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# **The Research On C2 System in networked environment**

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# Outline

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- **Introduction / Background**
- **Be Net-Centric System or not**
- **The future C2 System**
- **Component and Characteristics of future C2 system**
- **Summary**

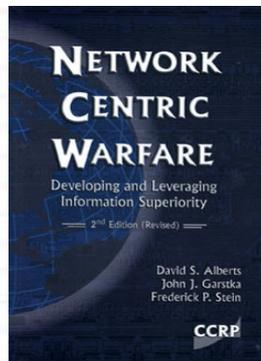
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# Introduction / Background

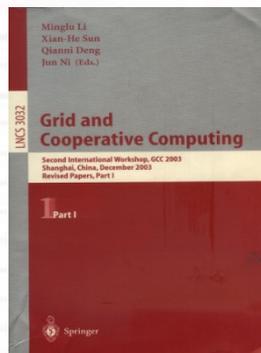
# Introduction/Background

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**There are two key factors to promotes the development of C2 system**



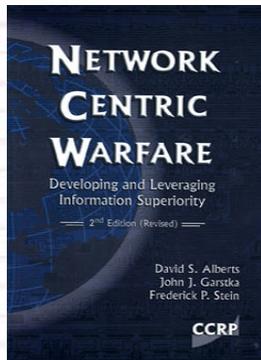
**The change of operating concepts and C2 theory**



**The development of information technologies**

# Introduction/Background

The new operating concepts always bring the new operating mode and C2 theory



**Concept of net  
centric warfare  
(NCW)**

**New C2 theory**

## **New C2 System**

- .Superior Decision Making
- .Flexible Synchronization
- . Shared Understanding



# Introduction/Background

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**Information technology brings endless possibility to application patterns and system conformation of C2**



**Mobile communication technology**

**Web 2.0 Web 3.0 Cloud computing**

**SOA ( Service Orient Architecture )**

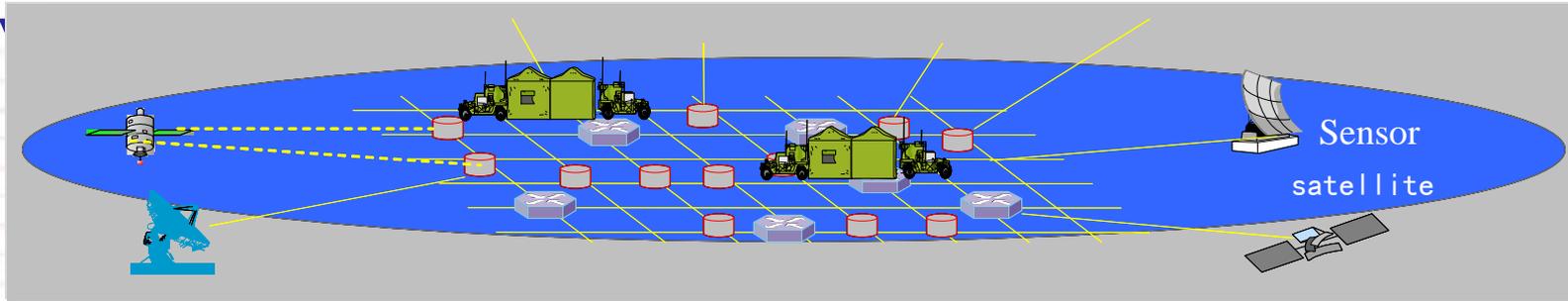
**It provides a number of new application patterns such as SNS, SaaS etc**

**It will provides a number of new application application patterns for C2**

# Introduction/Background

## What is the future C2 system in the network

env



C2 system is **network centric system** ? This means :

*C2 system is just parts of the large operational network without independence.*

*The development, operation and management of system depends on networked and information infrastructure within it*

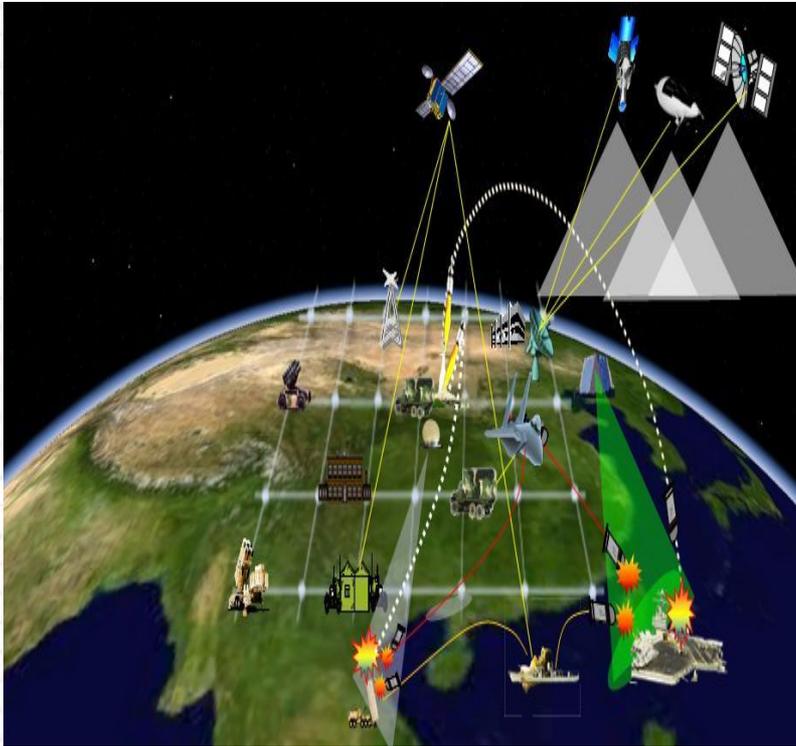
**It faces to various operating missions , safety and independent questions?**

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**Be Net-Centric System or not**

# Be Net-Centric System or not

**Operating forces becomes a large scale complex system via heterogeneous network**



The communication net linkage **army forces, weapons, sensors** and **C2 node** to form a large scale complex system.

*Attribute:*

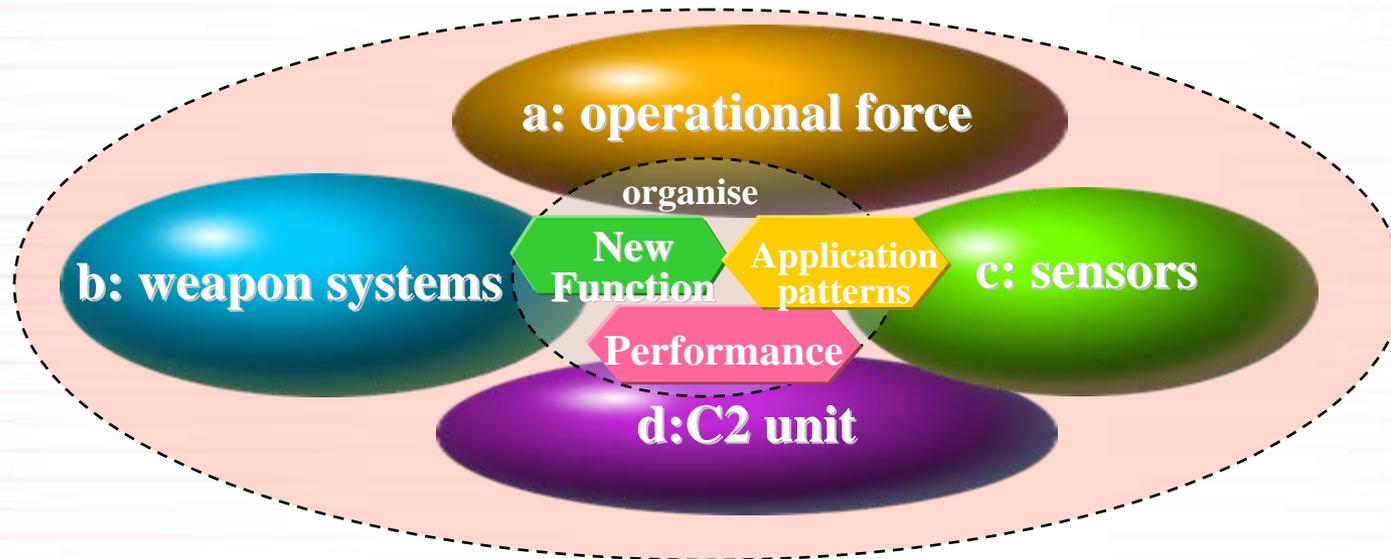
- 1、 Large number of Hardware, Software, Users, Information*
- 2、 Complex and dynamic relationship between combat elements*
- 3、 Wholeness and non-additive*

# Be Net-Centric System or not

From systematology view, the operation forces (the large scale complex system )will be more wholeness and non-additive.

Systems' non-additive formula:

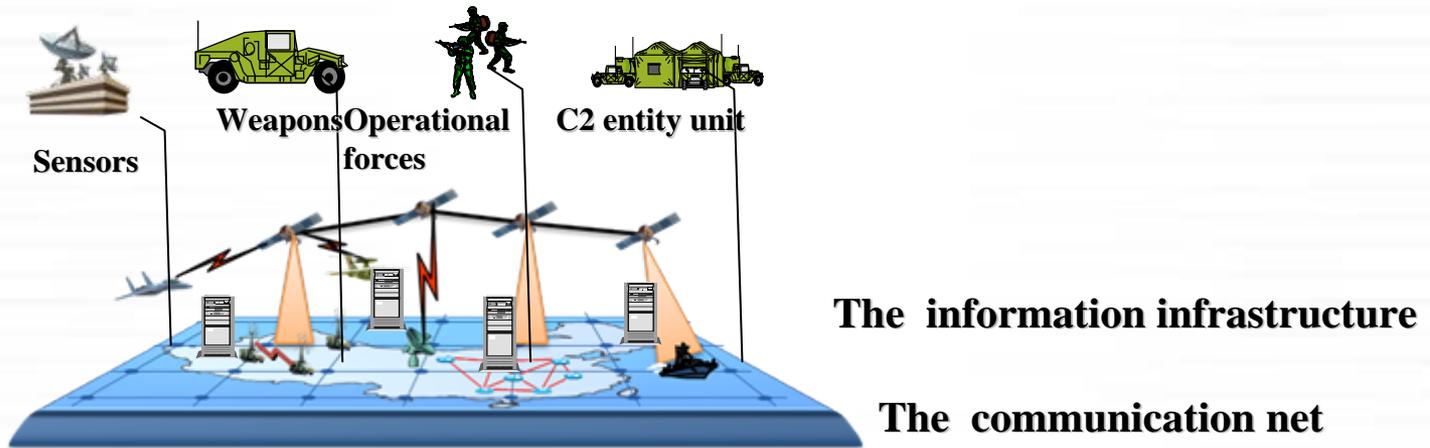
$$S \neq \sum_{i=1}^n A_i$$
$$A_i = \{ a_i, b_i, c_i, d_i \mid i \in N \}$$



# Be Net-Centric System or not

## The concept and meaning of net-centric system

Net-centric system means C2 system embedded in networked

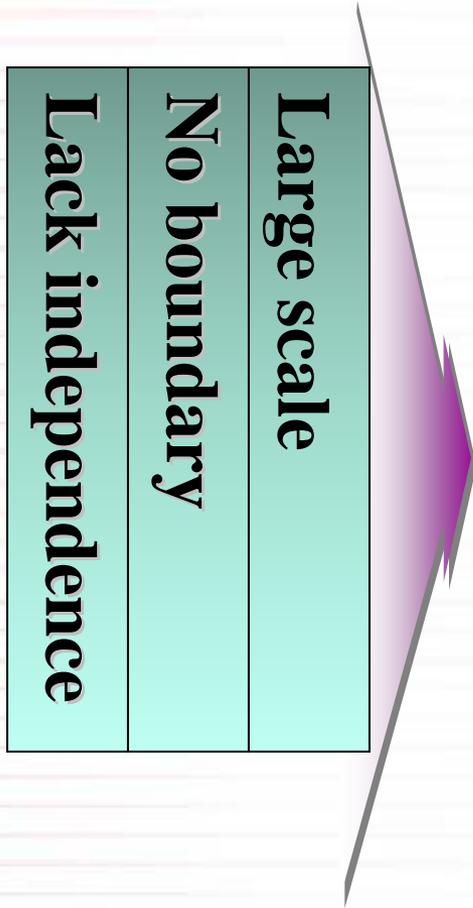


- *Design, development and integration of C2 system are based on information infrastructure of network.*
- *Operating and management of C2 system could not complete independently from network.*
- *There was no boundary between C2 system and others system.*

# Be Net-Centric System or not

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## The serious problems of net-centric system



**The restrictions on C2 method**

**Reduce the system's reliability and security because of lacking in independent**

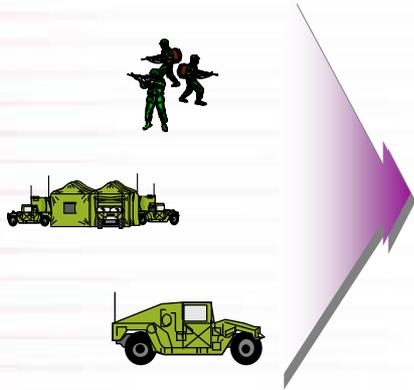
**It is very complex to manage system and creates even more uncertainty**

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**What is the future C2 System?**

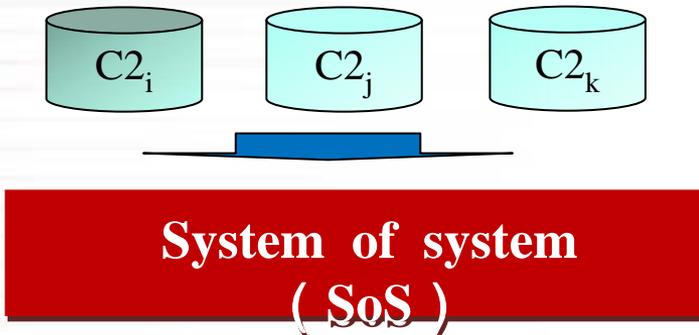
# What is the future C2 System?

## The concept and development of C2 system

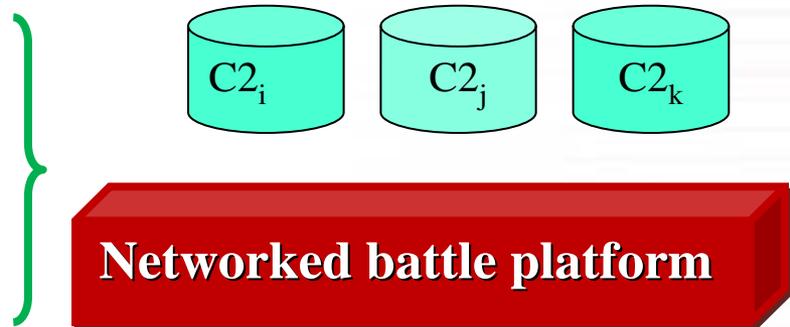


**The system to support command and control**

**Previously C2 systems buildup SoS(system of systems)**



**C2 system in a large scale networked battle platform**



# What is the future C2 System?

**C2 system is wholeness with specific function**

The function of system is generally presented as:

$$ET = \sum Ei + ER, i \in N$$

**Ei: The function of sub-systems**

**ER: The function of deriving from relationships of elements**

**ET: The function of whole system**

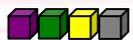
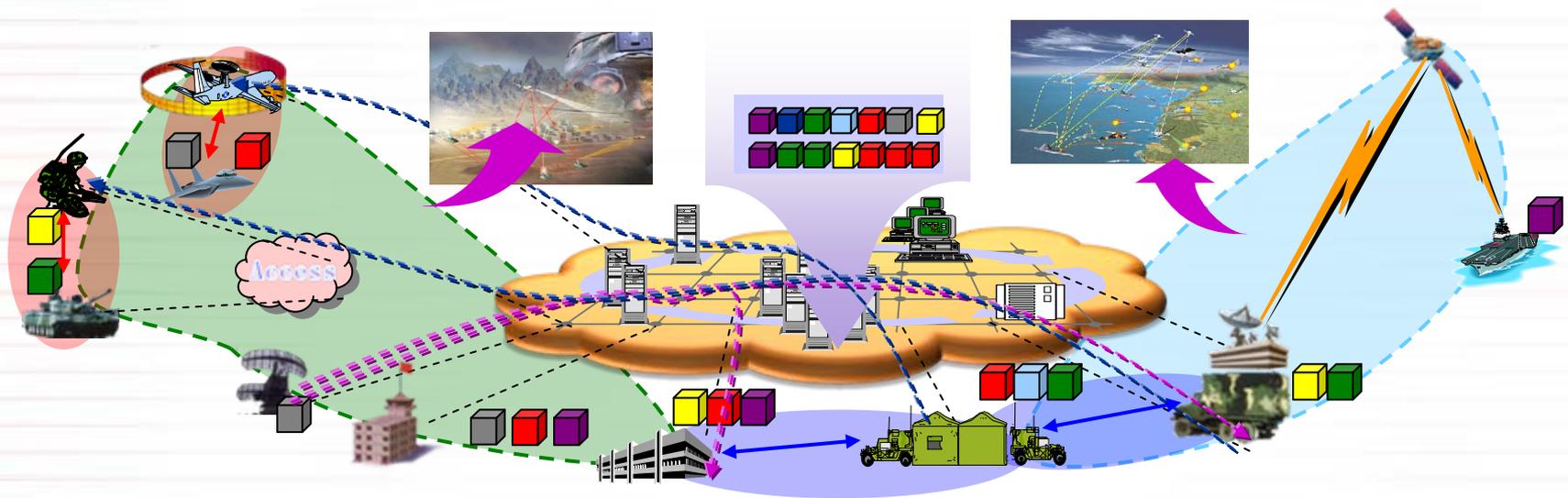
*Legacy C2 :ER is definite and limited*

*Future C2 :ER is dynamically changed*

# What is the future C2 System?

## The environment of the future C2 system

*Networked battle platform* is a large-scale complex system that together with tens of thousands of sensors, C2 nodes, weapons and army connected by heterogeneous wireless network and wired network.



*sensors, C2 nodes, weapons and army*

# What is the future C2 System?

## The component of networked battle platforms

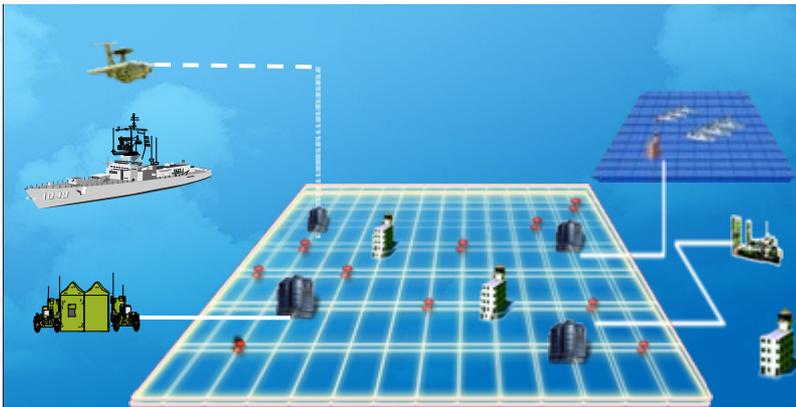
$C2_1, Weapon_1, Sense_1, Army_1, DII_1$



**networked battle platform  
elements relation matrix**

# What is the future C2 System?

## C2 system is networked-system



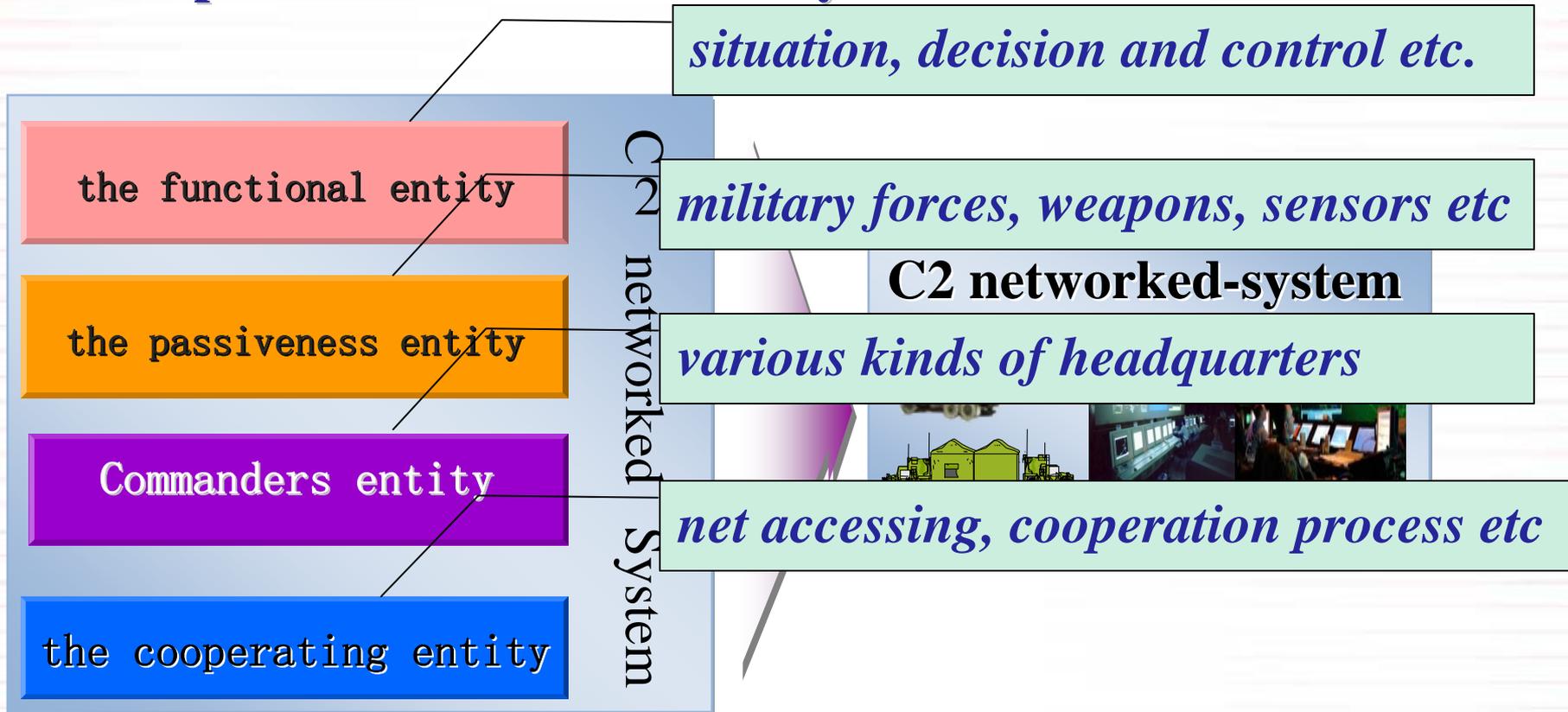
*While C2 system operation independently, it is a physical system*

*While connecting network, C2 system general exited as a component of networked battle platform, it is more like a logical system*

***C2 networked-system is an information system which can be operated and managed independently, it can be published one or more C2 units to networked battle platform, as well as be connected and cooperated with other operational elements to construct Communities of Interest(COI).***

# What is the future C2 System?

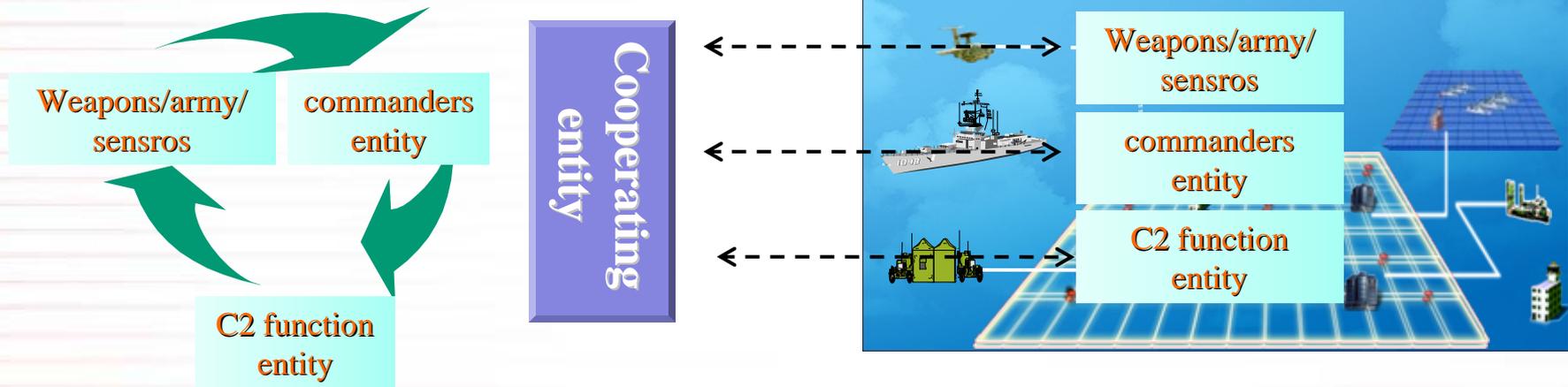
## The Component of C2 networked-System



# What is the future C2 System?

## Why it is called net-worked system

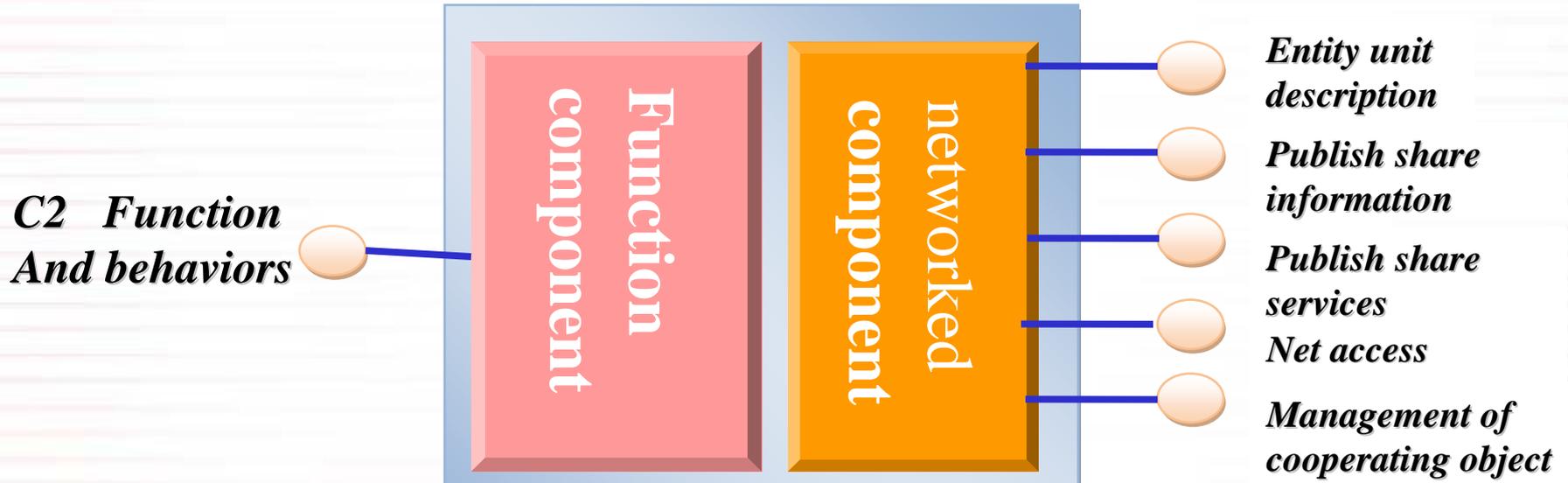
*It has cooperativity and agility via connecting networked battle platform*



***C2 system can connect networked battle platform via cooperating entity. The C2 unit entity can also connect networked battle platform.***

# What is the future C2 System?

## The C2 unit entity model



***Accessing network, publishing and providing C2 services,***

***they have the capabilities for sensing changes of systems state and adaptive to environment according to changes.***

# Results

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*In future C2 system is a networked system, but not a network-centric system.*

*System operation and management independently are the embodiment of its characteristic of independence and autonomy.*

*It is a physical system belong to certain organization and can be formed logical system used by another organization.*

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**Thanks**