



Challenges for a Distributed Collaborative Environment Functioning over Mobile Wireless Networks

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Functioning over Mobile Communication Networks'



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Plan

- Distributed Collaborative Environment (DCE)
- Middleware Architecture
- OPERA
- Preliminary Bandwidth Characterisation
- Tactical Wireless Environment
- OPERA Middleware in a Wireless Environment
- Conclusions



Distributed Collaborative Environment

- Involves direct human participation
- Allows:
 - Sharing of information
 - Discussion of alternatives
 - Making of joint decisions
 - Collective creation of authored work products



Some lessons learned for deployed digital systems

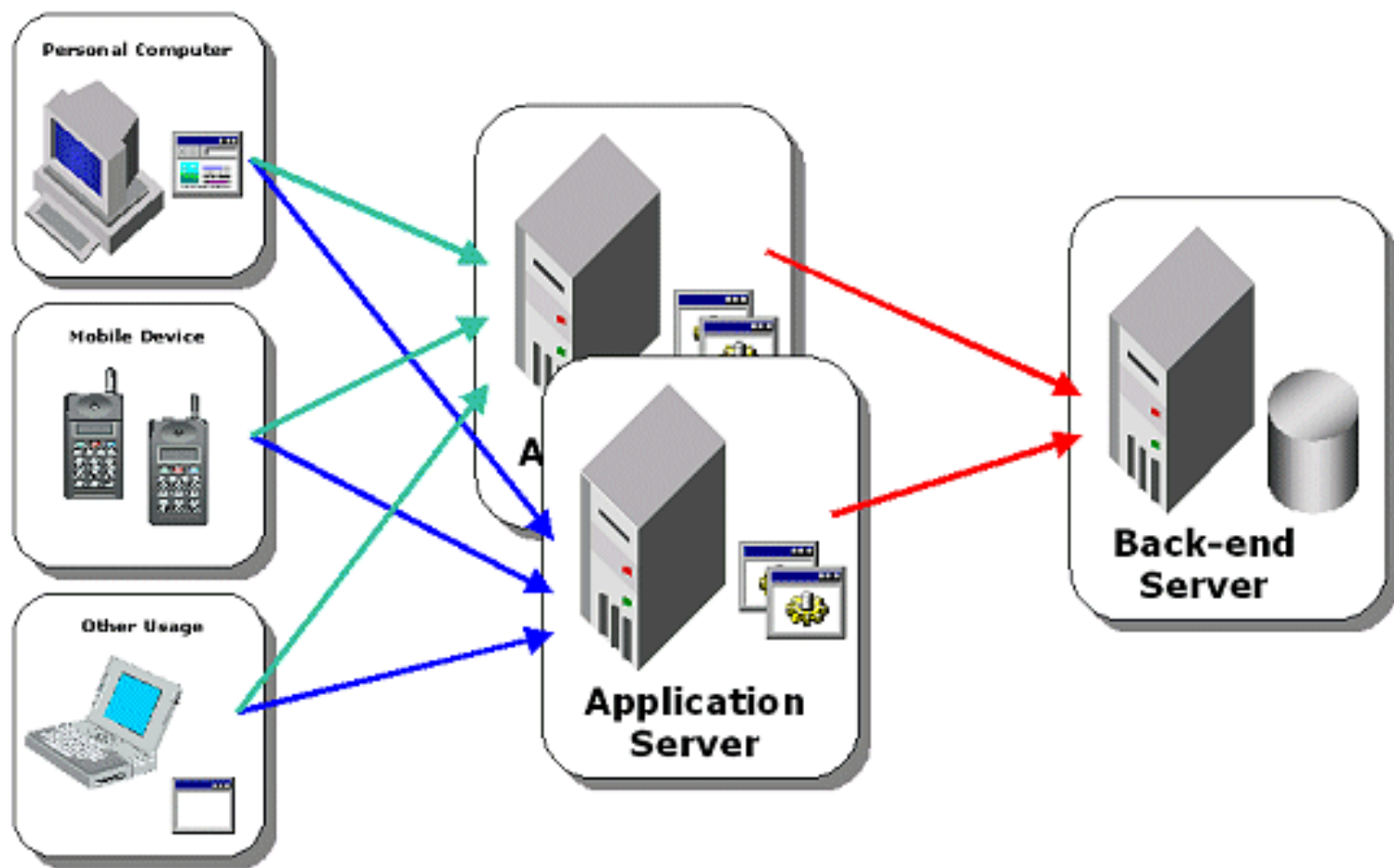
- Need for FBCB2 (Force XX1 Battle Command Brigade and Below) or like device down to company (tactical) level
- More bandwidth; must allow for complete transmission of basic Fragmentary Orders & Graphics to be useful
- Should have near real-time update of assets on battlefield
- Collaborative planning is a must
- Every vehicle and CP needs some type of system
- The collaborative planning tools were almost unusable due to data bottlenecks caused by low bandwidth links

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Multi tier Architecture



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OPERA

- Stands for “Operational Planning Environment and Reference Application
- Provides easy access to information on doctrines, organizations, equipment and resources
- Is a set of planning and calculation tools
- Facilitates the collaborative planning carried out by a group of functional staff experts
- Provides workflow control



OPERA Functionality

- Browsers
 - Equipment
 - ORBAT (Organization and personnel)
- Staff Checks, Planners and Calculators
 - Task
 - Logistic
 - Lift
 - Movement (Road, Air and Rail)



OPERA - Multi-User environment



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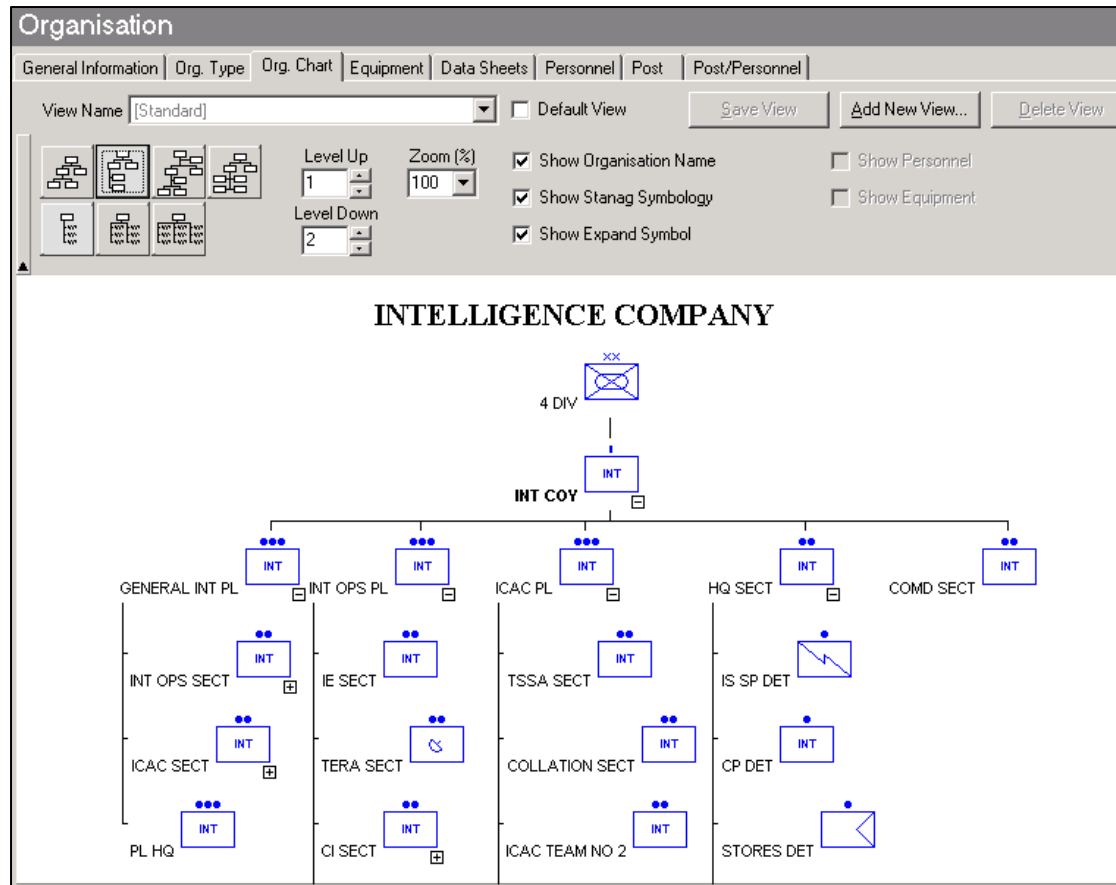


OPERA – Current users

- Corps
 - Division
 - Brigade
 - Regiment
 - » Company



OPERA – ORBAT Browser



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OPERA Logistic Staff Check

Establishment

References

ab

ab2

RIFLE COY

COALITION

GENERIC ENEMY (MOBII

GENERIC ENEMY (ROWEN)

Opera TO&E

INT PL

Equipment

Supply

Devost Op1

Op BRAVO

StaffCheck

Air Staff Check 1

Lift Staff Check 1

Logistic Staff Check 1

Road Staff Check 1

Rail Staff Check 1

Logistic Staff Check

Parameters

Name *
Logistic Staff Check 1

Organisation
INF BDE

Personnal Quantity *
4,681

Duration *
20.00 days

Distance

Average Speed
65.00 km/day

Parameter Set *
DEFAULT PARAMETER SET

Area Profile
ARCTIC

Additional

Supplies

Ammunitions

Non Packaged POL

Totals

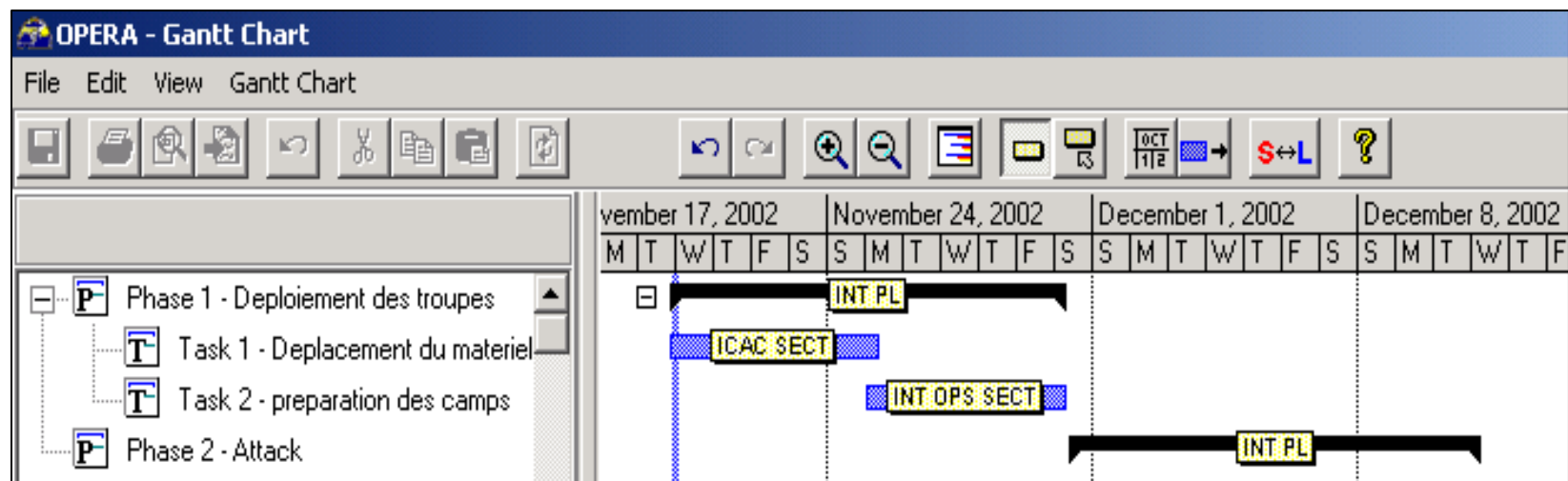
Category	Pallets	Liquid Quantity	Total Weight	Avg Weight/Day
Food	0.00	0.00 l	0.00 kg	0.00 kg
Medical	0.00	0.00 l	71,151.20 kg	3,557.56 kg
Petroleum, oil and lubricants	43.07	0.00 l	21,532.60 kg	1,076.63 kg
Water	1,310.68	655,340.00 l	1,310,680.00 kg	65,534.00 kg
Total	1,353.75	655,340.00 l	1,403,363.80 kg	70,168.19 kg

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OPERA Task Planning

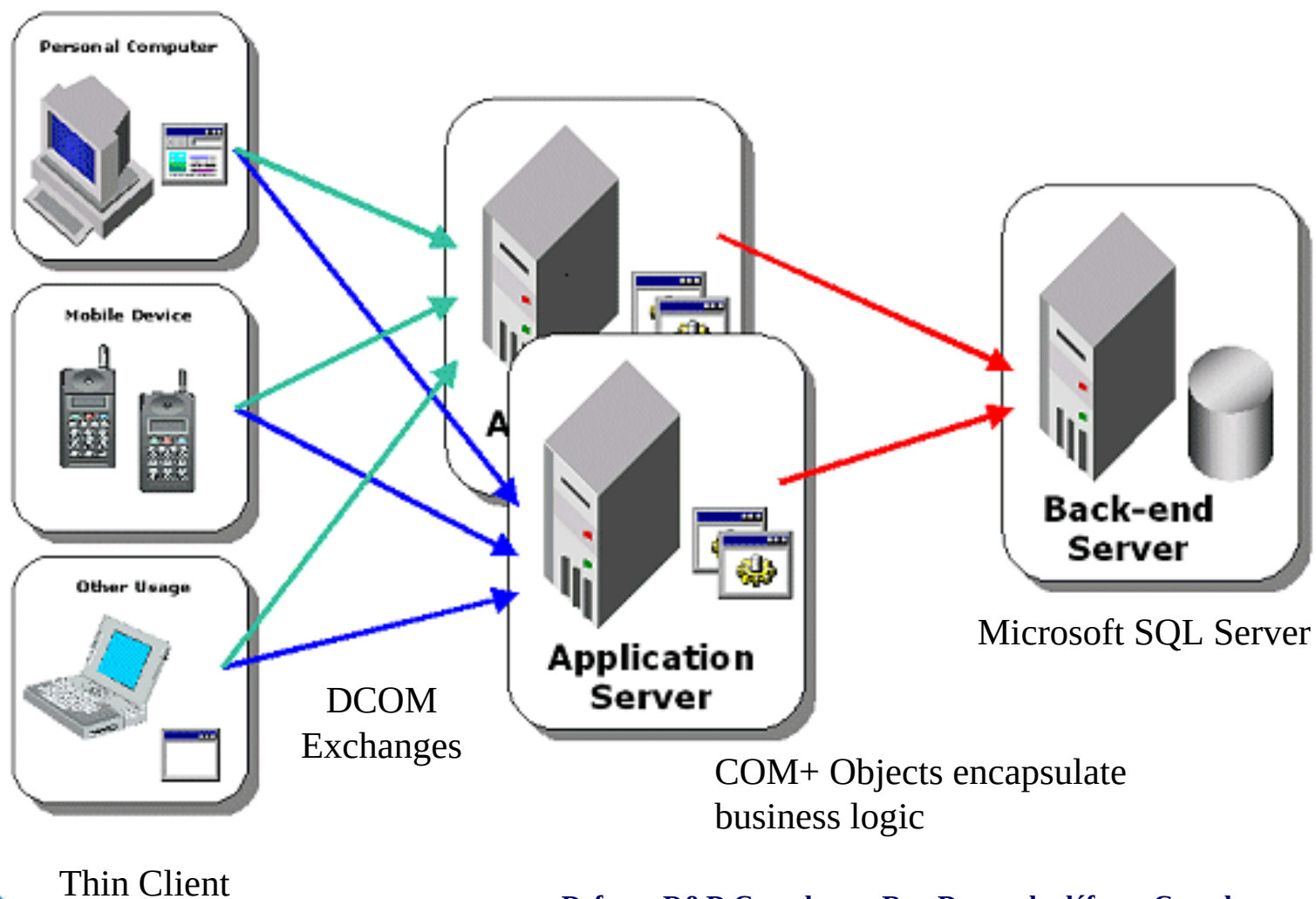


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OPERA Architecture



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OPERA - Bandwidth Characterization

- The objective was to determine the bandwidth required by OPERA for performing distributed collaborative planning
- The measurements of the network traffic occurred between the client and the application server
- Measurements included all network level exchanges.
- The testing was performed using an organization of a size of a Brigade
- 60 functions were evaluated



OPERA - Bandwidth Characterization (cont.)

- The test was performed a total of three times. The first test was to validate the scenario. The second and the third tests were to compile the measurement data into a comparison grid and to validate the results.
- The execution of the tests was done in an almost perfect network environment.
 - one client and one server with no other network or other application traffic generated by other users

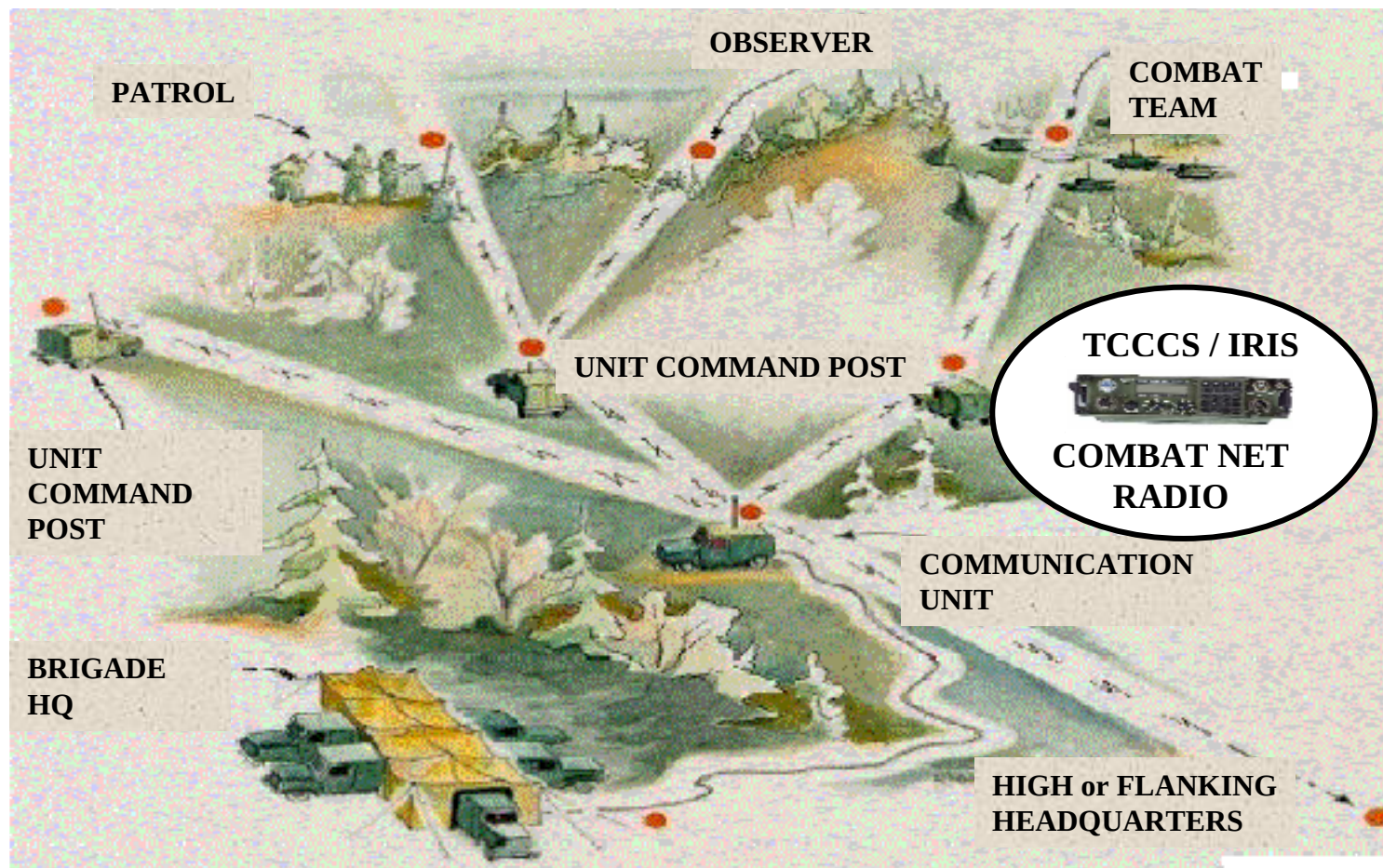


Bandwidth Characterization (Results)

- Basic traffic of 250 bytes per minute just to keep connections alive
- 33 functions (out of 60) exchange more than 100k bytes
- The display of a calculation progress bar consumed many network resources
 - a request sent from the client to the application server each 25 millisecs



The Tactical Domain



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Effects associated with mobile wireless communication grids

- low bandwidth (often less than 1000 bits/sec)
- variable throughput, and
- unreliable connectivity (frequent disconnections)



Potential Issues with OPERA in the tactical domain

- Keeping calculation progress bar updated in multi tier architecture consumed considerable bandwidth
- Potential disconnection due to network latency
- Forced disconnections cause clients and servers to be shutdown and restarted.
- The response time for most of the OPERA functions would be higher than 80 secs at 1k bits/sec



Probable Characteristics of Planning Process in Tactical Domain

- Developed and executed more rapidly
 - shorter time horizons
- Oriented toward tasks and movements
 - shorter, fewer logistical calculations
- More interactive
 - less workflow-oriented
 - more use of map overlays



Conclusions

- Distributed collaborative environment (DCE) offers tools to make joint decisions but requires human in loop
- OPERA is an instance of DCE based on a multi-tier architecture using distributed object middleware
- The battlefield provides very limited bandwidth for communications in the tactical domain
- Deployment of DCE like OPERA in a wireless environment raises major issues
 - response time
 - effects of disconnections
 - need to reduce volume of data transmitted
 - need for multi-tier architecture

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