NETFORCE PRINCIPLES

An Elementary Foundation of NEC
for
Creating Joint Netcentric Environments

Overview

- The Why and What of the Netforce Principles
- The Basic Netforce Building Blocks:
  - The Network-Node Paradigm
  - Basic Netcentric Actions and Node Types
  - Elementary Properties of Nodes
- Integration of Nodes into the Netforce
- Basic Node Interactions
- Multi-node Functions and Services
- The Generic Netforce Warfare Model
- Netforce Application and Future Work

The Why and What of Netforce

Why Netforce

- No common nomenclature (lingua franca) on elementary NEC/NCW concepts
- No reference model for elementary NEC concepts

- To provide a means of deriving net-centric operational concepts from common building blocks
- To reduce stove pipe solutions and to facilitate easier interoperability

What is Netforce

- Definition of the basic building blocks of NEC
- Potential reference model and foundation
- Colorless approach:
  - irrespective of force type, warfare type, domain type
- Widely applicable: defence as well as civil applications
- Compatible with major existing initiatives

Steps in Creating the Netforce Principles

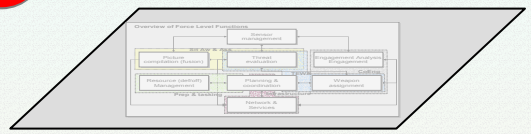
Concepts

defining generic netcentric concepts

operational
inter node functions

2

Quality of Service



netforce functions & services

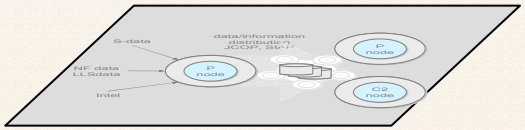
basic interactions

elementary properties

1

netforce interfacing

netforce nodes



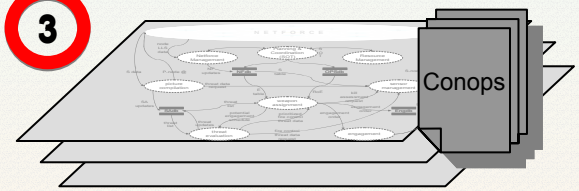
basic netcentric building blocks

Warfare area

designing netcentric warfare areas and netcentric CONOPS

generic warfare model

3

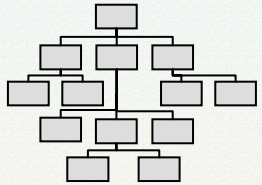


netcentric operations

Organizations & Systems

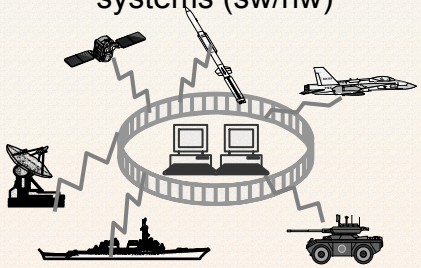
specification or mapping of organizational components and systems

C2 organizations



4

systems (sw/hw)



Netforce Action-Node Discussion

Network-node Paradigm: the net-centric force can be regarded as a collection of nodes interacting with each other (through a network)

Node	A component in the netcentric environment that performs one or more basic netcentric actions and is able to communicate with other nodes in the netcentric environment
Node types	The major characteristic of a node indicating the main basic netcentric action of the node
Netforce	The total collection of connected nodes that work together to perform specific operational capabilities. The netforce is the total netcentric system of systems (NSoS)
Network	The collection of nodes that perform communication and data/ information distribution functions

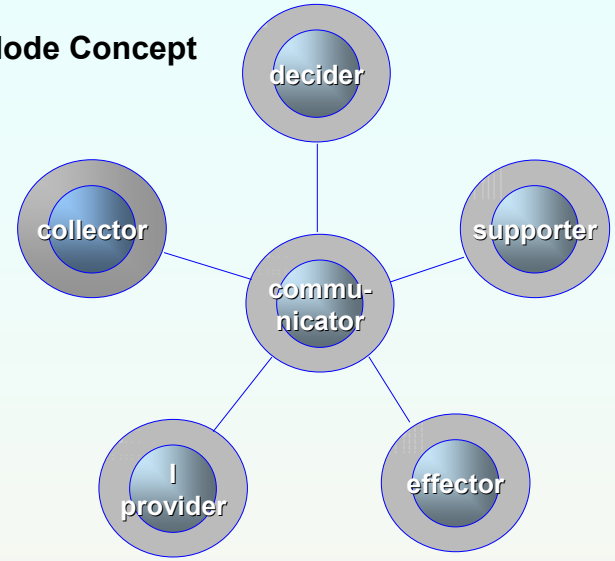
From a complete set of basic actions in a netforce environment we derive the basic node types that are required to construct each netforce environment

The basic netcentric actions are defined from an operational point of view.

Basic Netcentric Actions	Basic Node Types
observation, data/ information collection	collector
information processing & interpretation & provision	I-provider
decision making (command & control)	decider
action, engagement	effector
communication	communicator
support	supporter

Generic Netforce Structure

The Basic Netforce Node Concept

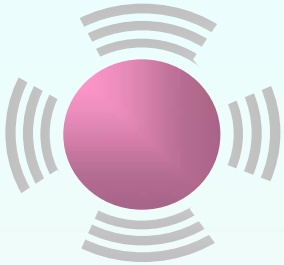


Netforce Nodes
- nodes communicate via the Com-nodes
- for more details on nodes see the specific node discussion slides
- netforce node types are applicable in the defence domain as well as the civil domain

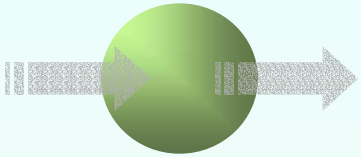
Node types / instances	Collector C	I-Provider I	Decider D	Effector E	Communicator Com	Supporter S
Node examples Nodes can be basic or composite nodes, persistent or temporal. They can exist on hierarchical levels (strategic, operational, tactical)	space-based	sensor data fusion	governments	weapons	Lk11,16,22	netforce manag ement cell
	MFR nav	SIAP, RAP JCOP	JFC JFACC	task forces	bi-directional LoS	communication management
	IR EO temp	info cell	CAOC	agile mission groups	Satcom, radio HF/UHF	maintenance repair
	human observer	data mining	platform command	viruses, worms (info ops)	internet connector	
	intelligent agent	info system	automated system	pamphlet (psyops)	ATM	

The Elementary Node Properties

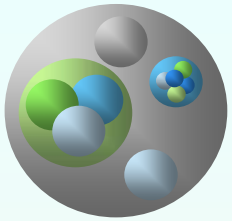
identity



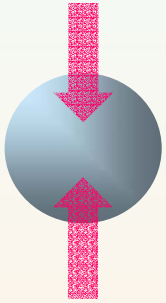
status



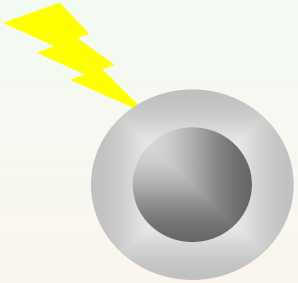
capability



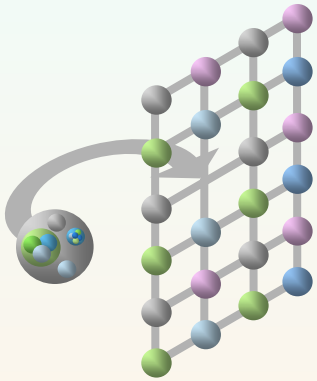
structure



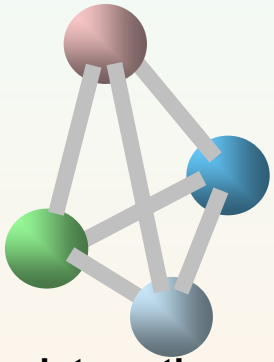
control



security



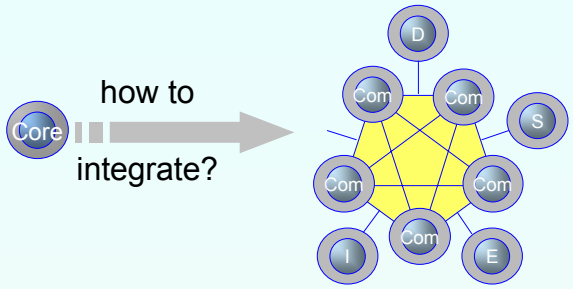
integration



interaction

The Elementary Node Properties
The Netforce nodes have specific elementary properties associated with them which are required to build higher order net-centric concepts with. The node properties are usually NOT single value attributes but complex specifications. The elementary properties fully specify a net-centric node.

Netforce Integration Requirements



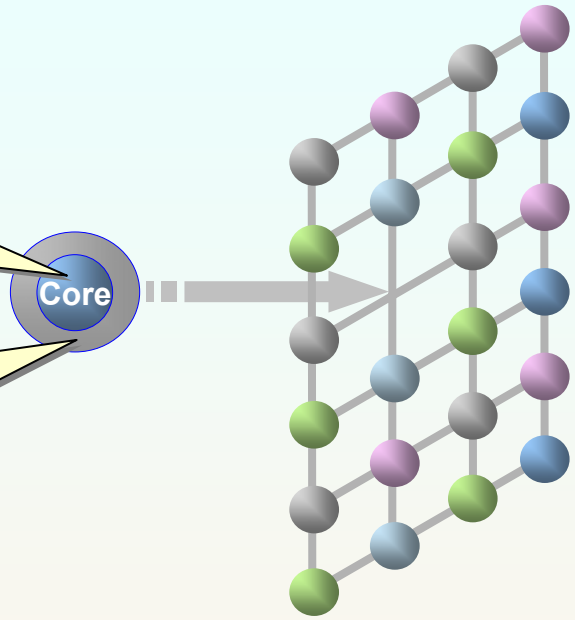
Some major Netforce requirements

- Each node must be able to plug & operate in the netforce
  - requires a logon/logoff protocol or registration service
  - node registration either to the whole network or to just its immediate environment
- The node capabilities (or services) must be known to specific other nodes in the netforce so that these capabilities can be used in a controlled and leveled way
  - requires a service declaration protocol (QoS principle)
- Changing capability and status need to be promulgated to specific nodes
  - requires a status reporting protocol (including life beat)
- Node access, node control and node use must be regulated
  - requires a node access control and security mechanism
- Legacy systems must be able to 'connect/integrate' with the netforce
  - requires a kind of encapsulation mechanism

The Integration Principle in NEC

Node core
The core or essential functionality of the node denoting its type, and surrounded and screened by an interface and integration layer.

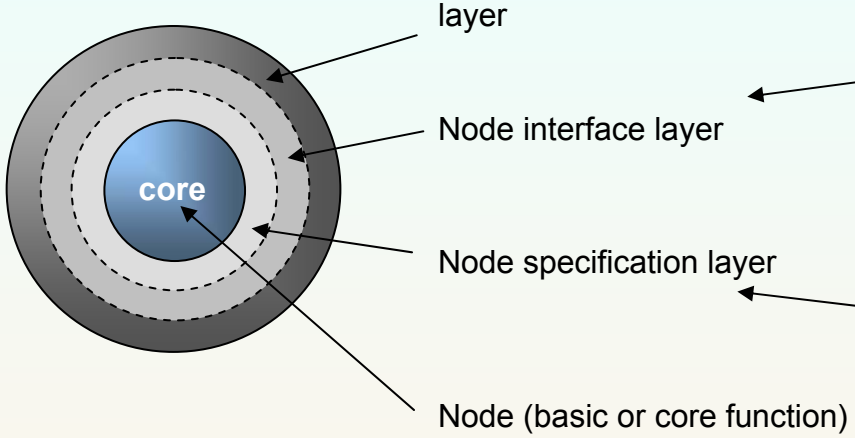
Netforce Interface Component
Standardised interface with a layered architecture:
- allows for interfacing the node with the netforce
- specifies the node capabilities to the netforce



Netforce Integration Approach
An open architecture approach for the netforce
Allows for information hiding of node functions; allows for node & force level functions to be declared to the network. Allows for encapsulation of non netforce compliant entities; allows for security management of netforce components

Netforce Interface Approach

The Netforce Interface Approach



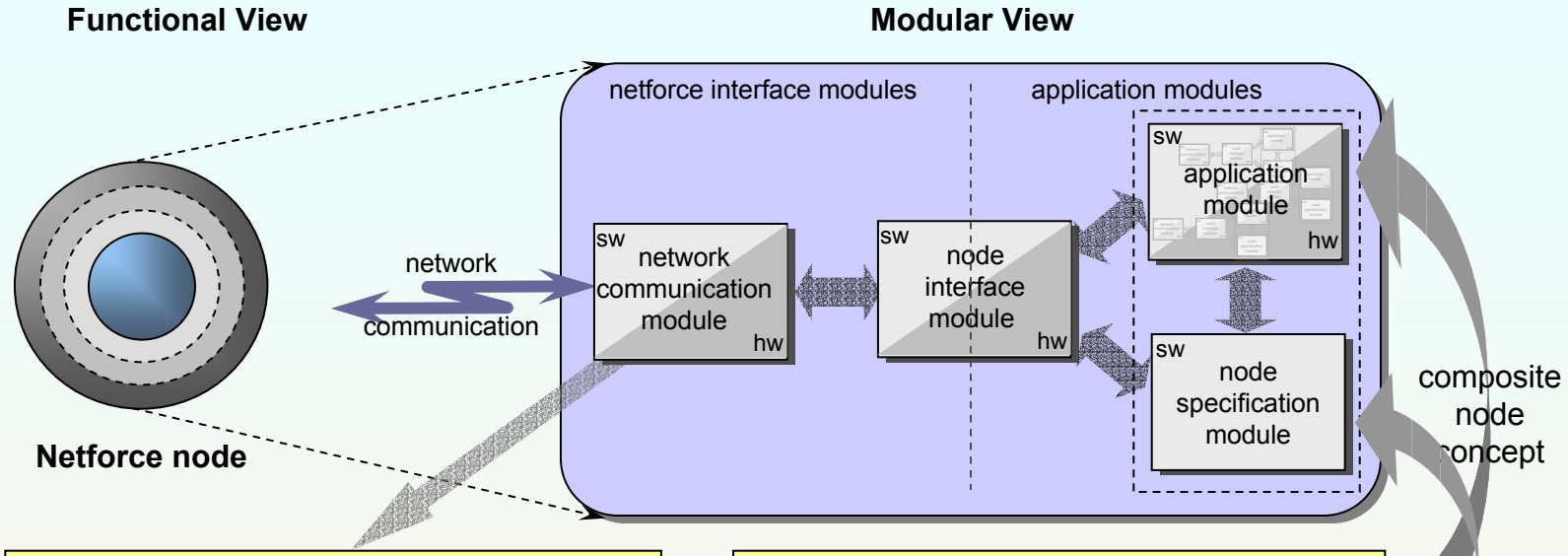
Network Communication Layer
- receive & transmit component & protocol
- security function

Node Interface Layer
can be proprietary

Node Specification Layer
- plug & operate protocol
- QoS declaration
- status & behavior control
  * node access control
  * data flow control
- security function

The Netforce Interface (NIA) approach allows for specific protocols to be provided to the netforce to allows nodes to become part of the netforce.
The NIA also allows for standardized node interfaces to be defined, like a generic sensor interface, or even for a generic modularization of composite combat management systems (CMS).
The NIA also allows for the encapsulation of non-netforce compliant components to become netforce compliant.

The Netforce Node Architecture



Network communication module
Provides interfacing and communication (encrypted) of the node with the network. It can be a SATCOM/UHF/etc. transmission, an ethernet connector, a connection to internet or other communication means, OR a combination of these means.

Application modules
Provides the core function(s) of the node. The application module itself can have a composite structure. This is specified in the node specification module.

The netforce interface approach describes the functional view on netforce nodes. The modular structure describes the internal architecture of a node. Four modules are distinguished:

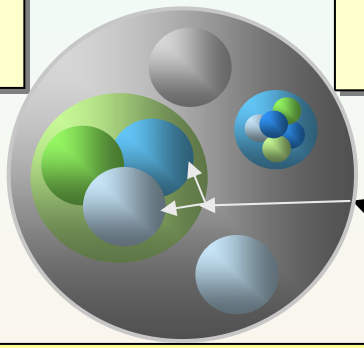
- the interface to the network
- the interface to the application
- the application itself (node core function)
- and its specification part (node specification).

Handling of Composite Nodes -1

Integration Modes
There are different ways to integrate composite nodes into the netforce:

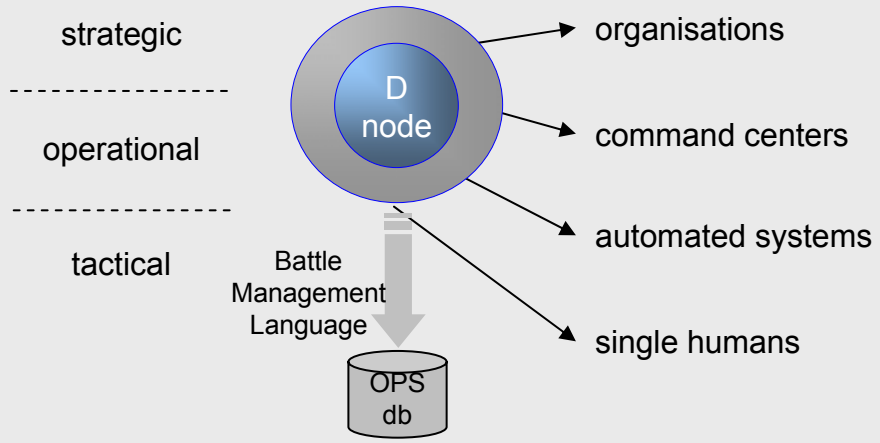
- as a composite node fully decomposed into its constituents nodes or sub nodes
- as a non-decomposed node with multi-NF capabilities
- as a composite node partially decomposed

Composite node issues
- declaration of the internal structure to the NF management function; this is done in the NSC logon/logoff protocol (sub function is node structure declaration)
- NF integrity maintenance when sub-nodal capabilities change
- specification of conditions of access to sub node functions; this is done by the NSC security function

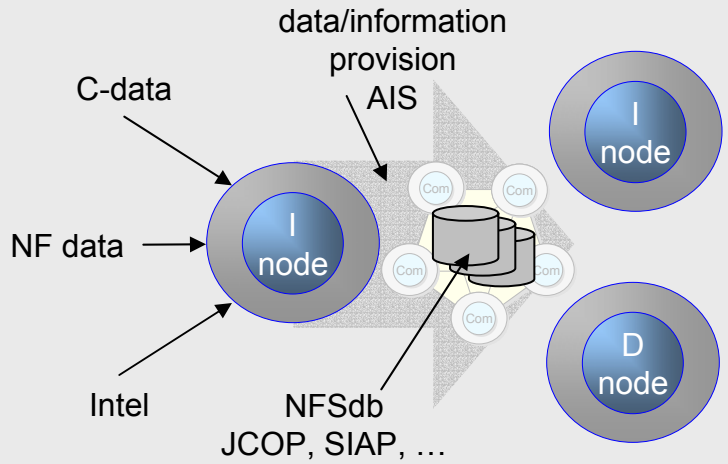


Composite Nodes
Most real world assets have multi-nodal capabilities. A naval combatant can have all the 6 essential NF functions. The same is valid for fighter jets, tanks and even soldiers.
The basic building blocks for real world assets are all the same: they are the 6 basic NF actions.
This is equivalent to elements of the periodic table which are all made up from the basic elementary particles: protons, neutrons and electrons.
In dealing with composite nodes we can make use of traditional data description techniques, like data schemes and data bases. A composite node is declared to the netforce using the node structure declaration.

D nodes and I nodes

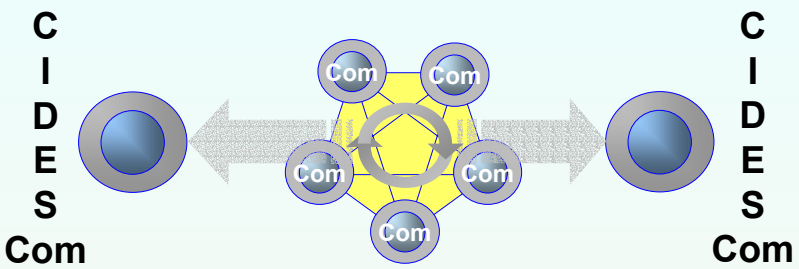


D Node Issues to be addressed
- projection on organisational and systems views
- human-machine interfacing
- organizational levels, organizations
- decision making:
  * polarisation and synchronisation
  * collaborative decision making
- d/I requestor: link to generic operational interfaces
- generates the OPSdb and BML



I Node Functions
- data PIP
  * processing & fusion
  * interpretation
  * provision to I&D nodes
    - according to data/ information needs of the D nodes
    - service principle
    - provision of agile information sources (AIS)
- administration of SA data, SOT data (e.g. JCOP, SIAP, etc.), …

Basic Netforce Interactions



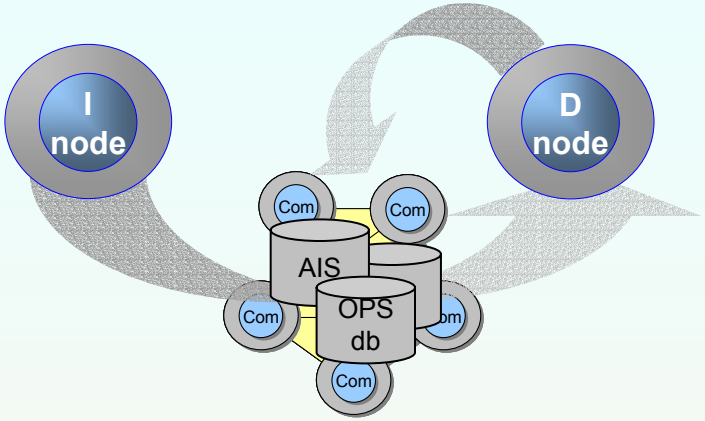
The Basic NF Interactions
- C-I: information creation
- I-I : information availability
- I-D: (shared) awareness
- D-D: synchronized decision making
- D-E: effector assignment
- E-C: engagement

All interactions are enabled by the network.

The basic netforce interactions
In describing the basic NEC actions we have identified the essential characteristics of the netcentric approach. These essential NEC characteristics were:
- the timely and accurate collection, processing, interpretation of data/information,
- its provision to all relevant decision makers,
- the ability of co-operative and synchronized decision making to create tailored measures,
- the ability to execute these tailored measures in a timely, accurate and synchronized way.

To achieve these characteristics we need to have a set of basic netforce interactions between nodes which constitute the enabling mechanism of NEC to achieve these characteristics.

I-D Interaction



dynamic information provision:
AIS: agile information sources

OPS data base
battle management language

I-D Interaction
- pre-defined and ad hoc data and information demands (adaptation to situation)
- static and dynamic data distribution functions: so called “agile information sources (AIS)”
- I-D interaction generates operational information requirement for the C-I interaction

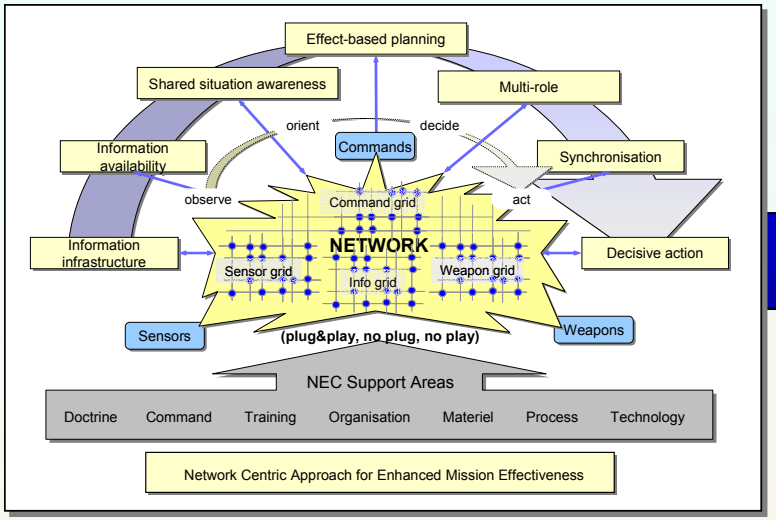
I-D Interaction
The DI interaction is the mechanism that provided decision makers with the necessary data/information for quality decision making. D data/information demands are static as well as dynamic, depending on the operational situation. Data/information demands can result in creating special I-nodes with their associated databases in order for timely provision of quality information. This may be called ‘agile information sources’, similar to creating ‘agile mission groups’. Information processed by I nodes can be stored in data bases, which can be of a distributed nature. The db can be the means of I nodes to provide data/information to D nodes. The I-D interaction also involves information management policies and services, security requirements, …

Netforce Functions & Services

- A Function or a Service (F&S) is:
  - the behaviour, management and control of multiple node capabilities to collectively and coherently achieve a specific purpose.
- Functions and services are:
  - created by co-operating (similar or dissimilar) nodes using basic netforce interactions.
- We distinguish different types of functions/services:
  - inter node and intra node F&S: between nodes or in a node
  - netforce and network services: providing essential management and control functions for the netforce and network
  - operational force level functions: to provide specific operational capabilities. (In DoDAF these functions are called activities)

The Set of Inter Node Functions

OODA Loop approach



Support approach

Inter Node Functions (INF)
Derived from the generic NEC concepts

Inter Node Functions

1 Collector/Sensor Management
* multi-objective optimization

2 Picture Compilation:
* tracking/ident/class/fusion

3 Situation/Threat Evaluation
* prioritization
* kill assessment

4 Effector/Weapon Assignment
* engageability, availability, RoE

5 Effectuation/Engagement
* time to deploy/ to engage
* Pk, co-operative

6 Resource Management
* also mission preparation
* force positioning

7 Planning & Coordination
* pre-operational planning
*

8 Netforce Management
* netforce & network management
* data distribution

Netforce and Network Management Services

Netforce

Netforce Management Services
- netforce node management
- netforce data management
- netforce security management
  * node access (based on NOAC)
  * intrusion detection, control

netforce/network management cell

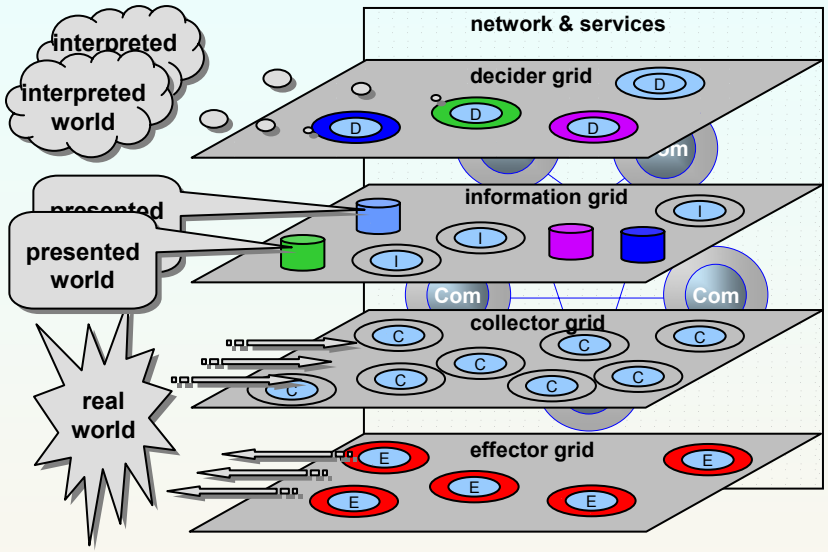
Network

Network Management Services
- 'standard' communication infrastructure functions
- routing, delivery, bandwidth optimization for specific data flows (negotiable as a QoS)
- network security management
  * multiple security levels
  * data access
  * data distribution
  * intrusion detection, control

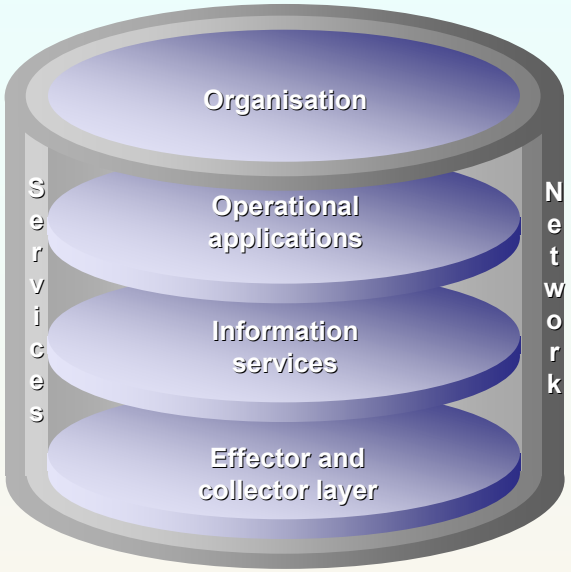
Netforce and Network Management Services
In the netforce S nodes provide services for managing the netforce and the network. The management services provide data for netforce maintenance and for optimization of the use of the netforce resources. Discussion of the netforce and network management cells (N(F/W)MC.

Netforce Systems & Services Architecture

Grid Structure



Netforce Architectural Model

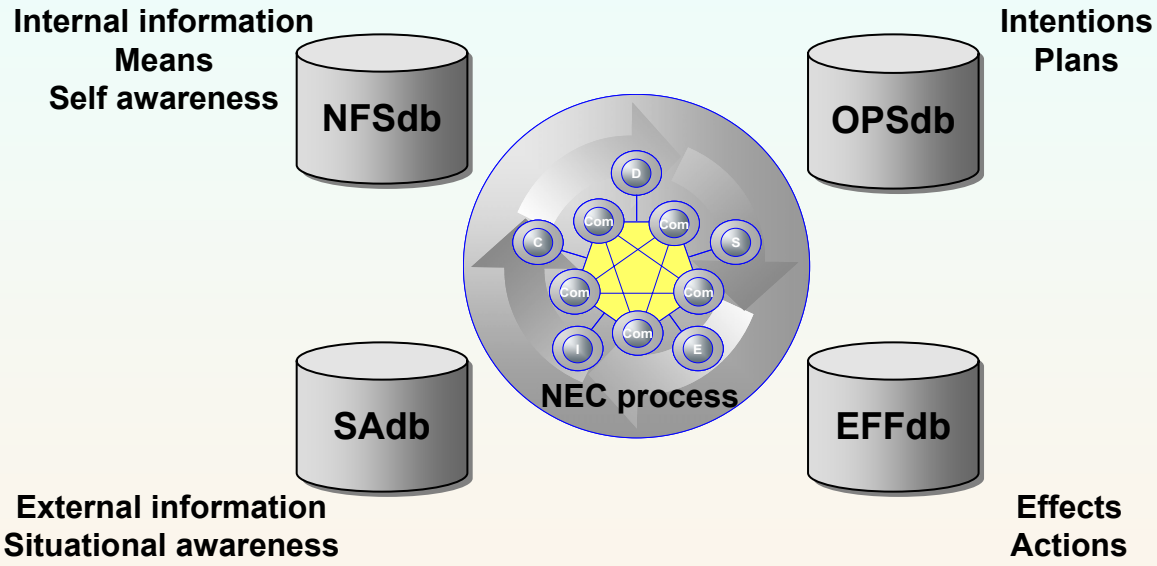


Netforce Grids and Architectural Model

The Netforce Systems & Services Architecture is directly related to other currently developed reference frameworks and models. Important ones to consider are the GIG Architecture, the GIG ES, DoD Netcentric DataStrategy, the Netcentric Operations and Warfare Ref Mod, xxx. All efforts to position the netforce functions and services need to be consistent with existing and emerging major, de facto initiatives, frameworks and models. With respect to the GIG architecture the Netforce SSA only deals with the top four layers of the GIG.

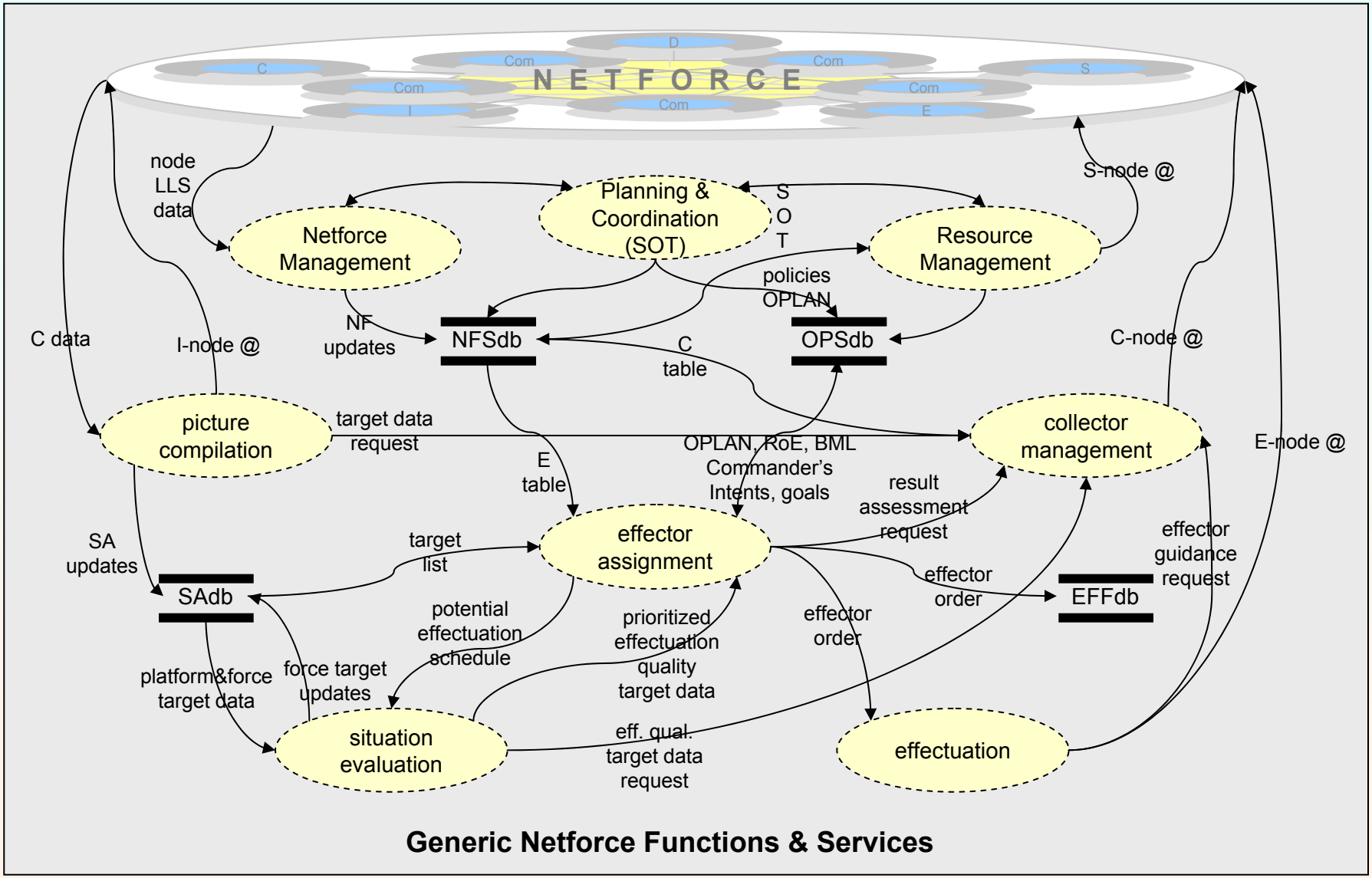
The Four Generic Netforce Data Sets

**For (any) multi-node environment,
where the nodes work together to achieve (a) common goal(s),
four generic data sets are required.**



The Four Generic Netforce Data Sets
- knowledge about the external environment to determine what needs to be done
- knowledge about the available resources and services to determine what can be used
- knowledge about the goals to determine the direction of potential actions
- knowledge about what is already set in place to achieve synchronization

Generic Warfare Area Modeling-1



Generic Netforce Functions & Services

Operational Context: Registration & Integration

Asset Entry (e.g. C-I-D-E-Com node)

INF Netforce Management Function
- node registration function:
  * ship ID, IP, status, composition, access and control, QoS
- NFdb

INF Plan & Coor and Res Man
- SOT (strategic, operation, tactical)
- D node structure (organization)
- OPLAN
- OPSdb

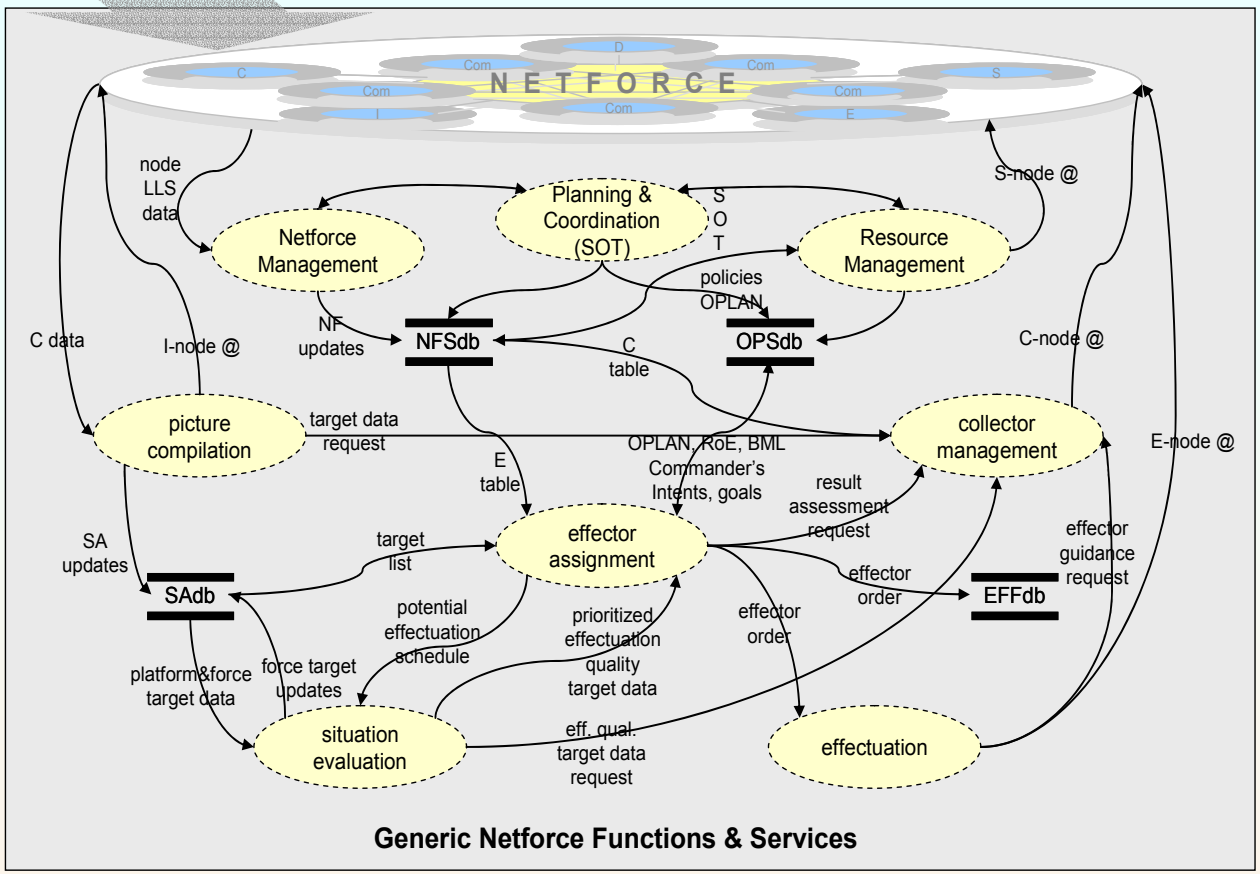
INF Picture Compilation
- C-I integration: determination of contribution to CSP/COP/CTP

INF Collector Management
- collector man&control
- QoS dependent: determination of amount of m&c
- OPSdb

INF Situation Evaluation
- D capability synchronization
- threat evaluation synchronization: IDCRITs, etc
- SAdb

INF Effector Assignment
- E capability synchronization, RoE
- co-ordinated engagement
- EFFdb

INF Effectuation
- E capability synchronization: co-operative engagement
- EFFdb



Generic Netforce Functions & Services

Netforce Registration & Integration: a matter of synchronization of the INFs
Registration procedure for all nodes of the NF. After registration function the INF synchronization starts. This process is governed by the nodes QoS. All relevant INFs are being synchronized for the (new) node.

Netforce Application and Future Work

- Development of Netforce Application Guidelines
- Formalizing the NFRM
  - for M&S purposes and system design
- Inter-node Function topics: architecture, control mechanisms, algorithm diversity, …
- National SENECA project:
  - NEC simulation environment
- National Royal Netherlands Military Academy
  - part of netcentric curriculum
- MTMD Forum Working Groups: BMC4I, M&S, OA
  - netcentric architecture definition, CONOPS, interoperability, inter node functions
- European MPEC WG:
  - inter node function definition
- NATO ACT, NEC