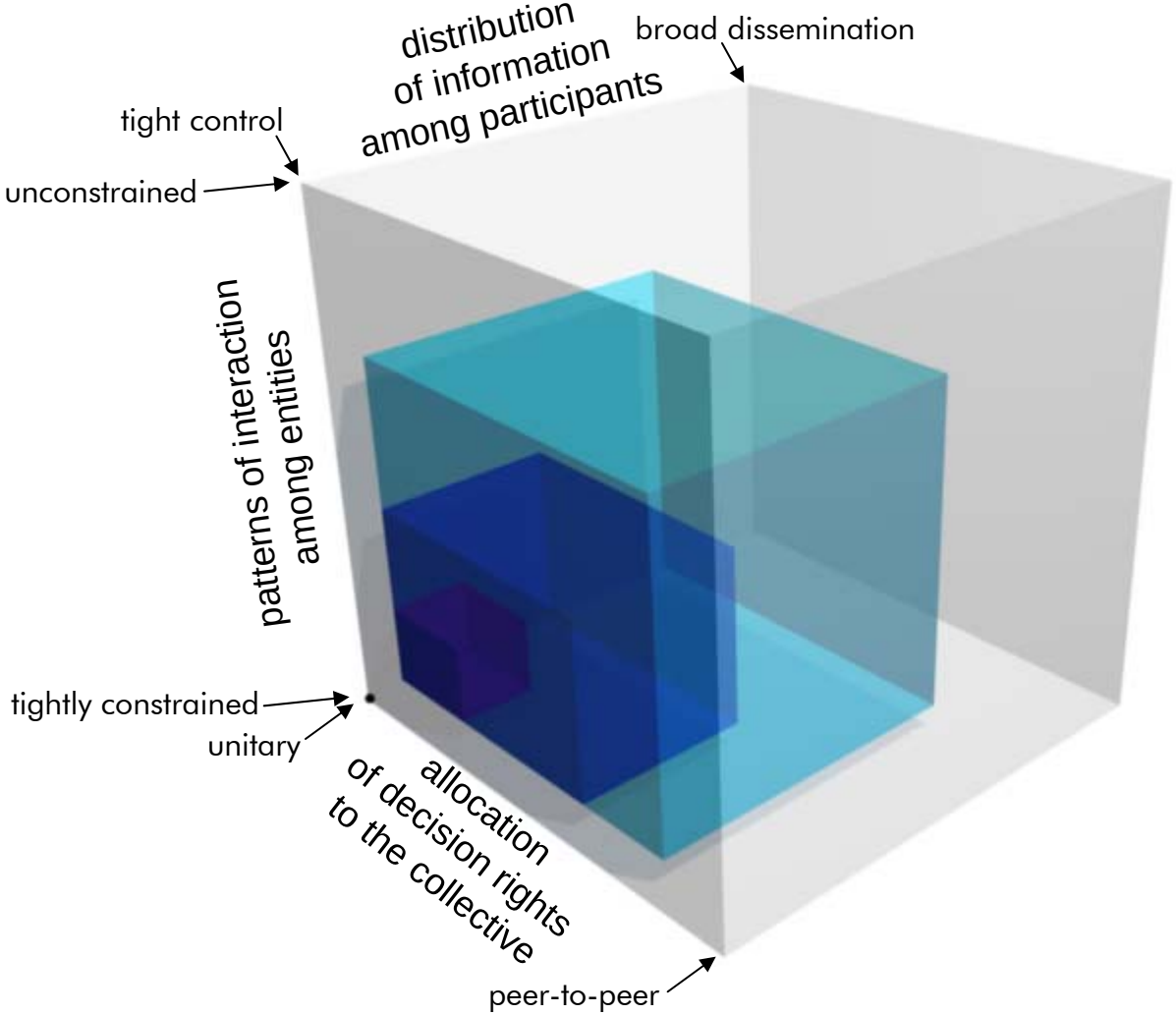

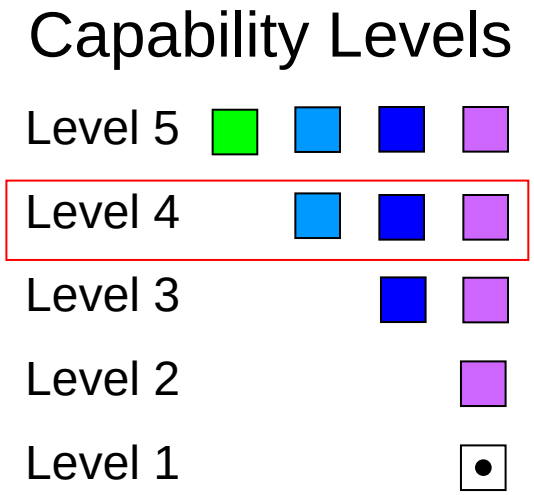

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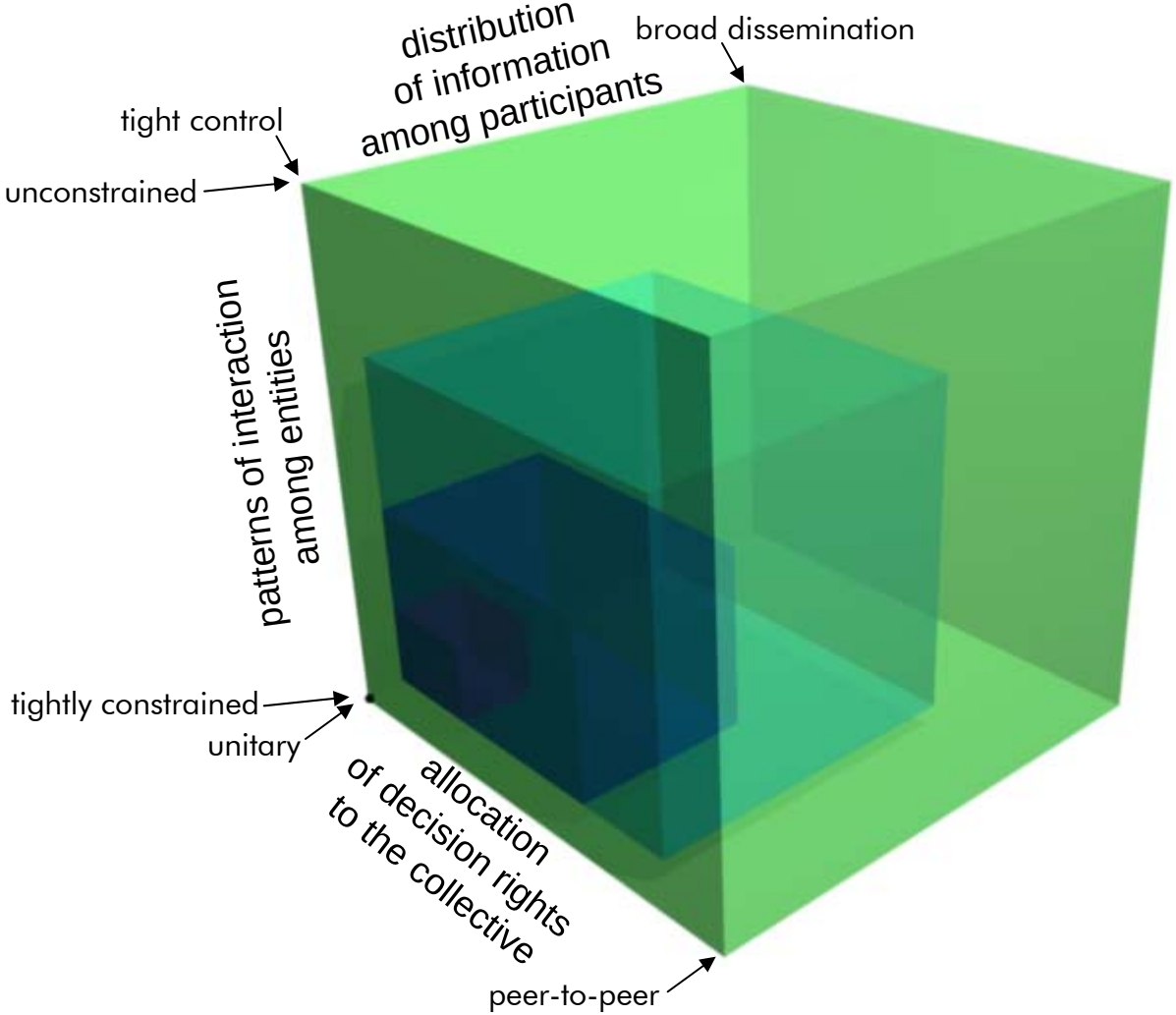

Capability Levels

Level 5

Level 4

Level 3

Level 2

Level 1

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Verification and Validation Effort

- Purpose of Verification and Validation effort
  - Is the articulation of the Maturity Model Clear?
  - Can the model be usefully applied?
  - Is the Maturity Model a valid representation of reality?
- Types of Validity
  - Expert (face) Validity
  - Construct Validity
  - Empirical Validity
- SAS-065 Approach to Verification and Validation
  - Conduct case study applications across a range of relevant situations
  - Conduct analyses of relevant experimentation
  - Peer Review (on-going)

Case Studies and Experiments

Mission	Case Studies	Dates
Combat Exercises	Brigade Exercises	2005
Combat Operations	Iraq	2003-2005
UK WISE Wargames	C2 Alternatives	2006-2007
Peace Operation	IFOR in Bosnia	1995-1996
Peace Operation	KFOR in Kosovo	1999
Small Natural Disaster	Elbe River Flood	2002
Small Natural Disaster	Strong Angel III	2006
Small Natural Disaster	Golden Phoenix	2007
Complex Disaster Response	Katrina	2005
Complex Disaster Response	Pakistan Earthquake	2005
Complex Disaster Response	Tsunami	2004
Situation Awareness	ELICIT Experimentation	2006-2008

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Uses of the N2C2M2

- **CD&E:** Development of new concepts, formulation of hypotheses and design campaigns of experimentation and exercises;
- **Doctrine:** Development of new concepts and assessment of current doctrine;
- **Operational Analysis:** Structuring field data collection and lessons learned analyses;
- **Education and Training:** help individuals and organizations to better understand the nature of Collective C2;
- **Modelling & Simulation:** Framework for development conceptual and executable models for C2 assessment.
- **Operational Design and Force Planning:** assessment of C2-related capabilities to face current and future challenges;
- **Programming and Budgeting:** investment decision support.

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The Role of the N2C2M2

- Use the N2C2M2 as
  - an analysis/assessment tool and
  - as a communication tool.
- No necessary fixed procedure to use the N2C2M2
- Useful but not sufficient. Use the N2C2M2 in combination with
  - The NATO COBP for C2 Assessment (SAS-026)
  - The Command and Control Reference Model (SAS-050)

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Requisite C2 Capability

- In analogy to Ross Ashby‘s Law of Requisite Variety, Requisite C2 Capability is defined as the Capability Level necessary and sufficient for accomplishing the C2 functions essential for reaching the objectives of an endeavor depending on its complexity and dynamics.

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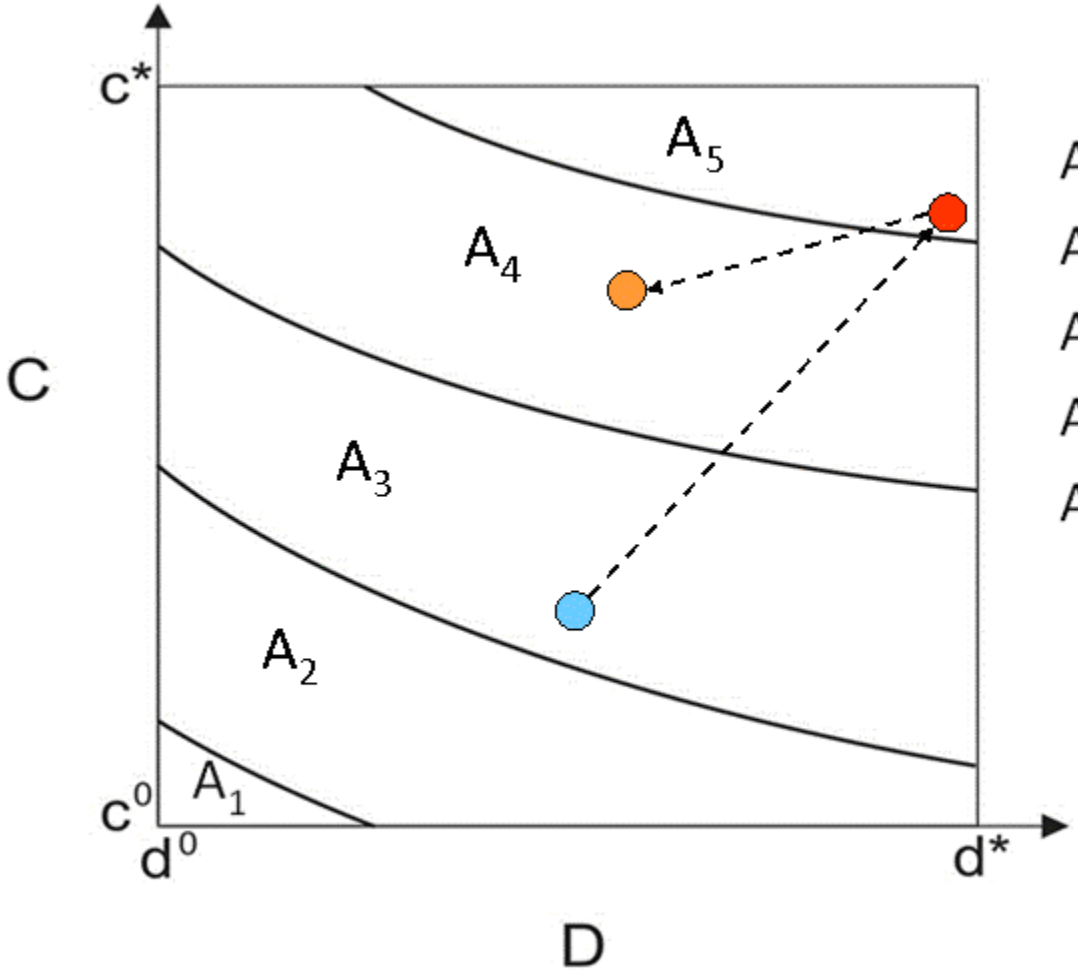
Need for C2 Agility

- Different C2 approaches are appropriate for different situations, partners, and circumstances
- Historical case studies indicate a need to change C2 approach during complex endeavours because the situations, partners, and circumstances change
- Empirical evidence shows that inappropriate C2 approaches impact C2 effectiveness and efficiency and correlate with adverse mission outcomes
- C2 Agility encompasses robustness, responsiveness, resilience, flexibility, innovation, and adaptability

Concept of Requisite Maturity



A_5 Edge C2

A_4 Collaborative C2

A_3 Coordinated C2

A_2 De-conflicted C2

A_1 Conflicted C2

Tsunami S&R / Relief

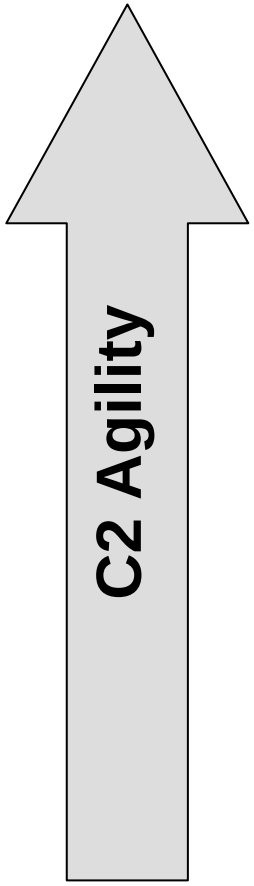
Recovery / Reconstruction

Elbe Flood

C2 Agility

- **C2 Agility** implies the ability to transition between C2 approaches as required to match dynamically changing situational characteristics (dynamically select and implement the appropriate C2 approach)

C2 Capability Levels and C2 Agility



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Level 3	Coordinated C2 De-Conflicted C2	Recognize 2 situations and match to appropriate C2 approach	Coordinated C2 De-Conflicted C2
Level 2	De-Conflicted C2	N/A	None
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Way Ahead

- SAS Panel has chartered an exploratory team to develop Terms of Reference and a Program of Work for a new Research Group focused on C2 Maturity and Agility
- Exploratory team meeting is scheduled in the UK on September 9-10, 2009
- Interested Researchers should contact their national representatives to NATO SAS Panel to be appointed to the exploratory team

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