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Peer-to-Peer Technology

An Enabler for Command and Control Information Systems in a Network Based Defence?

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Outline

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- Why peer-to-peer technology?
- Discovery
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- Blue Game 2004 Participation
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Motivation

- Towards a Network Based Defence *)
- Dynamic composition of capacity components
- Based on: Shared situation awareness
- All members of a force should have the same, consistent information available to them - also in highly dynamic situations
- But: variety of different equipment (e.g. PDA with low bandwidth) and information needs (customisation is needed)
- The challenge of (semi-)automatically compiling and distributing a Common Operational Picture in a dynamic environment with different user equipment and network connections

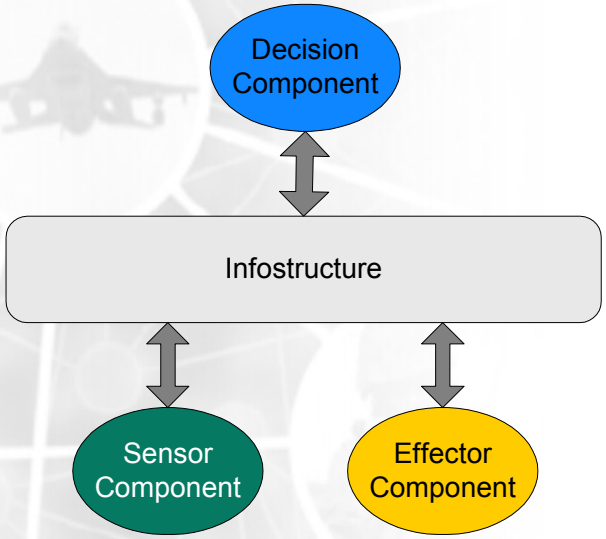
*) *Network Based Defence is the Norwegian adaptation of Network Centric Warfare*

Today's C2ISs

Todays Command and control systems:

- Highly centralized structure
- Central processing of information
- Message exchange between sites
- The network topology is quite static and network connections are administered by people
- Not responsive enough for dynamic composition and restructuring of forces

Network Based Defence C2ISs

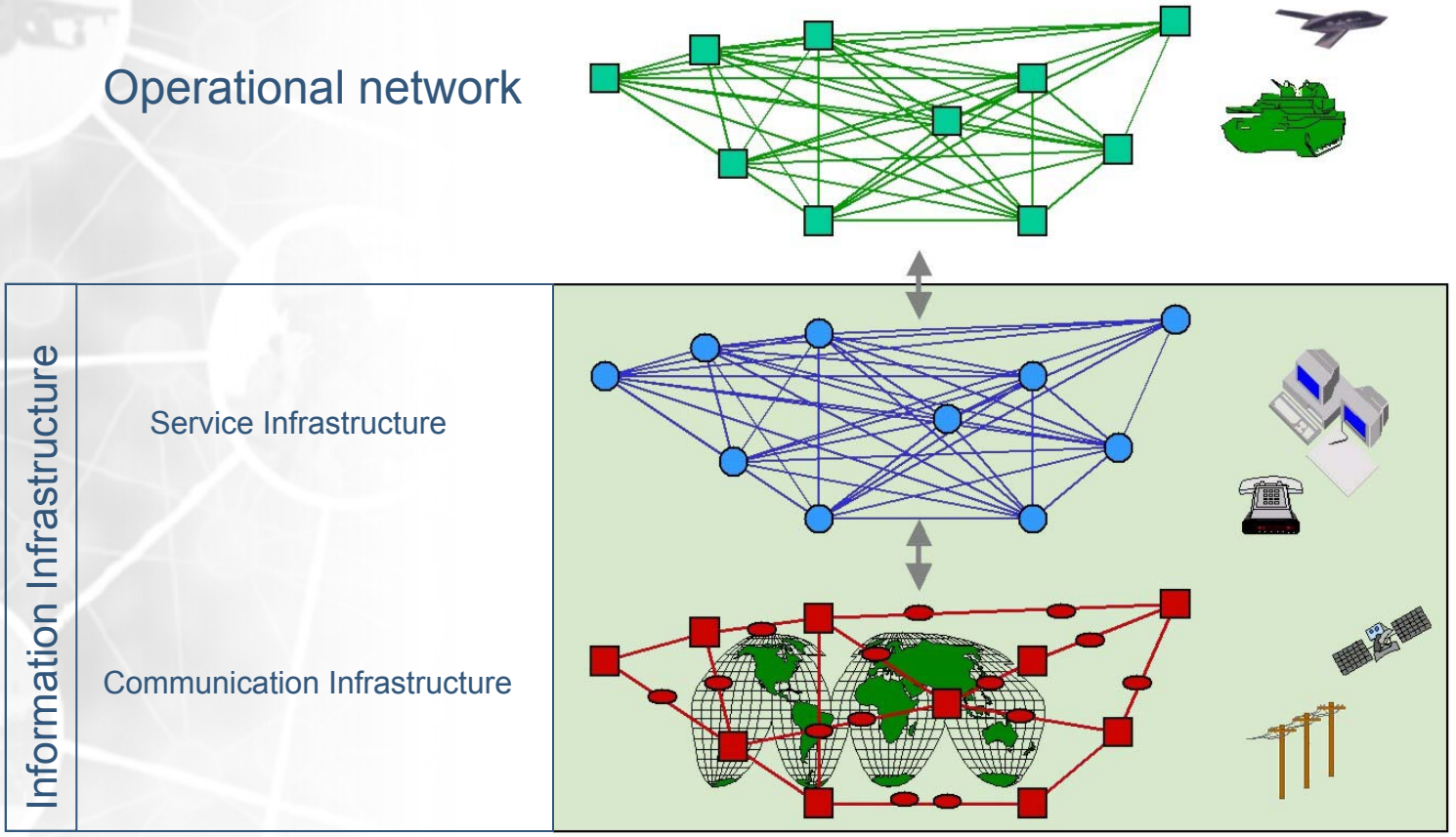


- High-level component model
- Military resources will be decomposed into components offering services
- The Infostructure has to enable discovery of services
- Services should be able to do such discovery as well as publishing their own resources continously

Therefore, a future C2IS is:

- System-of-systems
- Service-oriented architecture

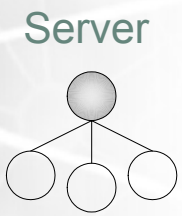
Information Infrastructure and Operational Network



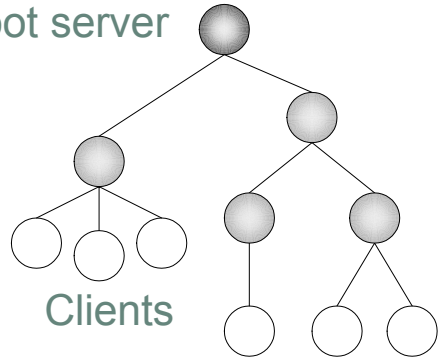
Peer-to-peer Technology

- Based on “equality”
- User ”plugs in to the network to find resources, and/or publishes her own resources for others to utilize”
- Designed to utilize resources (bandwidth, storage capacity, CPU) ”at the edge of the network”
- A collaborative system, based on voluntary participation of peers
- Virtual, homogeneous network on top of possibly various communication technologies, networks and platforms

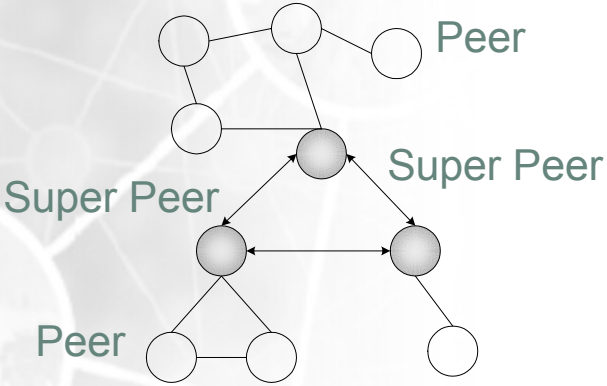
Topologies



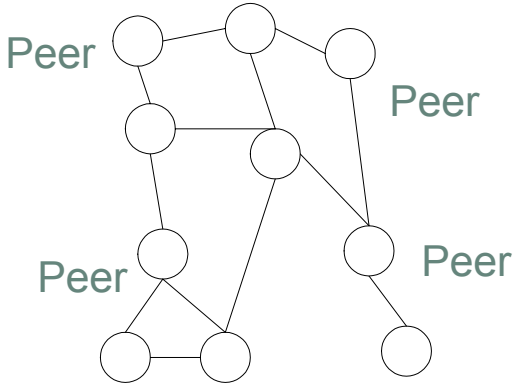
a) Client-server/centralized



b) Hierarchical



c) Hybrid



d) Decentralized

Why Peer-to-peer Technology?

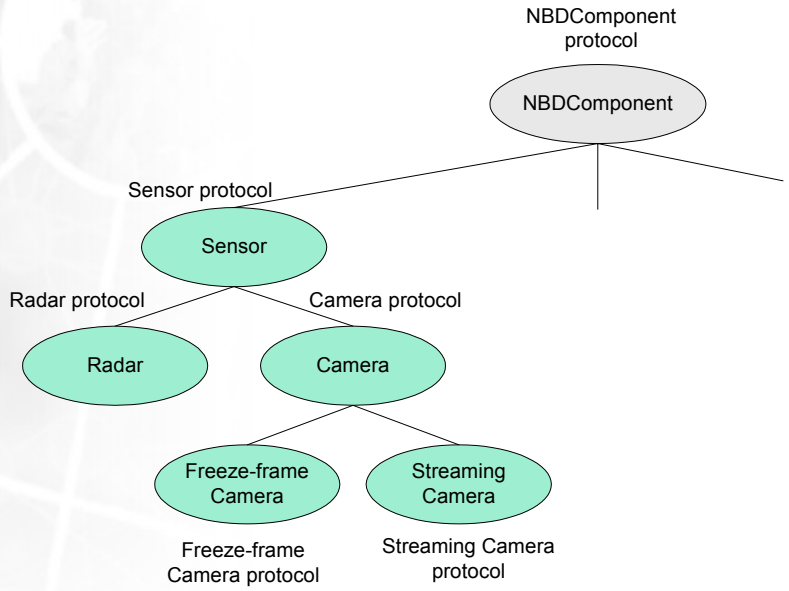
- **Robust**
  - Often garbage collection
  - Scalable (Napster etc.)
  - Supports network mobility
- **Less administration** (configuration etc.)
  - Services may appear and disappear continuously
  - Topology changes
  - Availability/survivability
  - Fail-over
- **Automatic discovery of services/resources**
  - This can be used as a universal discovery service, integrating different middleware services into the same discovery system
- **Information handling/resource exploitation**
  - Group/room mechanism to avoid information overflow

Why Peer-to-peer Technology? (cont.)

- **Possible applications**
  - Virtual whiteboards
  - Multimedia
  - Instant messaging
  - Information-/content-sharing applications
  - Clustered computing
- **Potential problems**
  - Security, needs to be de-centralized
  - Total bandwidth consumption higher (but less bottlenecks?)
  - QoS
- **Technologies**
  - Peer-to-peer: Jini, JXTA, Gnutella

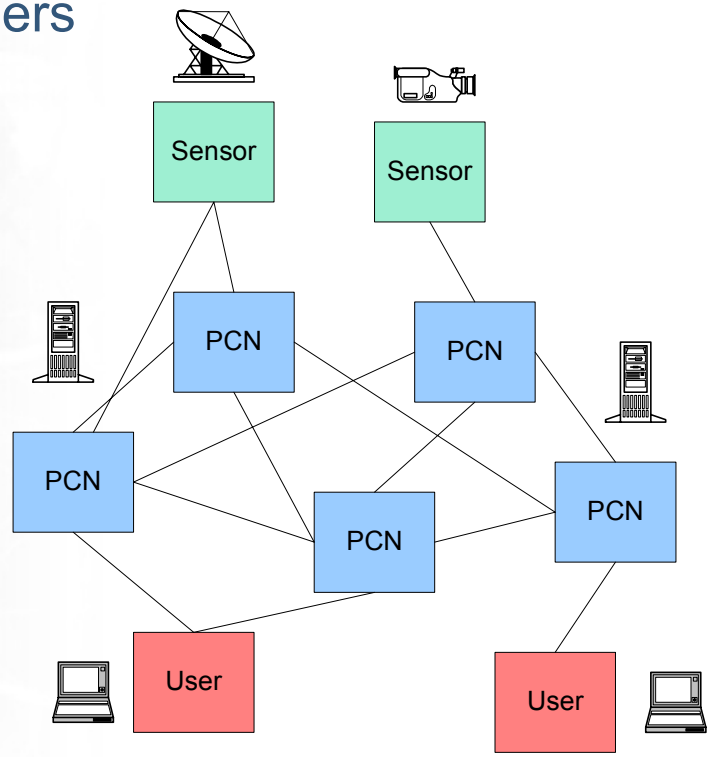
Some Thoughts on Efficient Discovery

- Often, a simple string is not enough (e.g. ”Radar”)
- Type-subtype relationship -> taxonomy of services and their protocols (message exchange definition)
- Semantics to avoid ambiguity (“Tanker”)
- W3C Semantic Web effort combined with p2p discovery?



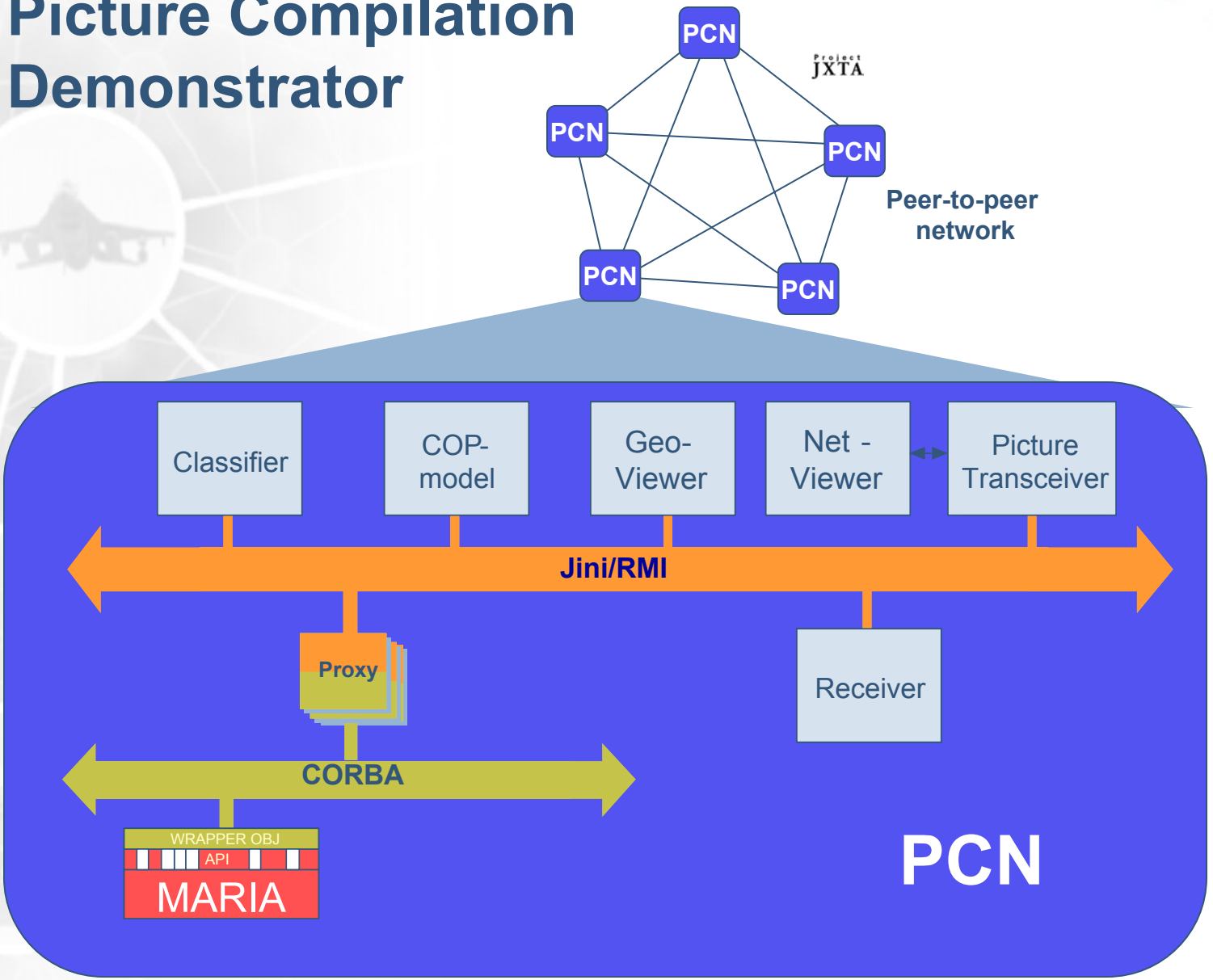
Distributed situation picture compilation

- A concept for distributed picture compilation is being developed
- Based on Picture Compilation Nodes (PCNs)*, a kind of agent that gathers information from sensors and other PCNs and delivers this to users

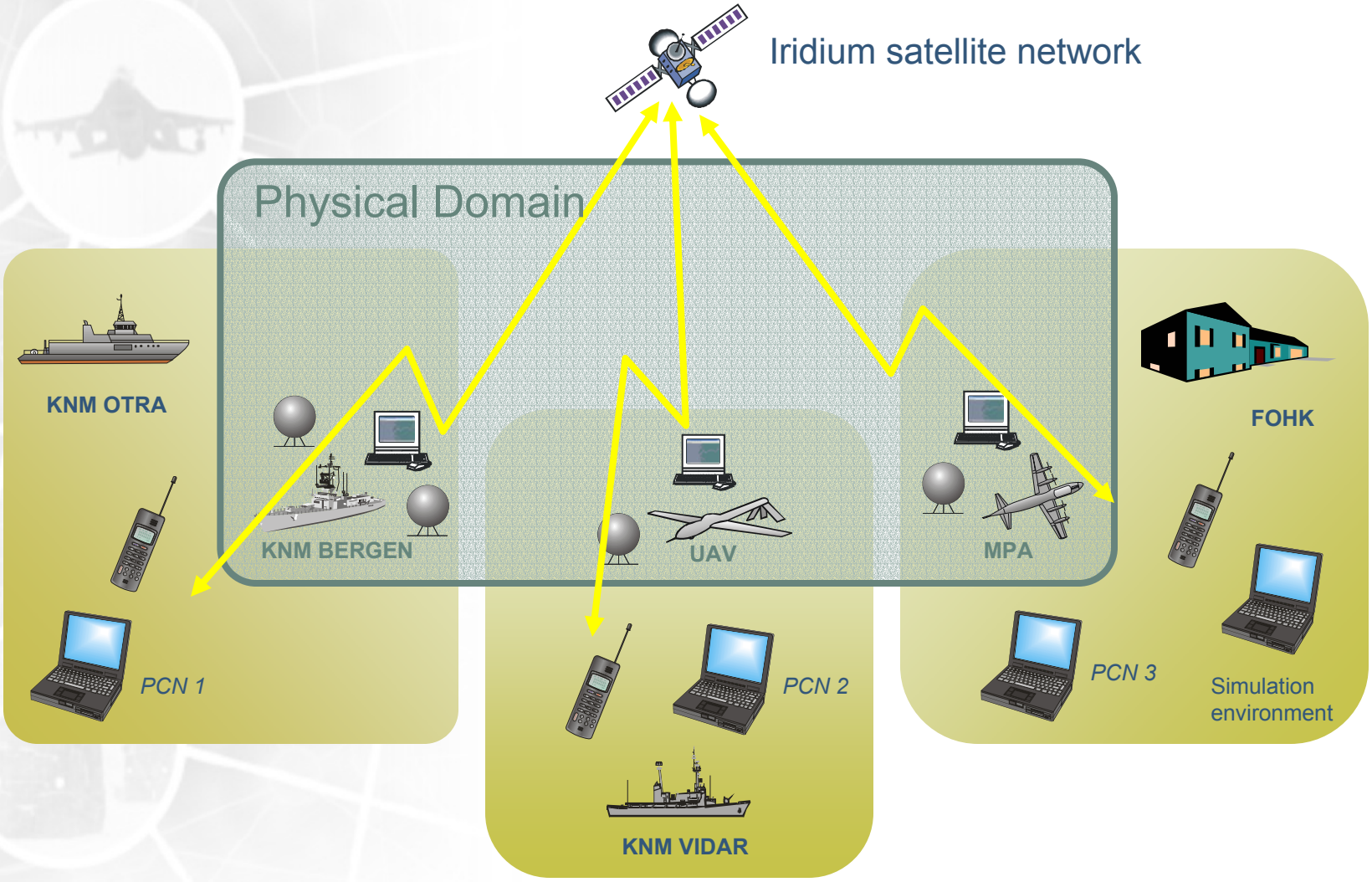


*) A PCN is referred to as a PPN in proceedings

Picture Compilation Demonstrator



Blue Game 2004 Participation



PCN = Picture Compilation Node

Challenges of internet Communication (Blue Game experience)

- A large step from high bandwidth LANs to low bandwidth WANs
- Internet obstacles
  - IP-addressing (dynamic, private/non-routable NAT)
  - Firewalls
- JXTA publish and subscribe
  - Lack of bandwidth economy (XML-based)
  - Relay peers
- Choice of available communication services
  - Low Orbit Satellite: Iridium and Global Star
  - Mobile telephony: GSM / GPRS
  - LAN Connection

Conclusion

- No such thing as a perfect solution all distributed computing problems
- Peer-to-peer technology may solve some of the new challenges in future C2IS
- Looks promising, but further work is needed

Questions?

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