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# Augmented Reality as a Tool to Achieve Common Ground for Network Based Operations

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# Command and control

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**Command and Control (C<sup>2</sup>)** presents a complex set of interactions between actors, the technology they use as well as the environment.



# Command and control

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**Command and Control** is characterized by:

- Decision-making
- Limited time
- Information under/overload
- Multiple and possibly conflicting goals
- Limited resources
- High demands for coordination
- Team-work

# Joint command and control

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- Many situations demand collaboration between commanders from different organizations, possibly even from different countries
- This in turn requires that commanders quickly adapt to new terminology, symbols and procedures since time-pressure is a common characteristic of C<sup>2</sup> work



(Sundin & Brehmer 2000)

# Different analytical levels of communication

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- A.) The technical problem of signal transmission
- B.) The semantic problem of how precisely the symbols convey the desired meaning; and
- C.) The effectiveness problem of how the meaning affects recipients conduct

(Shannon & Weaver, 1949)

**From a control perspective in a "soft" system, level C is the interesting, and most difficult one.**

# Working with situational pictures - Configuring action into objects

Meaning is rendered into objects by:

- Spoken language
- Gestures
- Facial expressions, “attitude”
- Deviations from normal state

# Objects and symbols in $C^2$

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- Representations of physical entities like units, terrain etc.
- Representations of states in the physical worlds.
- Objects and symbols carries a history with them. Meaning is constituted from the observers knowledge of earlier events.



# Symbols / Objects

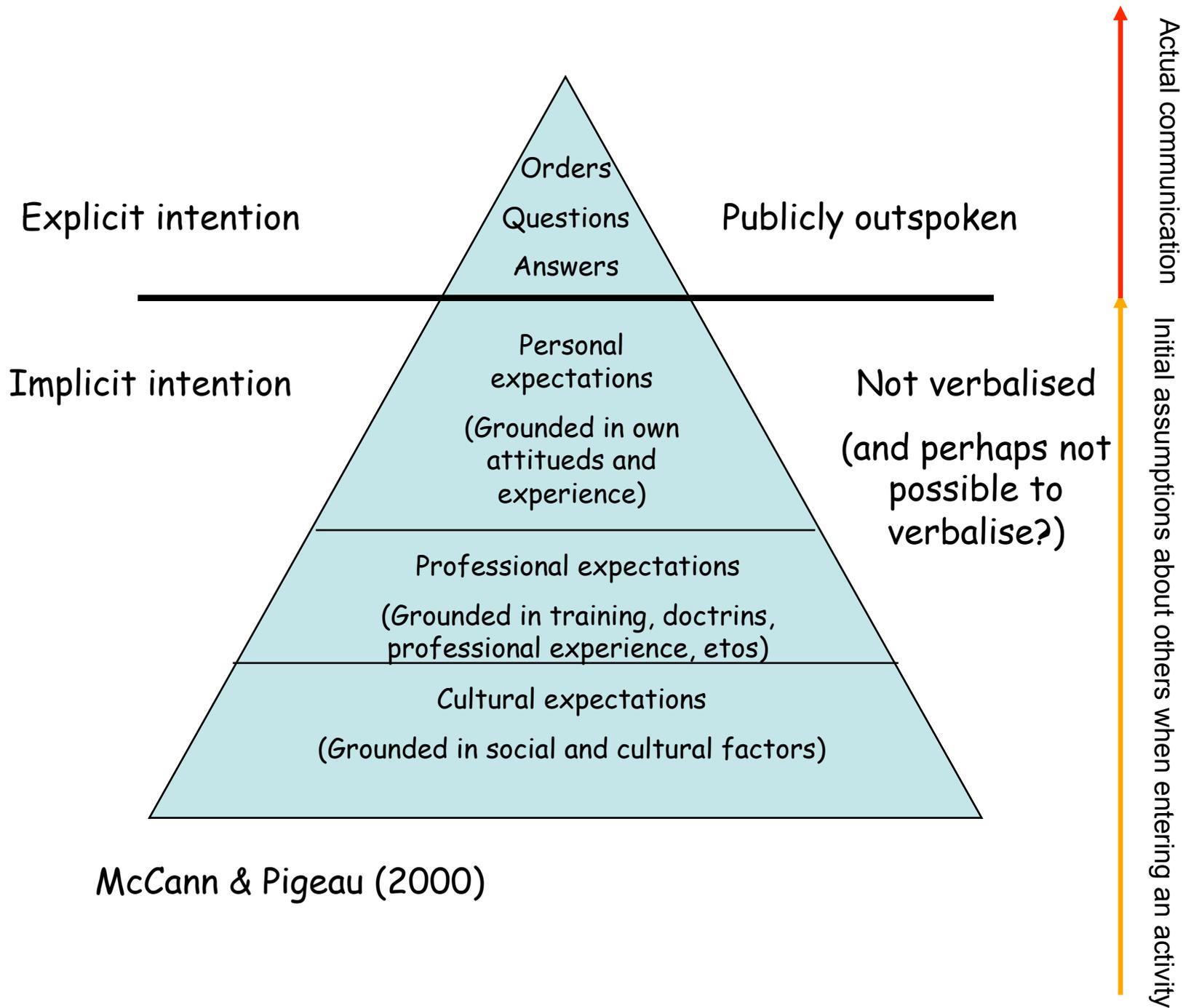
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- Can be formalised like military unit symbols. Abstract and information dense.
- Can be “images”, looking like the object they represent.
- Can be anything that has been denoted meaning by action; stones, drawings, coffee-cups etc.

# Common Ground

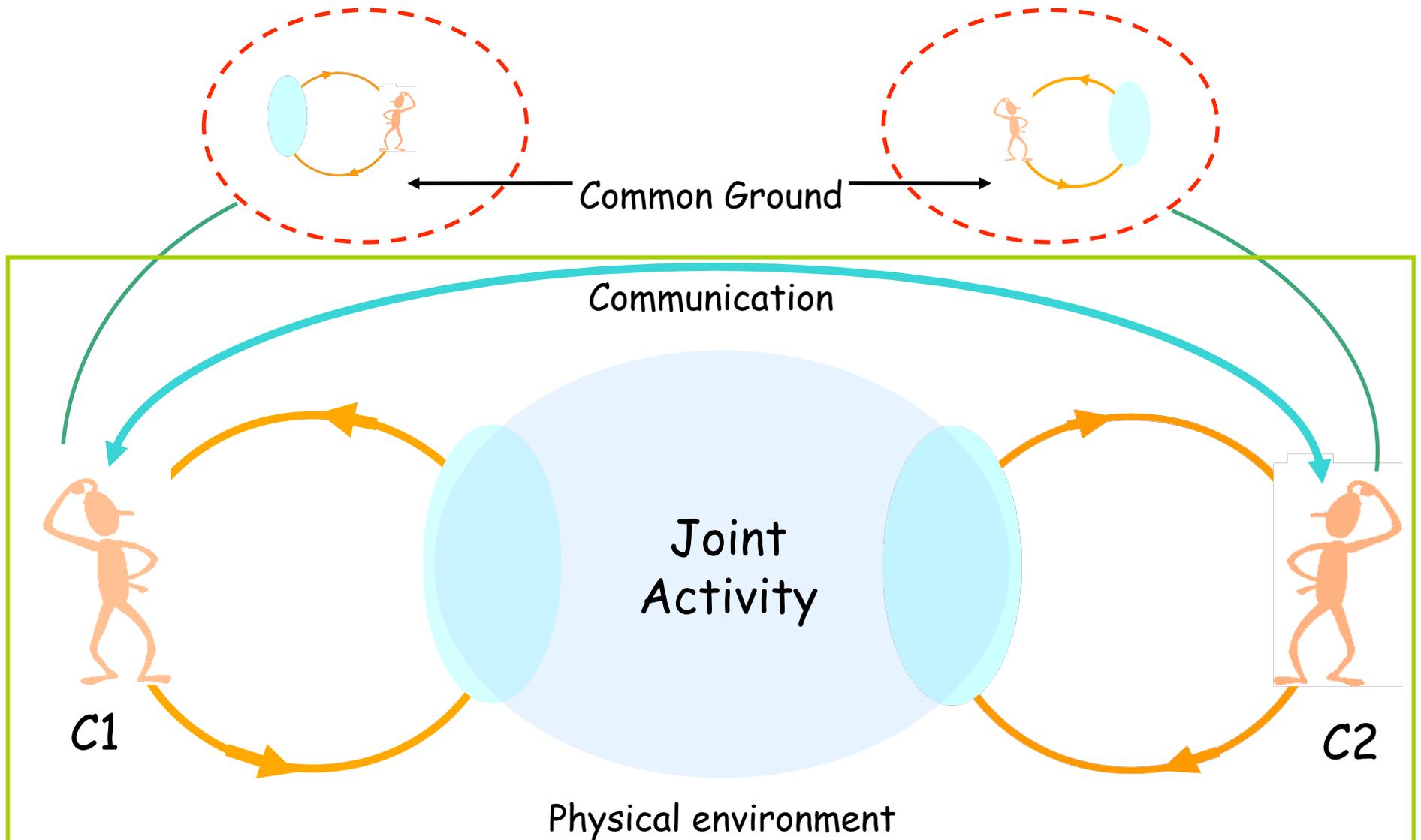
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- To coordinate efficiently, the commanders need to establish a shared understanding of what has happened and what is going on, i.e. a *common ground* (Clark, 1996)
- The establishment of common ground is normally a time-demanding process. The more "alien" the involved persons are to each other, the more time will be spent



McCann & Pigeau (2000)

# Establishing Common Ground



# Joint Activities

## Initial Shared understanding

- Of the activity
- Of symbol languages
- Roles
- Of the current situation

Public events (often changes in a situational map)

Beginning of an event

"event body"

End

Current state of the activity

Clark, 1996

- Understanding of intentions
- To mediate ones own intentions

(Point, look, gesture, talk etc)

# Focus

## Initial Shared understanding

- Of the activity
- Of symbol languages
- Roles
- Of the current situation

## Public events (often changes in a situational map)

Beginning of an event

"Event body"

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## Current state of the activity

- Understanding of intentions (Point, look, gesture, talk etc)
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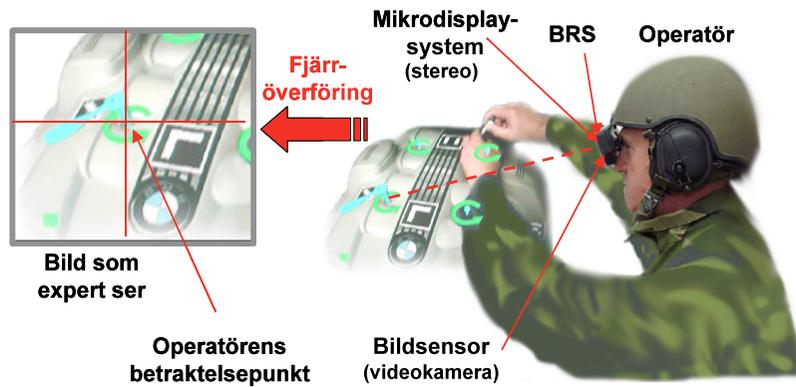
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**So how do we help establish the  
common ground?**



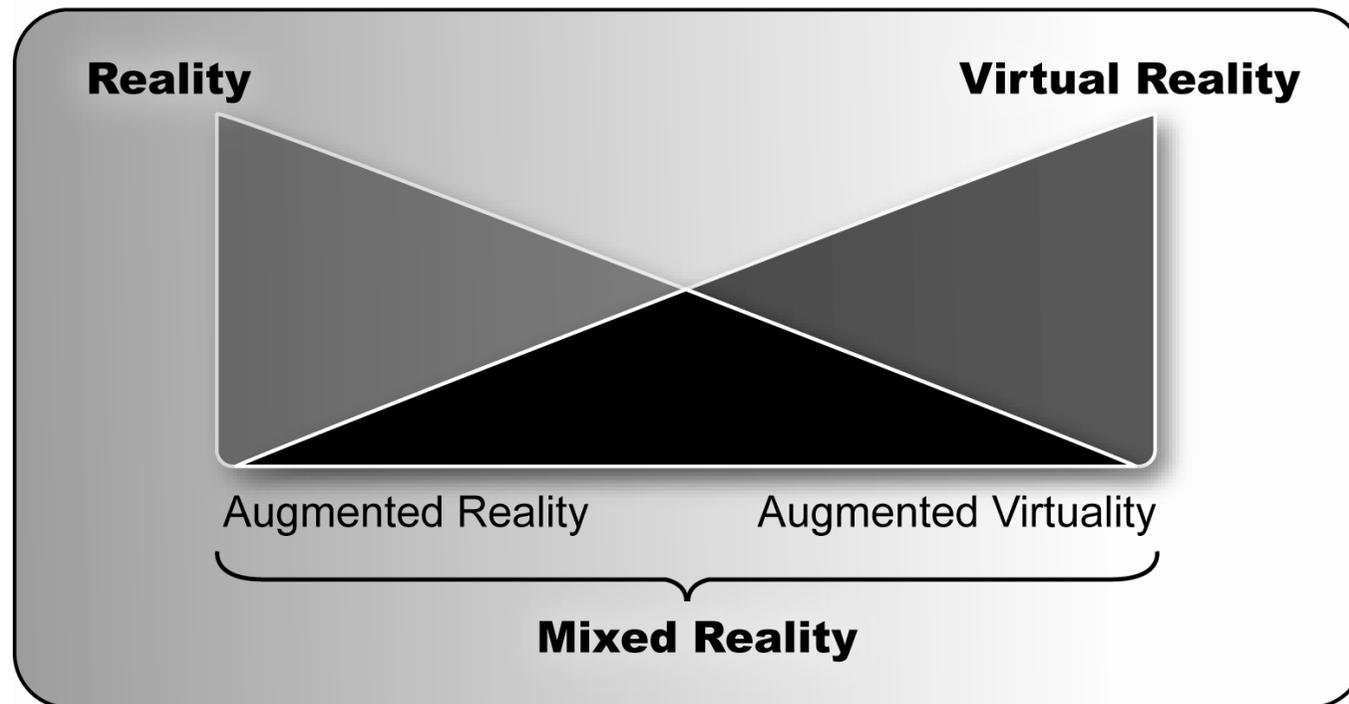
# Augmented Reality



# Mixed and Augmented Reality

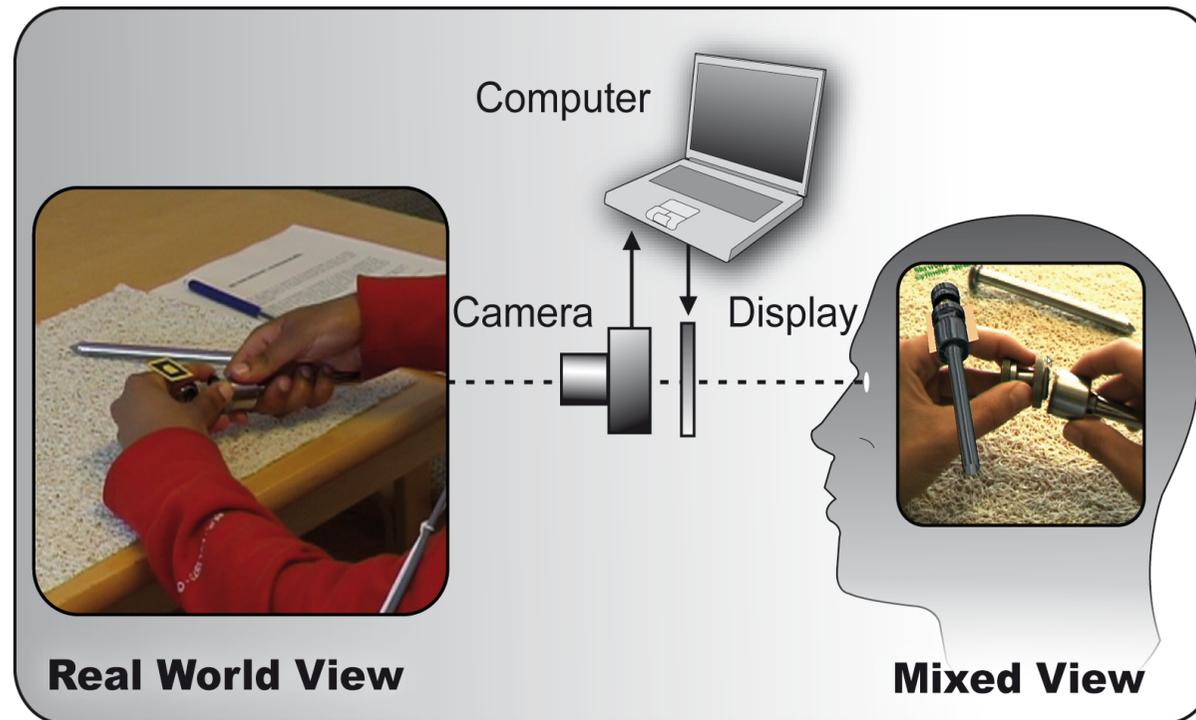
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A technology or a concept?



# Augmented Reality

It's about the merging of realities with the aid of technology



# Not a very new concept

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The first Head Mounted Display - 1968



# Research Question

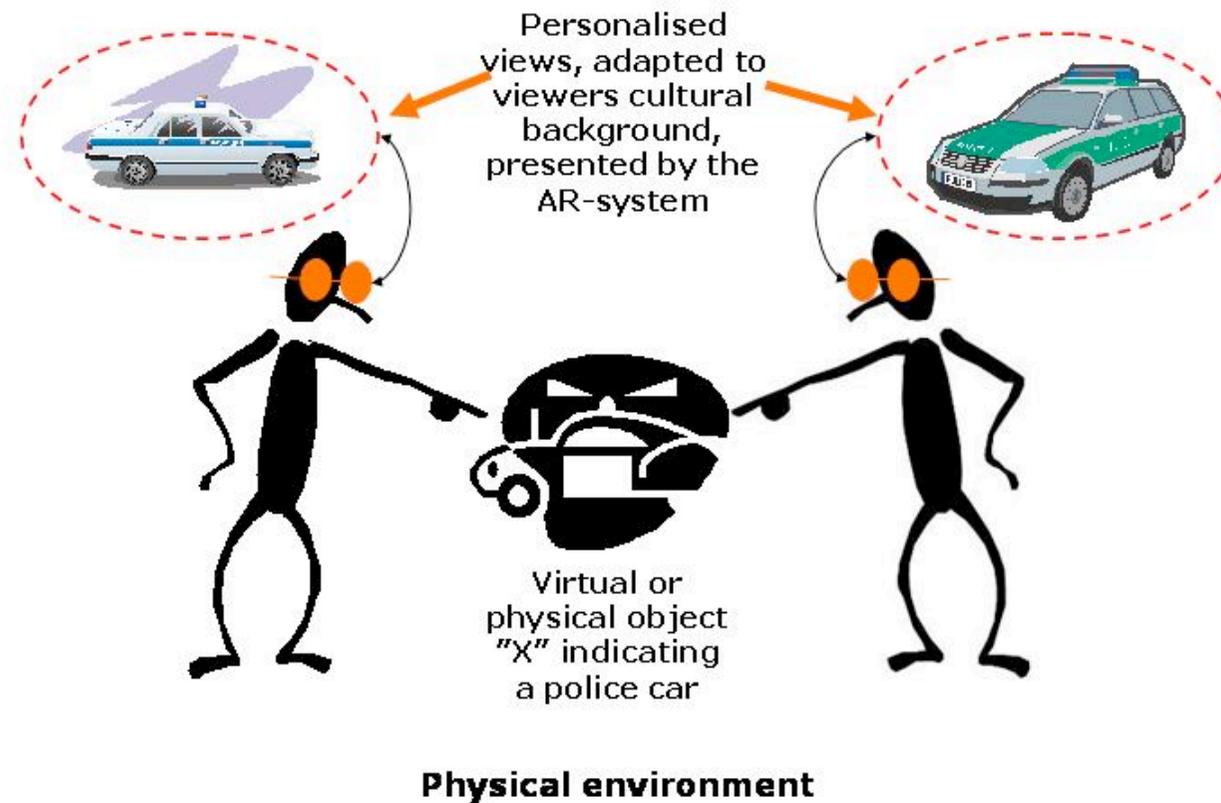
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How can AR-based systems be used to support initial common ground in crisis management where commanders from different organizations (with different background and competencies) have to work together?



# Research Question

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# Suggested study

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Simulation of a situation that demands cooperation

Research questions

- Actual effects
  - Does AR help commanders to reach a shared understanding faster than without AR?

Experience effects

- Does the participants experience that is faster?
- Do they experience that the system help them to get a shared understanding?
- Do they trust the AR technology?

# Scenario

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- The scenario is based on a forest fire fighting situation, where participants from different organizations have to cooperate in order to control the situation
- The involved organizations are the rescue services, the police and the military (both helicopter units and ground forces)



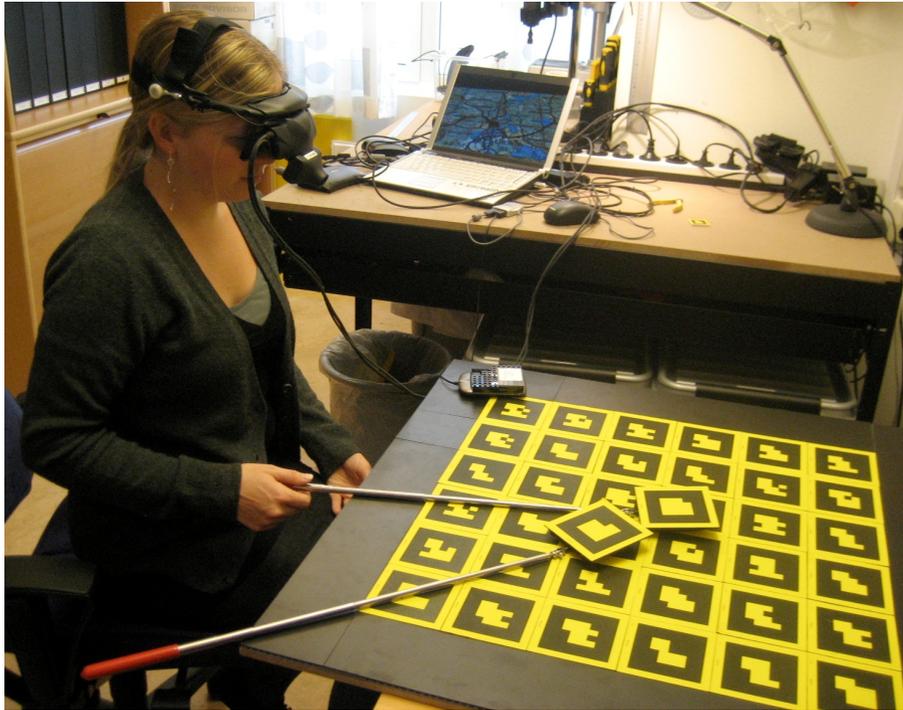
# Participants

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- The participants are professionals from the rescue services, the police and the army
- We have access to ten participants from each organization

# Alternative solutions

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# Alternative solutions

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Forsök för projektet  
"Samarbejde och  
semantisk interoperabilitet  
med Mixed Reality"

Forsök för projektet  
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# Which solution?

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- Pros and cons with both
- The aim of the research is future scenarios
- The digital map gives us more possibilities to expand and utilize the AR capabilities as well as data from other sources.

# Pilot study



# Pilot study



# Results so far...

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## Conclusions from the pilot study

- Improve the scenario and missions
- Expand the training period of the participants
- Find ways to pin point what aspects of AR actually are useful and how.
- What measurements should we use for the main study?

# Acknowledgements

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