Information Superiority for Close Battle

A Chink in the National Armor?

Offensive and Defensive Issues

Examples based on TF XXI AWE, March 1997

As Presented to the

Defense Science Board

24 March 1999

P.F. Gorman

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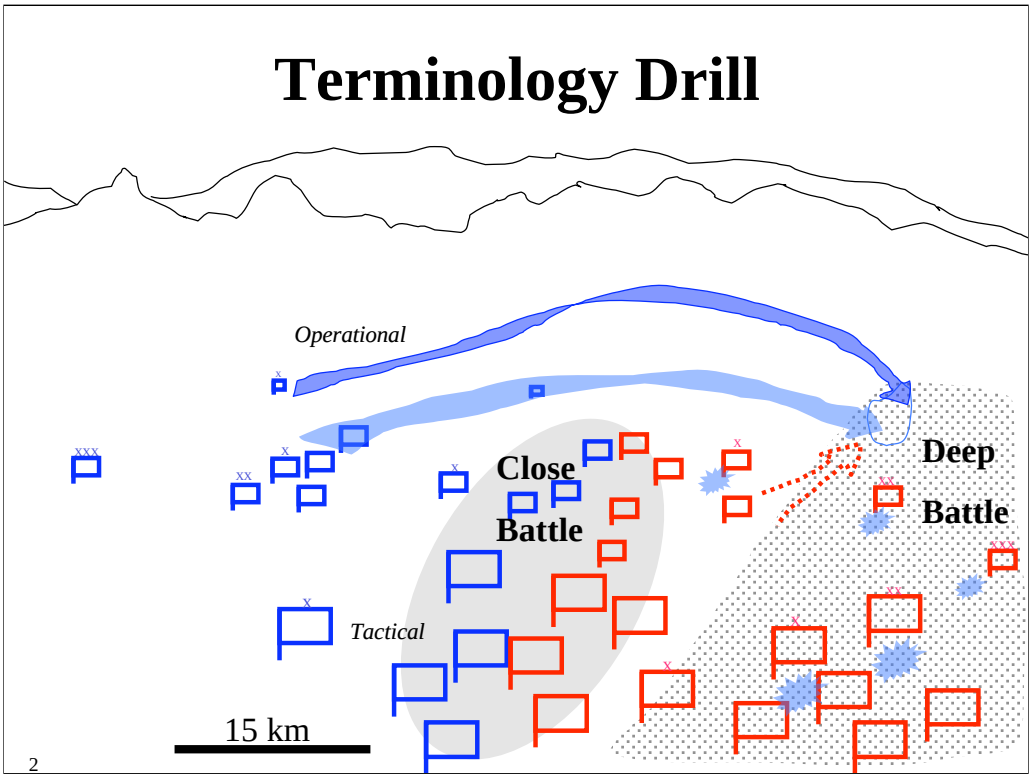
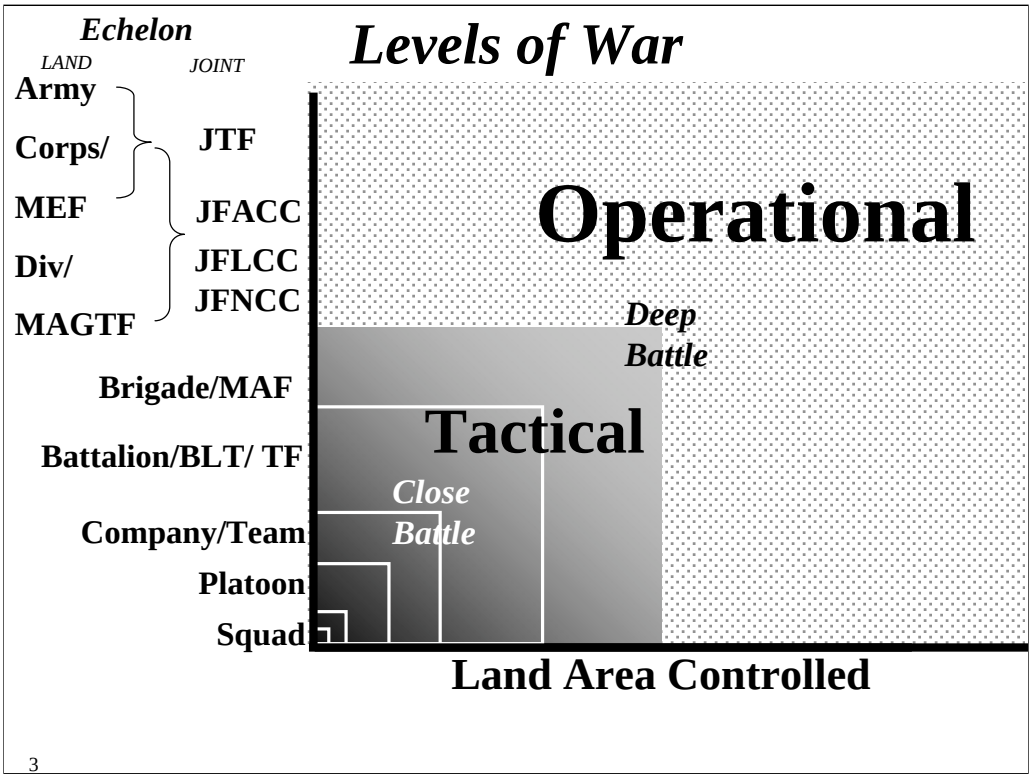

Terminology Drill
Operational
Close
Battle
Deep
Battle
Tactical
15 km
2



"At the operational level of war, large unit commanders mass or maneuver tactical formations to bring the enemy to battle on the best terms possible. Attacks in depth with air-delivered weapons, missiles and airmobile troops isolate portions of the enemy force for attack or break up the continuity of his operations….

Tactical operations are the conduct of battles and engagements within the context of campaigns and major operations. They are the domain of corps and smaller units. They are supported by higher echelons of command who set the terms of the battle and provide support for it. Brigades and smaller units may fight engagements — smaller, separate actions—either as part of a battle or as separate actions.. Tactical success is measured by the success of failure to achieve aims set by higher commanders.

Battles are large engagements involving brigades and larger forces. They may be localized, brief or intense or they may involve numerous engagements over a large area that take days to resolve.In any case, their effects are felt over a large area, and actions outside of the area of direct, sustained combat can greatly influence their outcome.

The conduct of battle differs from that of campaigns and major operations in some important respects. Speed of response, ability to change direction, and sensitivity to short-term events are among these differences. Conduct of both depends upon initiative, agility, depth, and synchronization…" FM 100-5

Command at the Operational Level

	USN ★★	USAF ★★★	USMC ★★	USA ★★★
• **Entities managed**	10^1-10^2	10^2-10^3	10^3-10^4	10^4-10^5
• **Freedom of action**	greatest……			..least
• **Command M.O.**	centralize……			decentralize
• **Communications**	assured……			..tenuous
• **Tactical Mobility**	ease……			difficulty
• **Doctrine**	*f*(materiel)…..……			*f*(behavior)
• **Blue SA**	precise……			.fuzzy
• **Red SA**				
– **Operational**	worst……			..best
– **Tactical**	best……			.worst

Land warfare at the operational level is impaired by poor integration in close battle

4

The array above compares typical service-components of a JTF, each under command of an officer of three-star rank. These are likely to be quantitatively different by orders of magnitude among numbers of *subordinate movable elements* (referring to groupings or personnel and materiel responsive to a single human intelligence: ships, planes, tank crews, infantry squads, supply detachments, survey parties, and the like).

However, more militarily significant than the order-of-magnitude shift in quantity within the array from left to right is the quality among the depicted differences: speed, range of operations, flexibility and maneuverability decline, and difficulties of command, control, and intelligence increase. Forming a Joint Task Force involves artful exploitation of complementing capabilities of each component, and commanding and controlling service components to that end is the prime purpose of joint doctrine, tactics, procedures and techniques. Land forces —USMC and Army elements —are inherently more difficult to plan for, to project abroad, and to coordinate once deployed.

It is reasonable to ask why employ land forces, given their disadvantages relative to naval or air forces. The answer lies in the difficulty of exerting control over land and people from the sea or from the air alone. When the mission of a Joint Task Force entails such control, then it must be provided with appropriate means. Land forces are essential when the objective includes any of the following:

—To deter the use of violence for political purposes(evidence U.S. determination, enhearten allies, inhibit the manufacture or use of weapons of mass destruction)

—To affect the governing of territory and population(provide humanitarian aid, forestall or redress aggression, destroy or neutralize usurping armed forces, separate combatants)

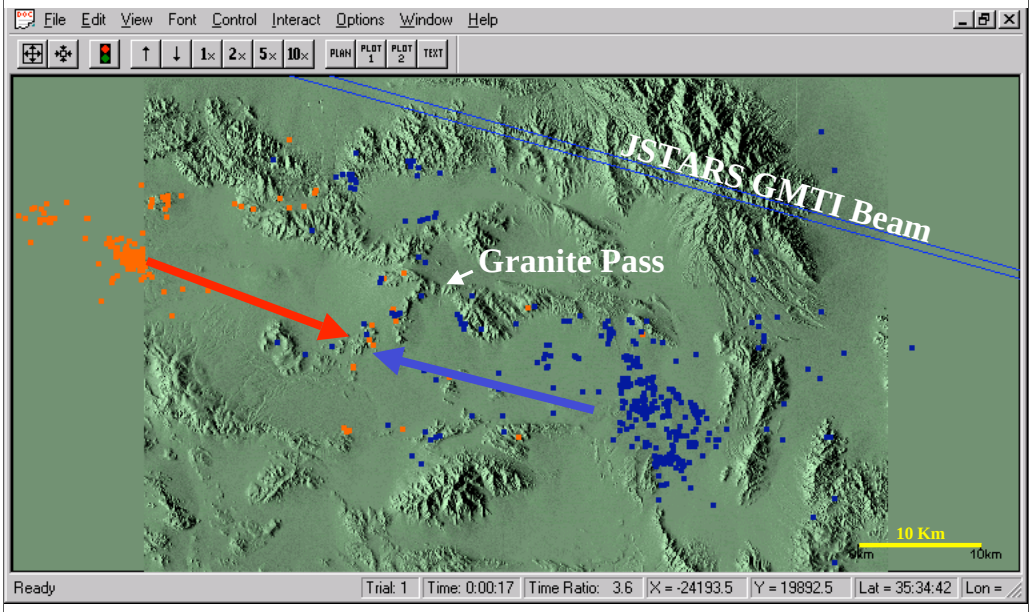
— To secure bases for air or sea components

— To assure precise, discriminate use of firepower

—To terminate conflict on terms favorable to the U.S.(delay, disrupt, or deceive hostile armed forces enable decisive fires and dominant maneuver)

However appropriate and efficient centralized command and control may be for the JTF itself, or for its naval and air components, its land component functions best with decentralized command structures. Indeed, Command Centers or large Tactical Operations Centers constitute a vulnerability for land forces, exposed as these would be to threats ranging from terrorist or guerrilla attacks, through direct or indirect fire, to actual capture. Hence, TOCs for land forces should not resemble those of sea or air forces, but should be, rather, highly mobile, dispersed or distributed.

The Need for Close Battle Integration



An example based on Task Force XXI AWE 16 March 1997

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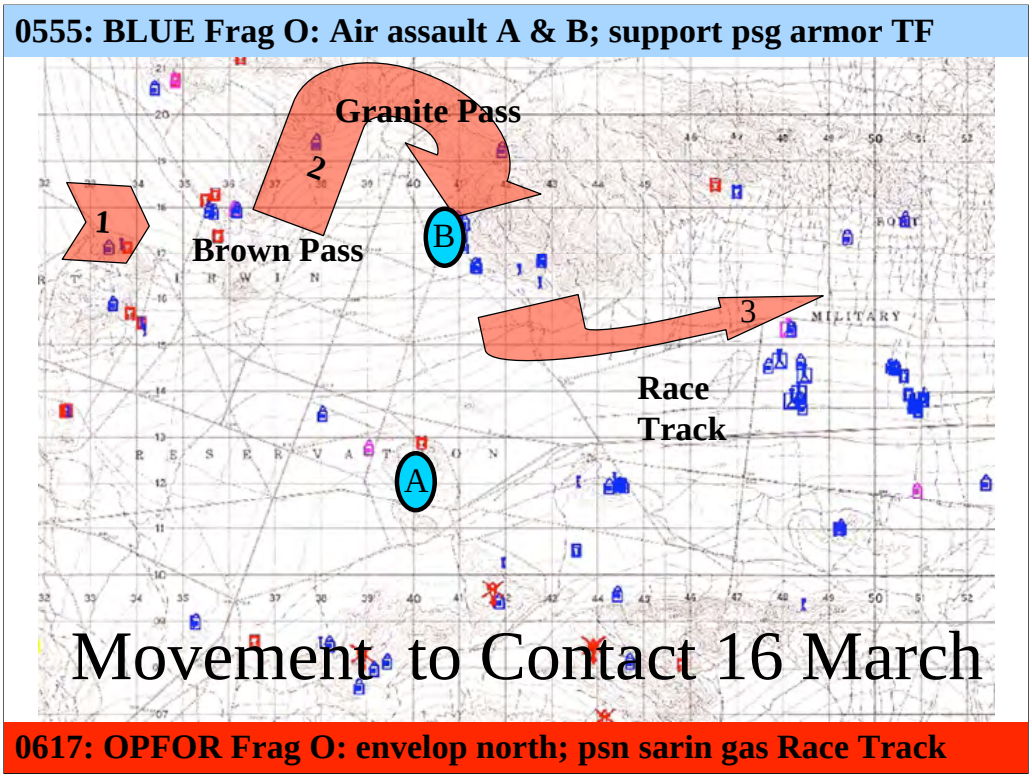
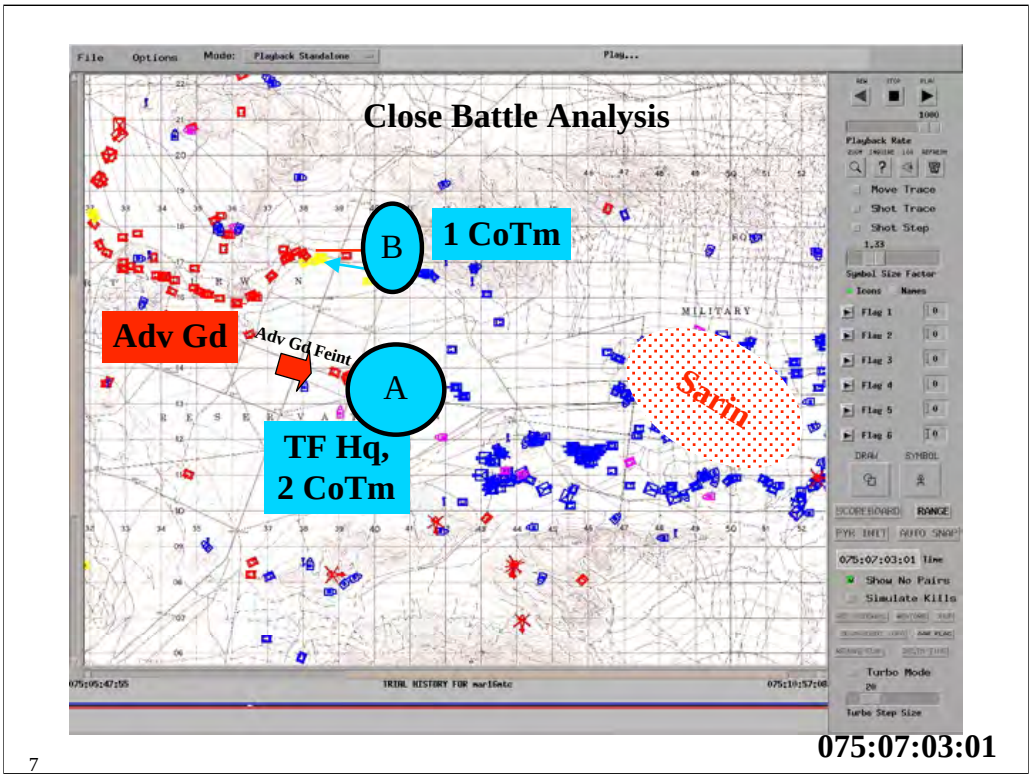


The date is March 16 (Day 075), and the time is 05:59 in the morning. Reconnaissance elements from both sides have been active throughout the night.

The bulk of Blue Force (BFOR) is off the map on the right (east); the main body of Opposing Force (OPFOR) is off the map to the left (west). Both have received orders to attack at 0600, and a meeting engagement on the ground displayed is imminent. The situation depicted shows the disposition of reconnaissance elements from both sides just prior to attacks by both sides. Blue icons show undamaged AFV of BFOR; when a BFOR AFV is hit, it turns purple. OPFOR AFV are shown in red; when an OPFOR AFV is hit it turns yellow.

The BFOR commander's plan is to advance westward with two battalion Task Forces echeloned to the right up the valley over the RACE TRACK [blue arrows 1 and 2]. The lead Task Force is to seize high ground north and south of IRON TRIANGLE, and the following TF will then attack to destroy remaining OPFOR.

OPFOR has prepared four options, the choice among them to be determined when the BFOR plan becomes clear. One of these, Plan FORK is shown: the Advance Guard is to exit Brown Pass [red arrow 1], hook northeast [red arrow 2] to control IRON TRIANGLE, and to facilitate the passage of the regiment proper in an attack along the north edge of the valley [red arrow 3].



An hour has past since the inception of the two attacks. BFOR advanced with two task forces in echelon right, and within 45 minutes the lead TF had occupied IRON TRIANGLE and the high ground to its north and south. The rate of advance was about 15 mph (0.4 kilometers per minute). The lead task force sent a team north of IRON TRIANGLE, and the TF (-) occupied high ground to the south.

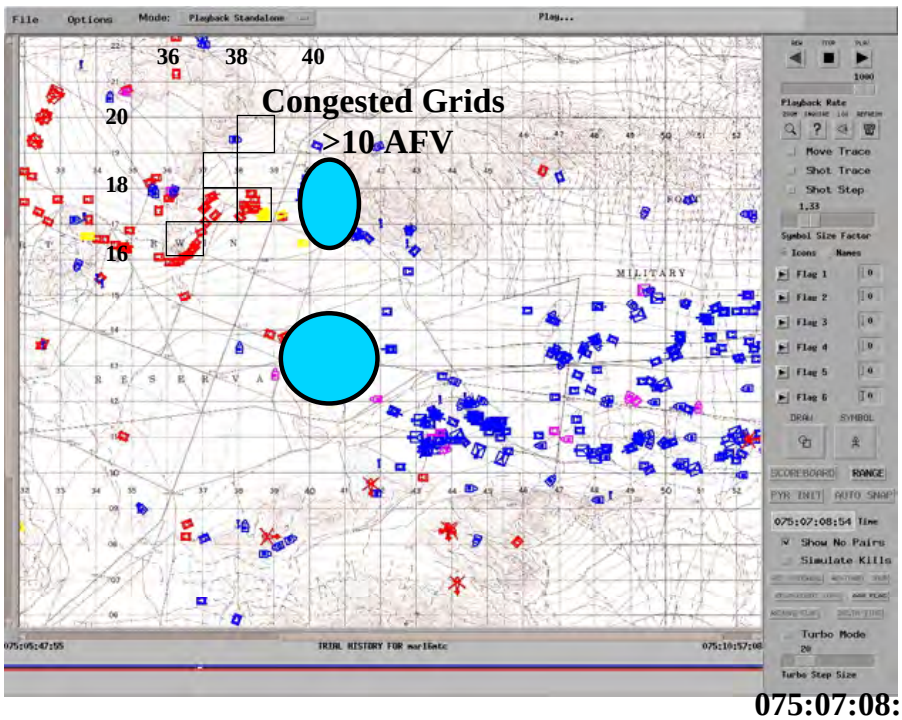
However, the following BFOR TF had difficulty in pinpointing the location of the persistent nerve agent vicinity RACE TRACK, and was both slowed and disorganized.

OPFOR exacerbated the resultant confusion by firing two volleys of FASCAM to extend the obstacle northward, and three lines of non-persistent chemical agents to the southeast of the obstacle so that the northeasterly breeze would drift the gas over forces struggling with the obstacle.

The OPFOR commander ordered his forces to execute option FORK. The screen portrays his Advance Guard entering the valley from vicinity BROWN PASS on the west. The foremost team of the Advance Guard made a diversionary attack on the BFOR elements south of IRON TRANGLE, while the remainder headed northeast per plan.

BFOR sought to deny BROWN PASS with a FASCAM volley, but OPFOR quickly moved south of the obstacle via an alternate route (BROWN CUT).

BROWN PASS and its environs might have been better defended by positioning SLUGS or ROP in the defiles, and using returns from these to cue FASCAM and loitering missiles of AFSS.



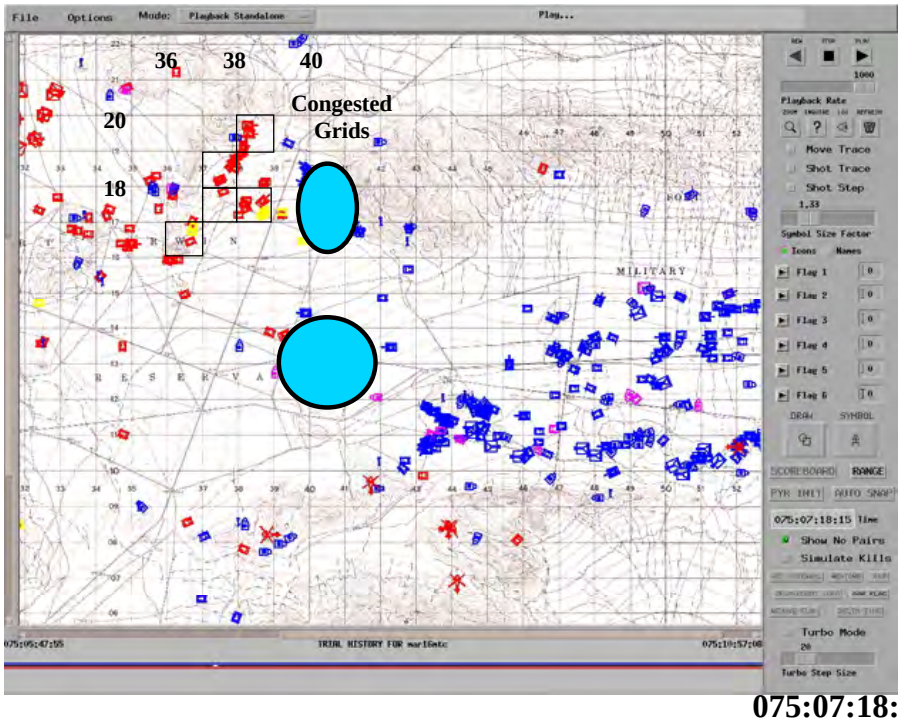
8

The OPFOR Advance Guard moved briskly, at about 30-35 mph (1 kilometer per minute). At grid 3817, OPFOR encountered a stout BFOR defense. As units in combat jockeyed for position, the OPFOR column jammed up. The OPFOR Advance Guard commander ordered his elements to move northeasterly toward the mouth of GRANITE PASS to envelop the BFOR defenders.

The screen shows several grid squares useful for assessing the locus and persistence of the target sets engendered by congestion, which was defined loosely as ten or more AFV per 1 square km. E.g., grid squares 3616 and 3817 at the time shown.

The next several screens will show how the situation developed in ten minute intervals.

The BFOR defense could have been more effective had loitering missiles been used to extend the range of the tank and BFVs. For targets within sight, but out of range, the defenders might have used their laser range finders to pinpoint targets for the missiles.

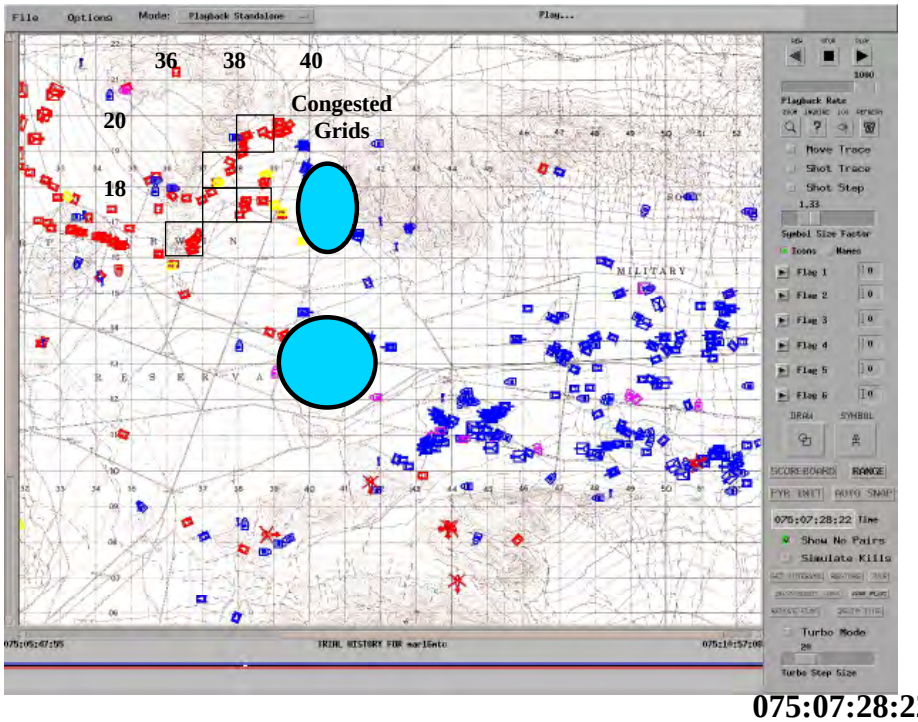


9

Ten minutes later the OPFOR flanking maneuver is well underway, and the lucrative target sets have moved to grids 3718 and 3819.

In the meantime, OPFOR was staging a series of demonstrations across the BFOR front, including an ostensible move to attack the BFOR from the south. In reality, however, the OPFOR main body was pressing at top speed toward BROWN CUT.

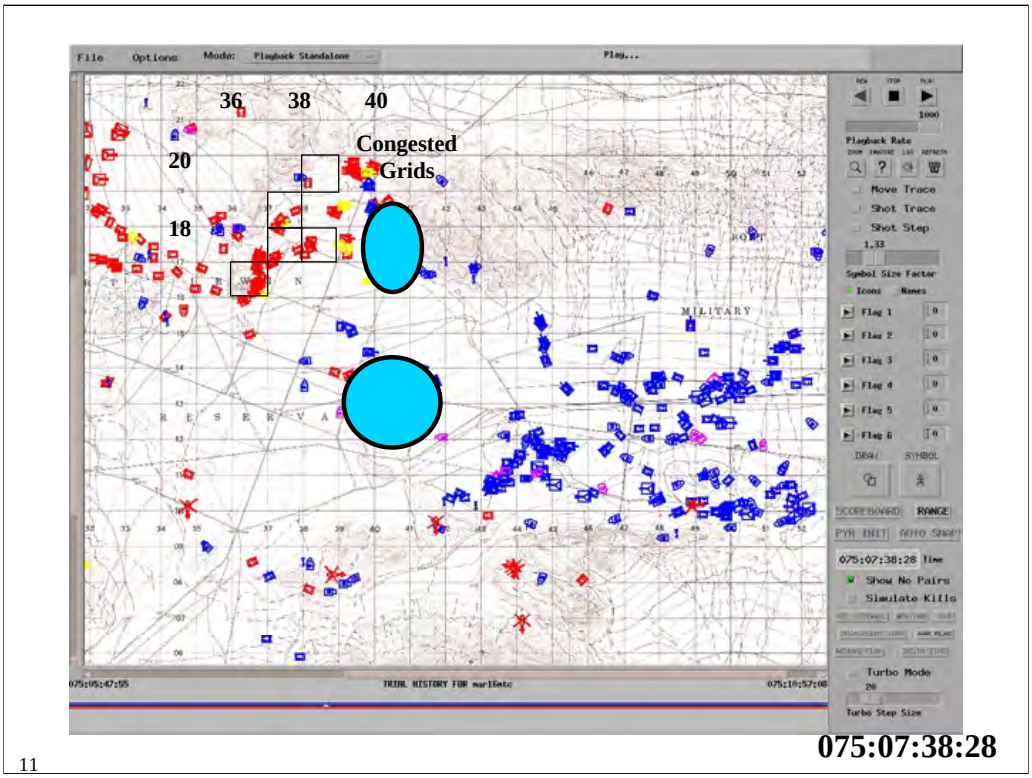
The obstacles around RACE TRACK continued to delay and to confuse the BFOR reserves.



10

Here the OPFOR Advance Guard has fixed the north flank of BFOR, and the lead elements of the main body have begun to arrive on the scene.

Loitering missiles on call of the BLUFOR armor team commander in the north could have extended the reach of his defense, enabled engagement without position-disclosing muzzle flash and blast, and exacted a heavy toll for the enemy's massing his armor on the flank.



The Advance Guard, now attacking southeasterly toward IRON TRIANGLE, has begun to roll up the BFOR flank. Arriving OPFOR units have joined the attack, and more are coming.

This, and the foregoing three charts, 7:08, 7:18, 7:28 present an interesting tactical narrative of 30 minutes of engagement by the northernmost BFOR TF. Dense target arrays had been presented, but these were usually of short duration:

Grid Square	Start	End	Persistence
3616	7:09	7:14	5 minutes
3616	7:24	7:38	14 minutes
3717	7:13	7:19	4 minutes
3817	7:09	7:19	10 minutes
3718	7:12	7:19	7 minutes
3819	7:14	7:35	21 minutes

Of the grid squares examined, 3616 had the greatest potential for targeting, for all elements of the Advance Guard and the follow-on forces passed through that single square. In the entire engagement, ten or more OPFOR AFV were in that square for the times shown, plus 40 minutes from 7:49 through 8:29 as the main body passed: an hour in all.

Planning for and control of advanced sensors will be a difficult an art as today's fires and maneuver. Careful terrain analysis could have led BFOR to position MOP at key defiles such as 3626 and 3819, conjoined with SLUGS, and supplemented as the sensor fields became active with P-MAV. Such sensors arrays could have detected the target sets of the table in locus and time.

>10 AFV Targets

Grid Square	Start	End	Persistence
3616	7:09	7:14	5 minutes
3616	7:24	7:38	14 minutes
3717	7:13	7:19	4 minutes
3817	7:09	7:19	10 minutes
3718	7:12	7:19	7 minutes
3819	7:14	7:35	21 minutes

12

No Remote Fires —artillery or air— struck enveloping OPFOR!

The Reason Why:

- **OPFOR initiative, speed, and misinformation (deception)**
- **Superior OPFOR information about terrain**
- **BLUE dependent on higher echelons for warning, targeting**
- **Slow BLUE response to calls-for-fire: > 8 min/echelon in arty**
- **Stove-piped BLUE info; integration left to higher commanders**
- **BLUE commanders in close battle unable to visualize:**
  - **— What unit does not know**
  - **— What unit can see, sense, or shoot**

13

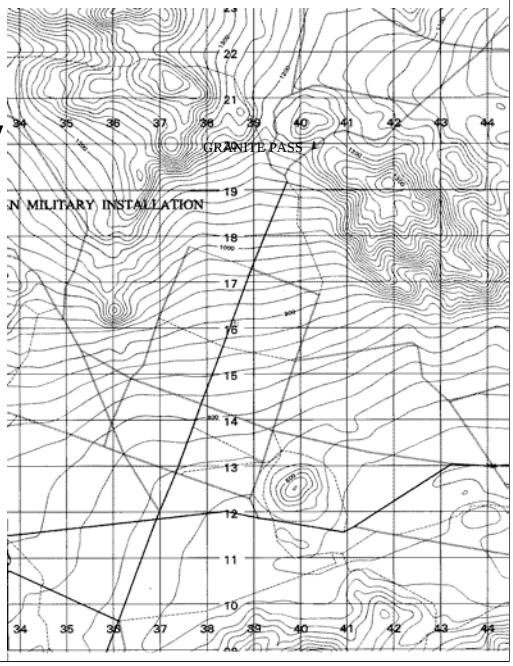
To Transform Info into Lethality:

INFO

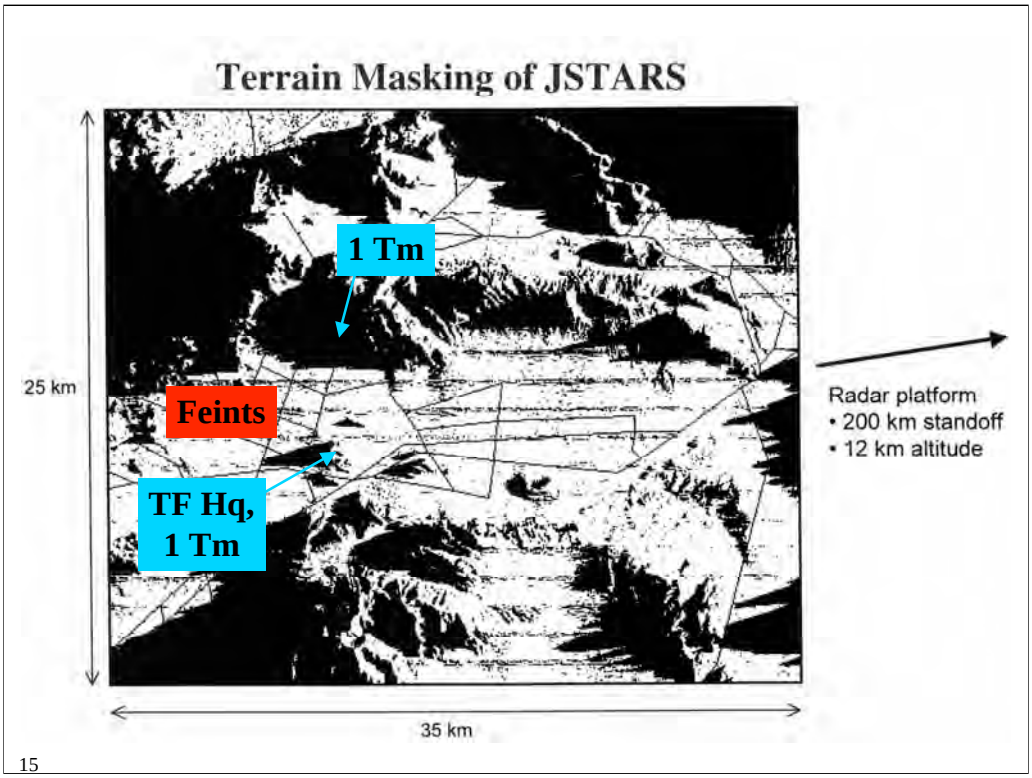
Terrain√

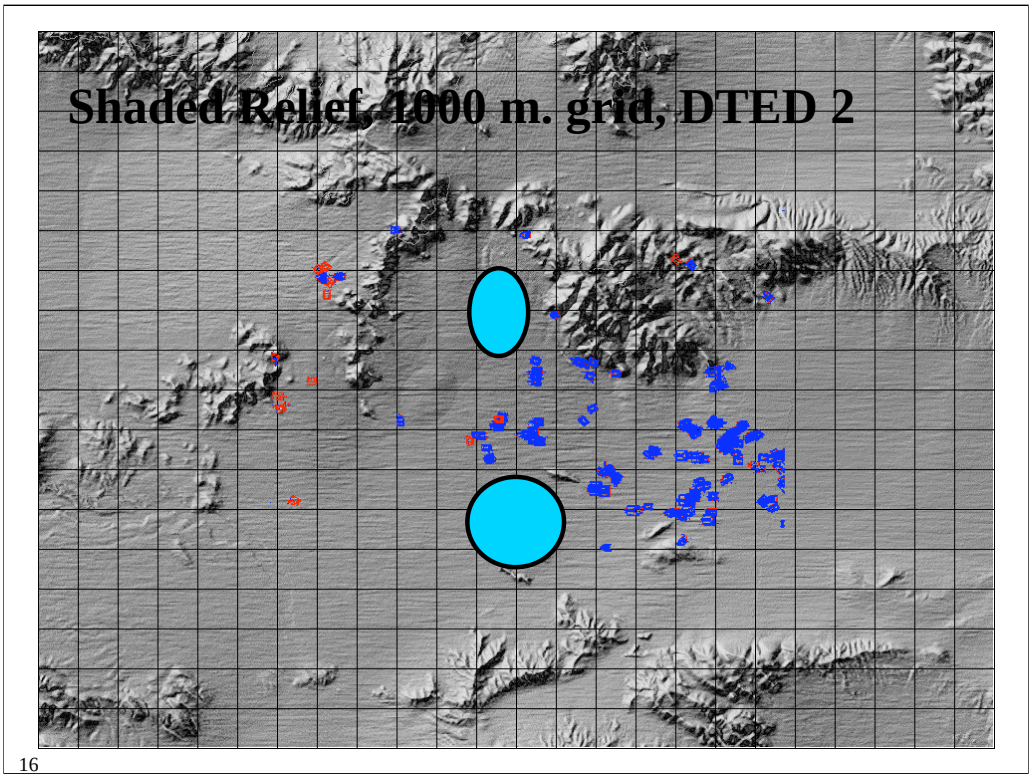
Timing

Targets

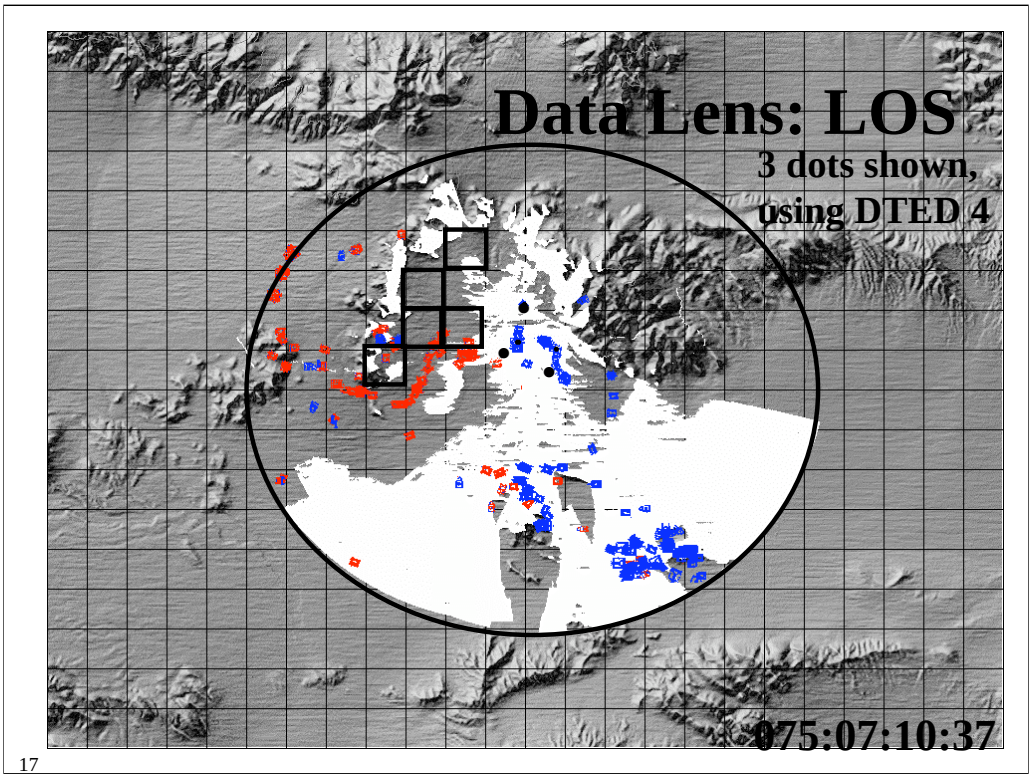


14


Terrain Masking of JSTARS
1 Tm
Feints
TF Hq,
1 Tm
25 km
35 km
Radar platform
• 200 km standoff
• 12 km altitude
15



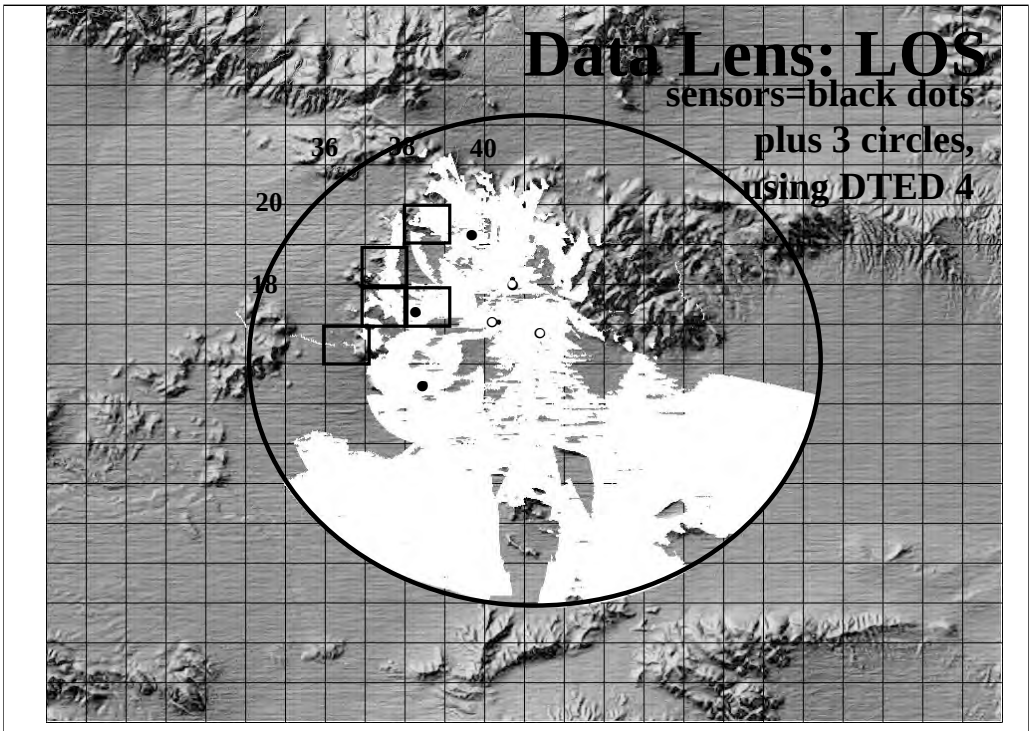
Initial laydown of forces prior to the start of the engagement. 1000 meter shaded relief on 30m DTED time 0750645



In the previous briefing I sent you,, I used an east-oriented viewshed because I knew that the attacking forces would be in the east, striving for concealment from defenders in the west. The darkly colored portions of the east-oriented viewshed depict locations that offer relatively poor visibility for targets to their east. Relying of the reflexivity of the visibility relation (if A "sees" B, then B "sees" A), we posit that there exist few locations in the east that can achieve a clear LOS to these darkly colored location. Thus, they should constitute relatively well concealed areas, given that potential observers are to their east.

Also note that these visibility analyses estimate RELATIVE visibility. A darkly colored area does not mean that the location WILL provide concealment; it does indicate that it provides better concealment than other locations within the analysis area. Absent a complete "tabletop" area, natural terrain usually offers sufficient variation to produce a range of LOS from different areas so that the relative nature of the estimate holds up pretty well.

The chart above shows the actual LOS calculation from the three points indicated by the black dots (on or near blue locations). Here, white depicts a point visible from at least one of these three observer locations (out to a range of 7KM). The shaded relief shows through in areas either out of range (beyond 7KM) or not visible from any of the three locations. Note that the visibility estimate corresponds pretty well and that red is able to exploit a masked area for the main body to advance while a smaller red force fixes blue from a visible location. Time: 075:07:10:37



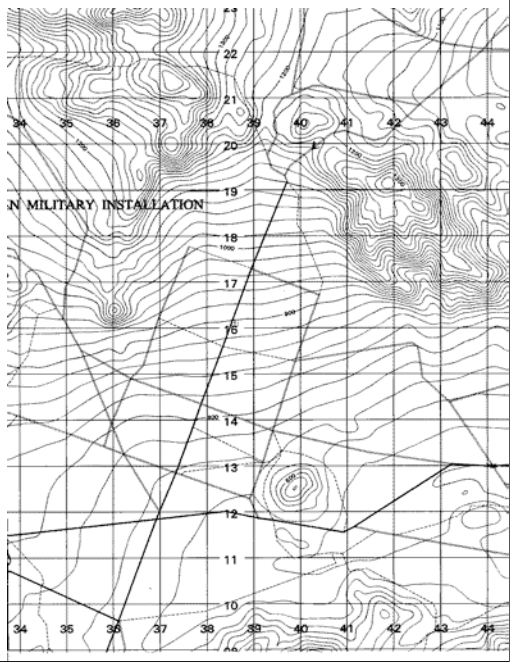
A new line-of-sight composite given that three sensors are added as new "observer" positions (as shown by the three new black dots). Visibility over the concealed approach is now greatly improved.

To Transform Info into Lethality:

Terrain

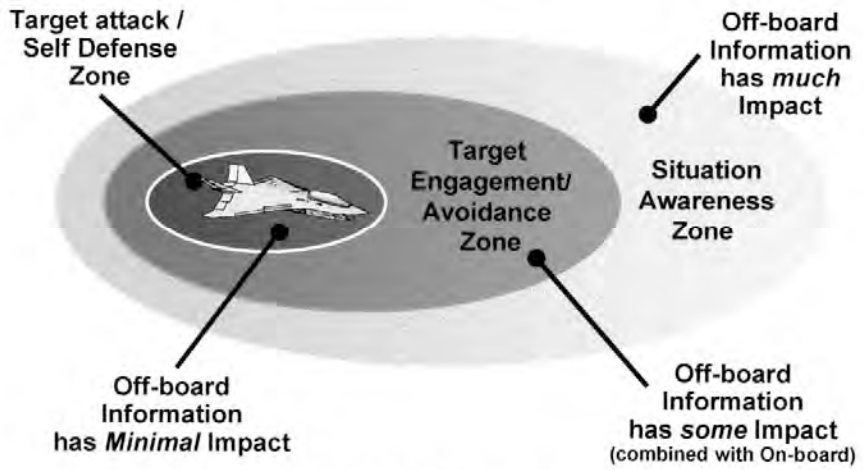
Timing√

Targets√



19

Unthinkable For Joint Strike Fighter (JSF, ca. 2008) to Fly Without Organic (on-board) Provisions for Tactical RSTA

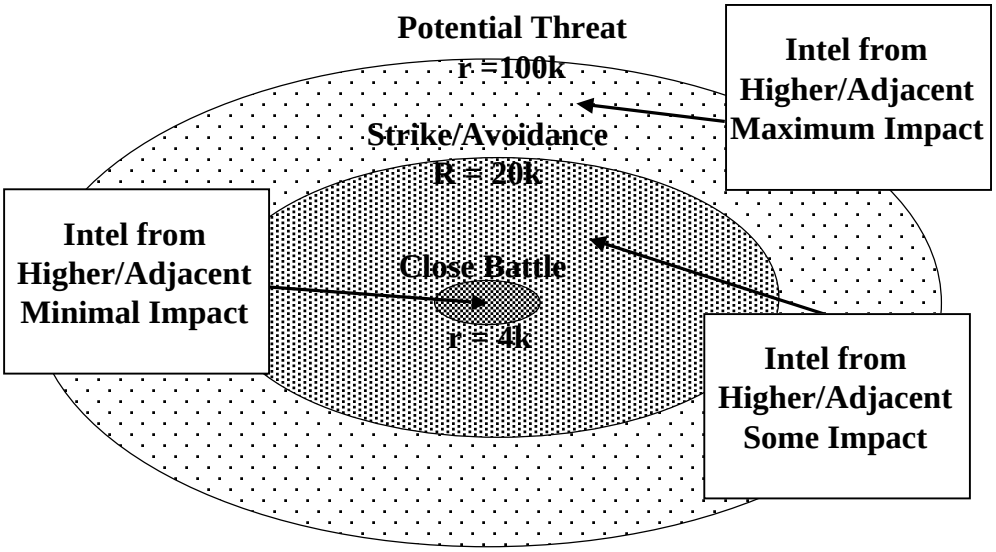


On board capability still required

Source: JSF System of Systems IPT

2

The Case For Organic RSTA

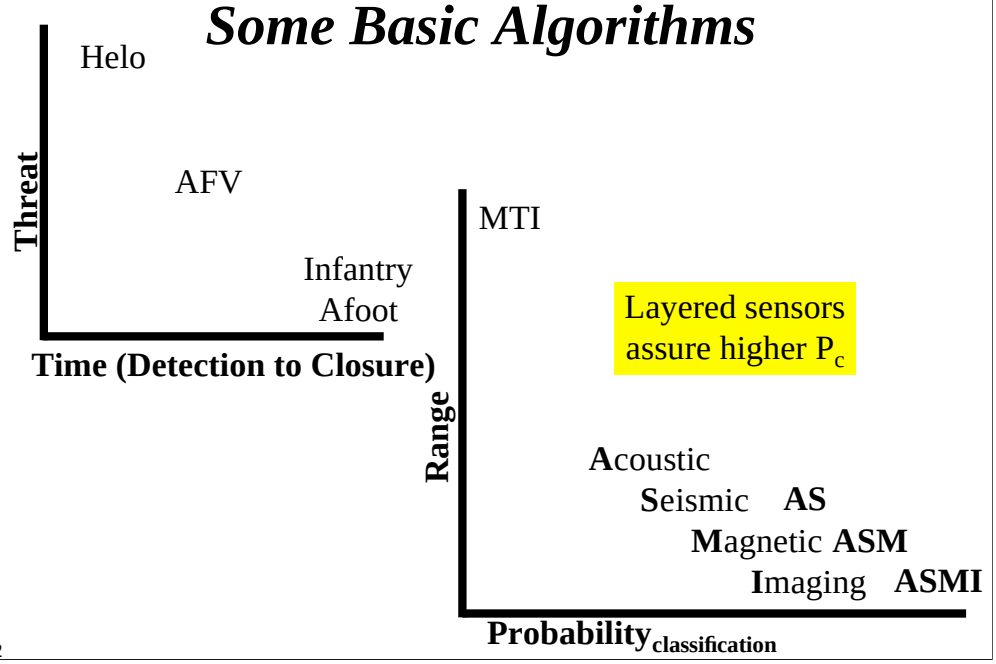


Land units have even greater need than a/c for self-protection in CB:
Threats more diverse, harder to detect
E.g., enemy afoot, in buildings, jungle

21

Sensor-Derived Info for Close Battle

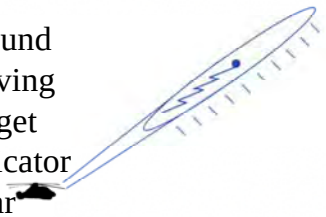
Some Basic Algorithms



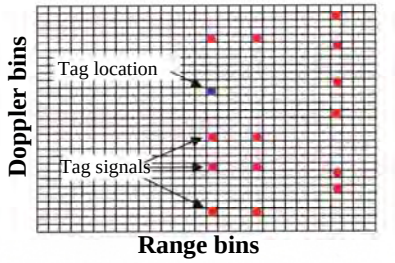
22

Digital Radio Frequency Tags (DRaFT

Ground
Moving
Target
Indicator
radar



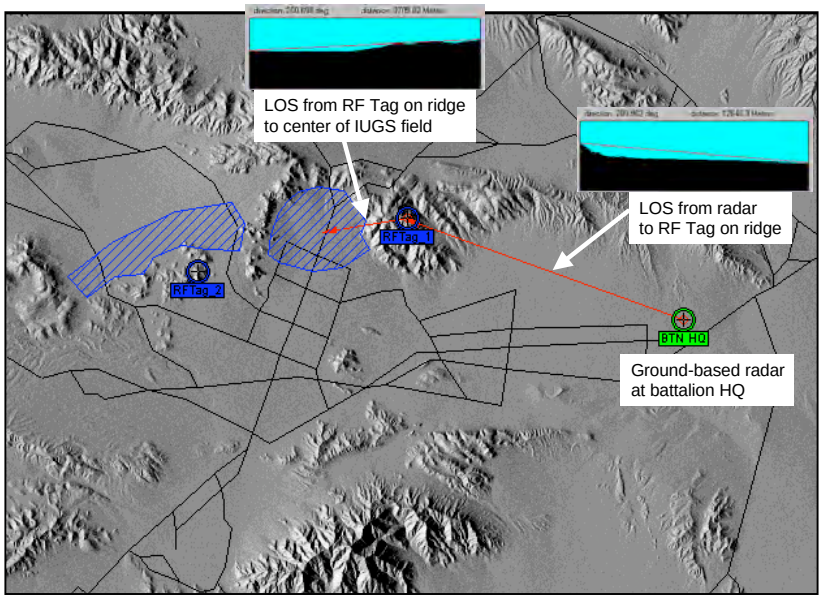
Processed GMTI Returns



- Radio transceiver
  - Activated by radar signal
  - Transmits data to radar
  - Coded into range/doppler cells
- Potentially very covert
  - Tag signal buried in clutter
- Tag uses low power
  - Uses radar energy or small battery
- Tag is small, light, cheap
- Deployable on ground, in UGS, on vehicles, or on persons

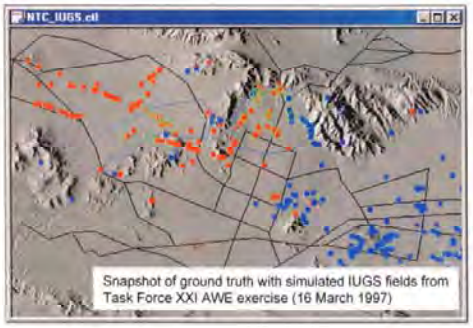
23

DRaFT and IUGS Simulated in NTC Data

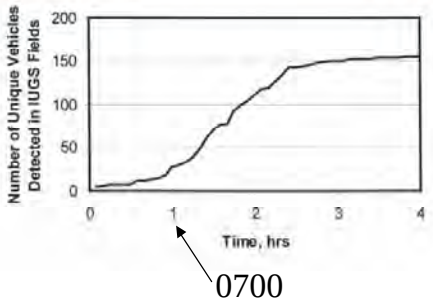


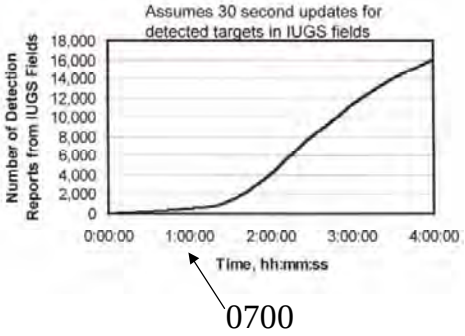
24

Gnd Radar+DRaFT+IUGS Improve Info on OPFOR



- IUGS with RF Tags linked to battalion ground-based radar(s) provide tactical awareness not available from theater-level systems
- CONOPS options include:
  - providing warning only (~100 unique Red target reports over two hours)
  - providing detailed tactical picture of the battlefield (~16,000 target updates over three hours)





25

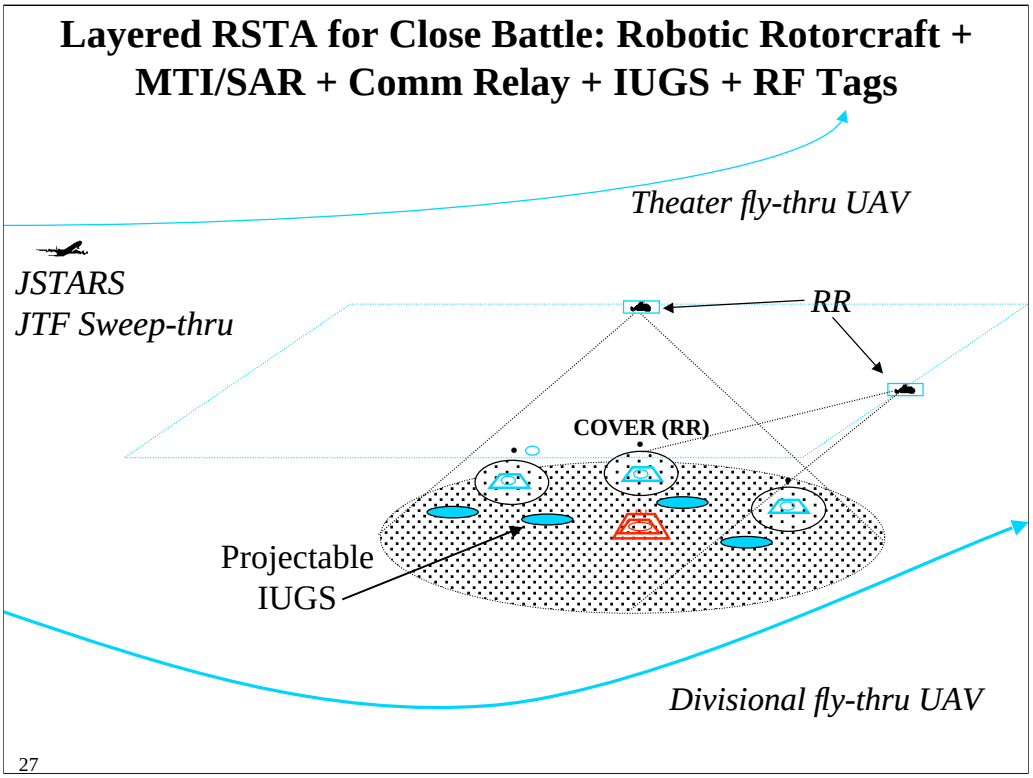
Robotic Rotorcraft
Hummingbird 160

DARPA TTO

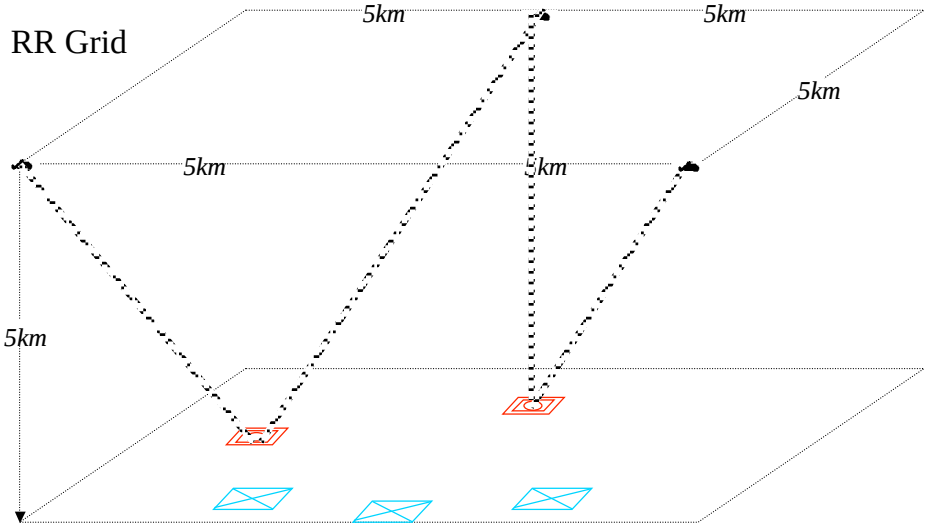
- Advanced design rotor blades (<Mach 1)
- Autonomous VTOL; GPS way-point nav
- Ceiling 30,000 feet
- Payload 200 pounds
- Endurance 48 hours
- Fuel: MilStd diesel
- Max speed: 70 knots

configuration
competition
sensitive

26


Layered RSTA for Close Battle: Robotic Rotorcraft + MTI/SAR + Comm Relay + IUGS + RF Tags
Theater fly-thru UAV
JSTARS
JTF Sweep-thru
RR
COVER (RR)
Projectable
IUGS
Divisional fly-thru UAV
27

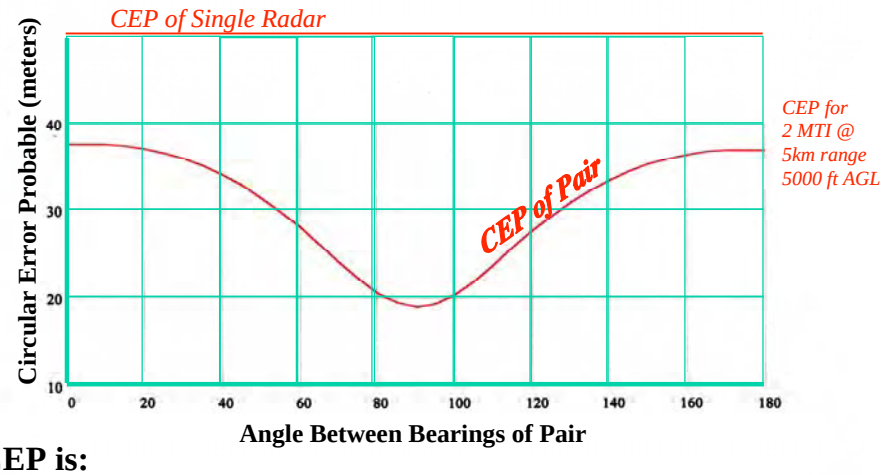
Collaborating Tactical MTI/SAR/Comm Relay on Robotic Rotorcraft (RR)



High P_D , P_C for non-cooperative targets

28

Accuracy of Collaborating Pair of MTI



- **CEP is:**
  - **a. ~ independent of altitude; at max range < 25 meters**
  - **b. reduced ~ .7 by flying pairs in parallel**
  - **c. reduced ~.5 to ~.25 as ∠ bearings approaches 90°**
  - **d. less if GPS/INS error is offset by benchmark DRaFT**

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Circular Error Probable (CEP) in meters*

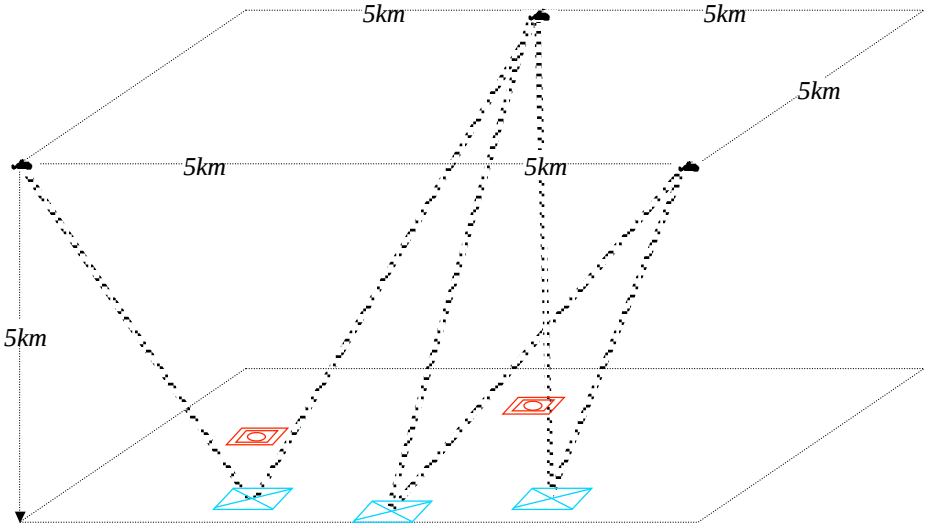
Robotic Rotorcraft W/MTI	Angle of Bearing Between RR/MTI	MTI Range (Kilometers)		
		5	10	15
single	n/a	52	96	142
pair	0^o	38	72	100
pair	90^o	18	20	25

CECOM data

* includes GPS/INS errors

30

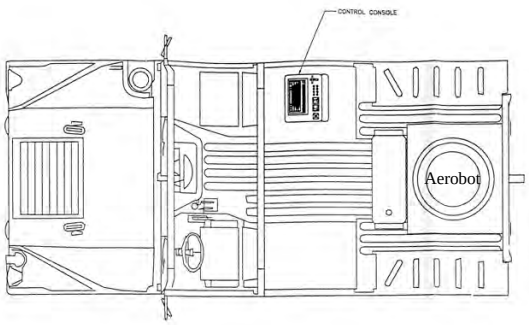
Collaborating Tactical MTI/SAR/Comm Relay on Robotic Rotorcraft (RR)

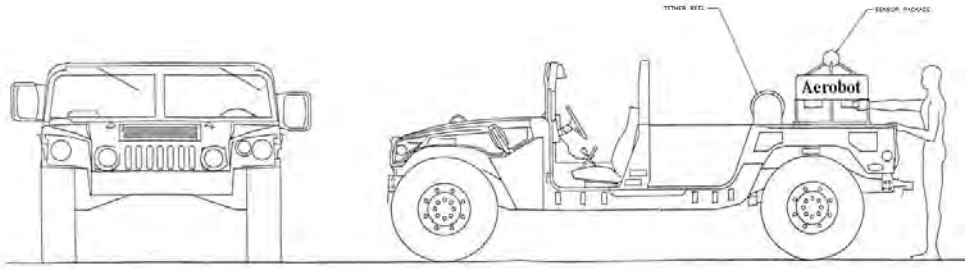


Precise Locus and Track of Cooperative (RF tagged) Targets

31

C O V E R
Commander's Vehicle
For
Elevated Reconnaissance
Tethered Robotic Rotorcraft
30" diamX45" high
30 lbs gross
15 lbs 45 MHz MTI
Max. alt. 300 ft.





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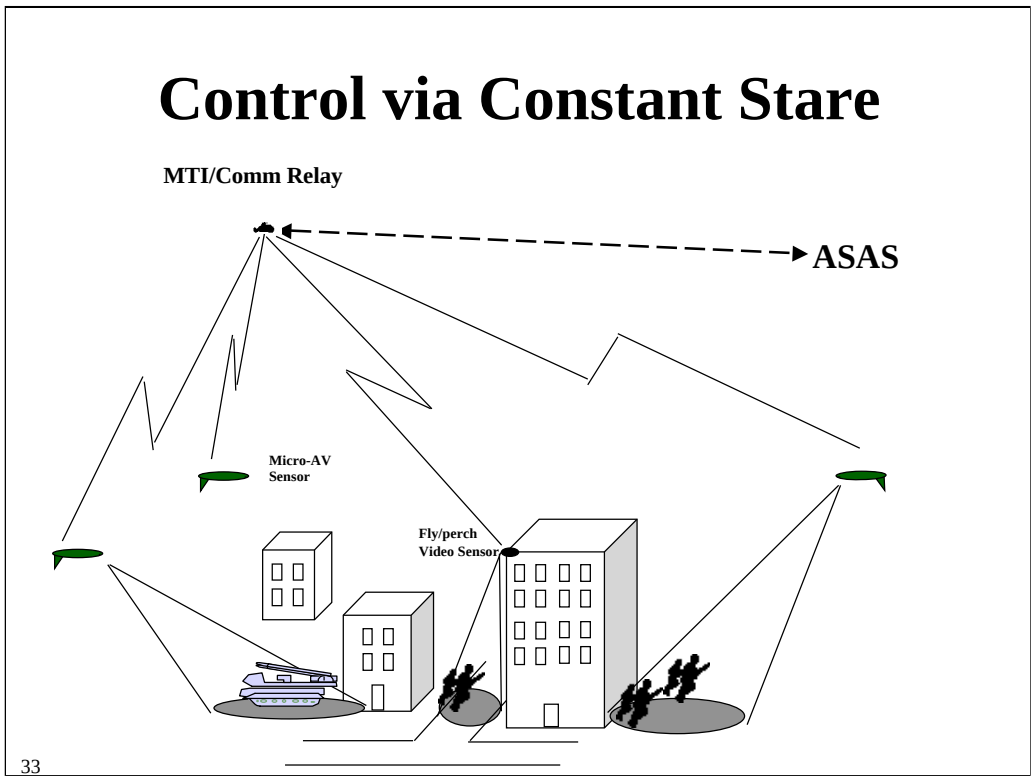
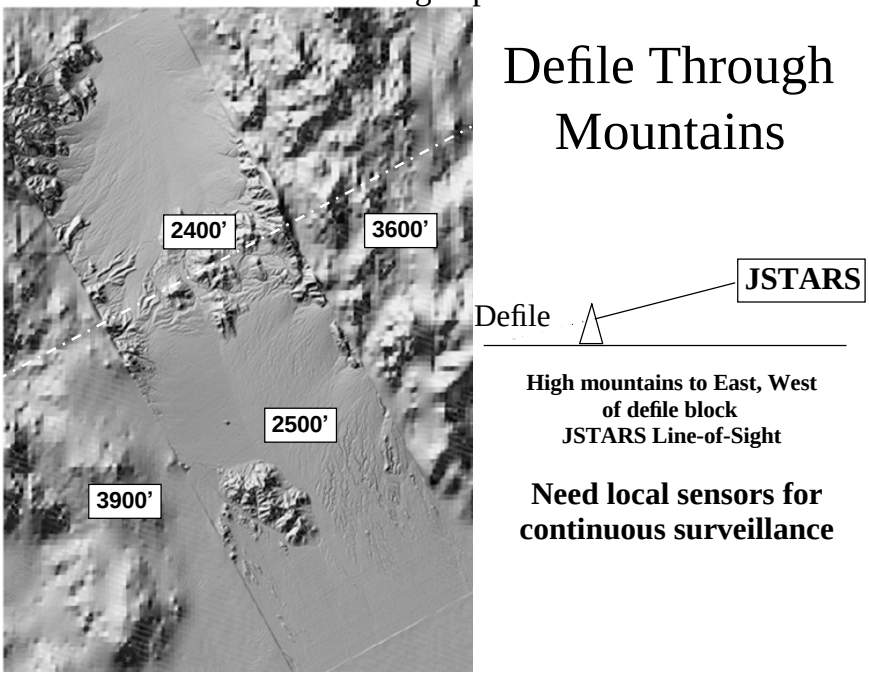


At present almost all unmanned aerial vehicles fly point-to-point missions, collecting information on a large amount of terrain that they overfly. But there is another concept of UAVs: fixed position over an area of special interest so that continuous surveillance is maintained. Data from this "constant stare" could then be processed using change detection techniques, automatically alerting the user to activity in the area of interest, and facilitating its identification. Micro Air Vehicles may be particularly well suited for such missions. In the cartoon, an urban scene is depicted, and a swarm of MAV have been posted to observe the comings and goings of specific buildings. But a similar swarm of MAVs might be used to observe defiles between mountains, as well as streets between buildings. It is thus that we will use them in the forthcoming experimental scenario.



Defile Through Mountains

High mountains to East, West of defile block JSTARS Line-of-Sight

Need local sensors for continuous surveillance

The schematic to the left makes the point that JSTARS, even with a 9 second revisit time, might not be able to see into a defile if it is at a modest standoff distance. Hence, other sensors will be needed to conduct supplementary, continuous surveillance for situational awareness. Micro Air Vehicles could perform such a mission.

from Layered Tactical RSTA

- Range and azimuth accuracy (*f* MTI collaboration*)*
- Tracking via constant stare
- Blue SA and assured info superiority
- Sensor-decider-shooter linkages
- IFF and classification of non-mil entities
- Blue lethality and survivability
- Tactical internet reliability (e.g., FBCB2)
- Option for low-cost, commercial tele-comms

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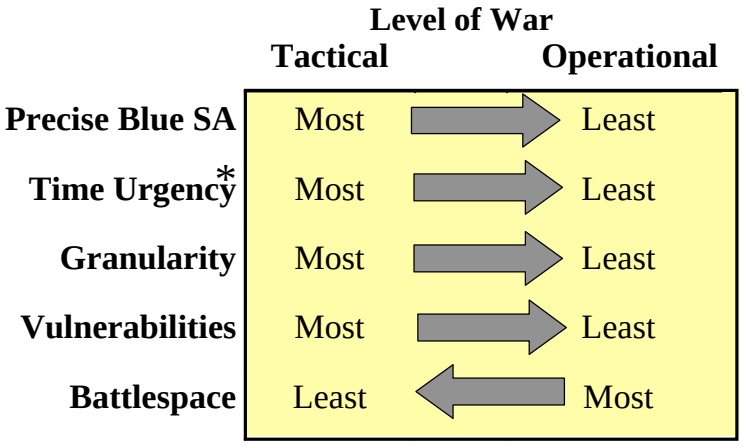
Information Requirements



∗ Time urgency for **air** forces is greatest at the operational level

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This diagram highlights some of the key differences.

"Blue SA" (situational awareness) refers to the precision with which friendly elements may be located by tactical decision makers.

"Time Urgency"refers to the control of maneuvering land forces, including rotary wing aviation. (Time urgencies for control of fixed wing aviation and missiles is greatest at the operational level.

"Granularity" refers to the numbers of entities under control and to the details of the environment that must figure in tactical decisions for land forces: terrain, the works of man thereon, and the resident population and their chattel.

"Vulnerabilities" refers to the relative lethality of the zone of tactical operations on land, where, in general, more enemy weapons bear, and most friendly casualties occur.

"Battlespace" refers to the area of land control over which is at issue between the antagonists, and to the airspace over it.

Information for Land* Forces

Priority	Tactical Level*	Operational Level#
1	Blue SA	Red SA
2	Maneuver Visual topograph e.g., 1:50,000 UTM	Operations Visual Joint Opns Graphic e.g.,1:250,000 lat/long
3	Control of artillery and missiles	Control of attack air and air defenses
4	Red SA	Blue SA
5	CSS	TPFDL, CSS

*** Observed in TES**
 # Observed in CPXs

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The five priorities listed for the tactical level of war were derived by IDA observations of mock combat at the National training Center, Fort Irwin, CA.

Those listed for the operational level were derived from conversations with experience senior officers, but have not been otherwise verified.

"CSS" is combat service support: logistics, personnel, medical, etc.

"TPFDL" refers to the time-phased force deployment list, the planning document that governs overseas force projection.

What Does the Commander Require for Close Battle?

A fused, real-time, true representation of the battlespace — an ability to order, respond and coordinate horizontally and vertically to the degree necessary to prosecute his mission in the battlespace.

Gen. John Shalikashvili, CJCS, 1997

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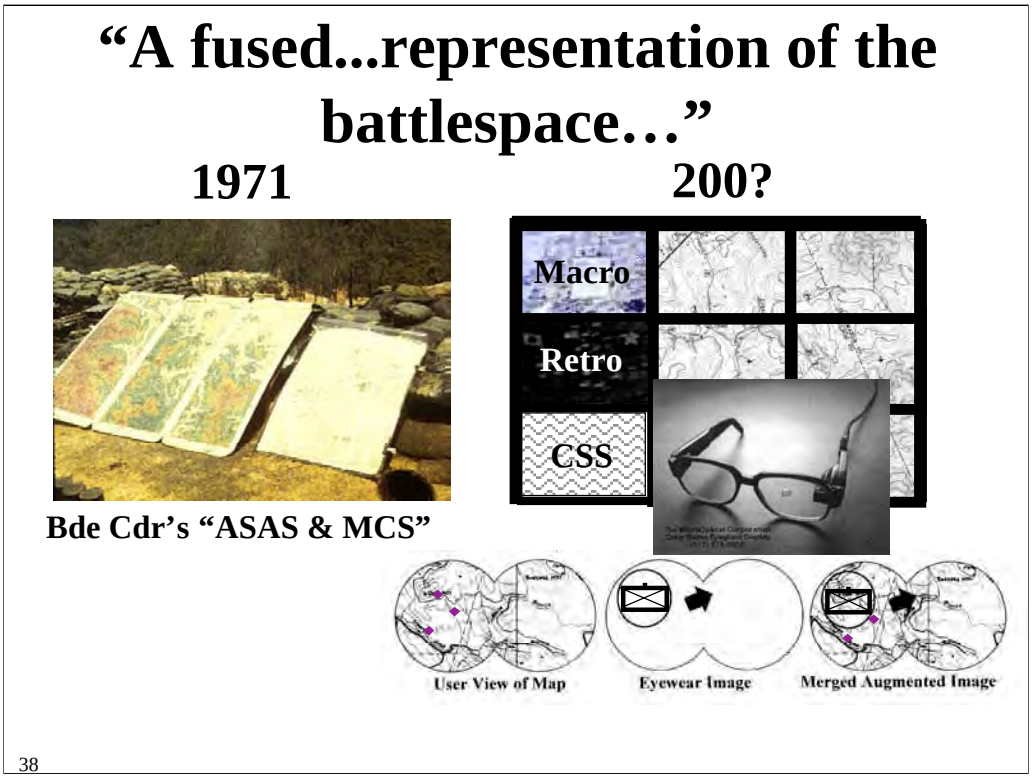
The visualization of the scheme of maneuver, as FM 100-5 points out, is "the central expression of the commander's concept for close operations. The scheme of maneuver—

- Outlines the movements of the force.
- Identifies objectives or areas to be retained.
- Assigns responsibilities for zones, sectors,or areas.
- Prescribes formations or dispositions when necessary.

Identifies maneuver options which may develop during an operation.

The commander's scheme of maneuver usually determines the subsequent allocation of forces and governs the design of supporting plans and annexes. Fires, barriers, air defense priorities, electronic warfare (EW), deception efforts,combat support, and combat service support (CSS) arrangements are normally guided by and coordinated with the scheme of maneuver…"



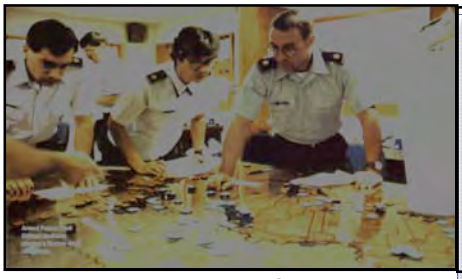
On the left are two portable command support devices used by the commander of 1st Brigade, 101st Airborne Division, in northern I Corps, RVN, 1971. Both are designed to be carried about the battlefield, on a helicopter, or in a jeep, or on foot.

On the left of the 1971 picture is a three panel, aluminum-backed stack of acetate overlays atop a color-contoured tactical map (1:50,000). The overlays recorded past activity of the enemy as observed by various sensors and units. This retrospective was inherently valuable in dealing with an enemy that operated in a fashion inverse to U.S. procedure: the North Vietnamese inserted their logistic infrastructure into the battlespace first, over a period of months, perhaps years, and introduced combat troops only when all was in readiness to support them. By tracking records of sightings and findings, it was possible to anticipate where they were planning to strike, and in what strength.

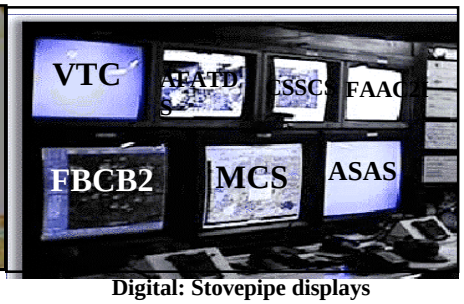
On the right of the 1971 picture is a comparable single-panel map and overlay showing the current position of all friendly forces in the same area —U.S. and allied— plus all operations planned for the day: fires and maneuver. These are described as being precursors for today's computerized All Source Analysis System (ASAS) and Maneuver Control System(MCS).

The 200? Picture depicts a segmented display for visualizing the scheme of maneuver and fires, designed to be used with a set of glasses capable of providing a "data lens," that is enabling the viewer to interrogate an icon on the map and see what it is in detail (depicted is an example of a purple diamond-shaped icon that the data lens interprets as a rifle company moving NNE.

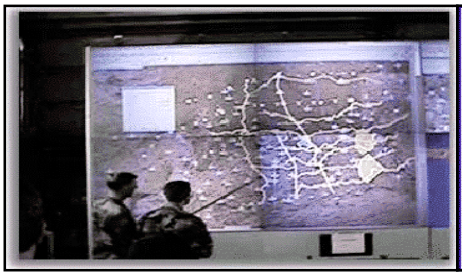
State of the Art in C2



Analog: Map tables, walls, floors, sand tables



Digital: Stovepipe displays



In development: giant displays, hordes of manned workstations, bigger TOCs

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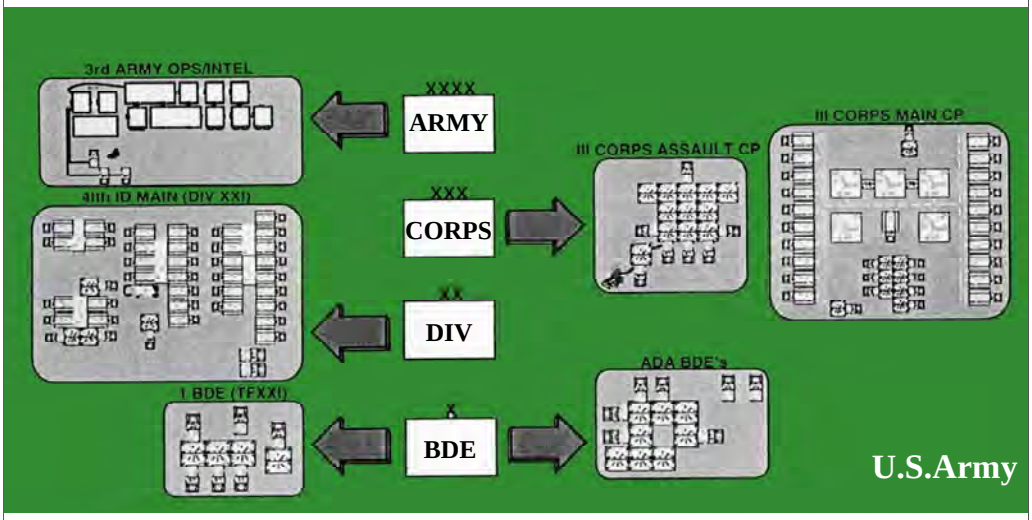
Say what's hard

State-of-the-Art
Tactical Operations Centers



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The Army is spending hundreds of millions of dollars on standardized Tactical Operations Centers that consist of vehicles and canvas shelters erected over and between vehicles, equipped with large numbers of computers, and powered by many generators.

Such facilities are potentially vulnerable, and will be discussed in the following charts.

Measures for C3 Survivability

- Large “Operations Centers” present distinctive images and are also broad spectrum emitters
  - Multi-spectral imagery commercially available
  - Pattern tracing or “tracking” can pinpoint even a well hidden TOC
  - TBM or MLRS-type weapons are obtainable
  - Infiltrators/terrorists are “low tech” attack option
- Therefore, modularize to enable use in buildings, cellars, caves, and minimize to prevent tracking
- Also minimize manning: TOC signature ~ *f* (numbers of people)

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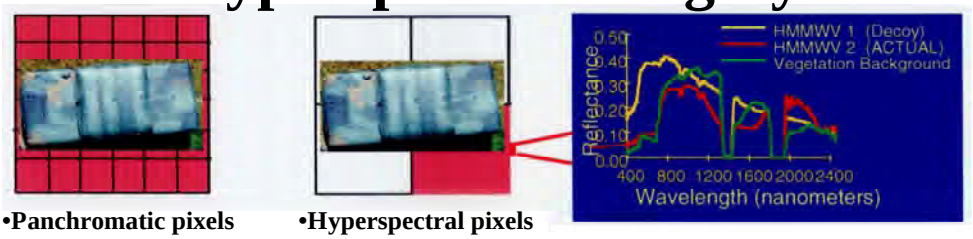
The next chart will discuss multi-spectral imagery.

Radar tracks of attendees at TOC briefings flag the general location, and ELINT can pinpoint a TOC.

Even relatively small adversaries can obtain first class intelligence and lethal weapons.

Hence, enable CPOF to spread out, and to function with fewer persons

Hyperspectral Imagery



•Panchromatic pixels
One HMMWV
• One pixel to detect
• 24 pixels to classify

•Hyperspectral pixels
•Spectral signature of HMMWV in one pixel
• Detects, classifies, and identifies material

• Spectral signature of HMMWV
• Compared with decoy, background
• Amenable to automation

- **Not yet perfected, but technology moving rapidly toward high probability of detection (P_d), low false alarm rate (P_{fa})**
- **Can be on aircraft as well as space craft**
- **Commercial: U.S., Germany, Australia, Japan, France, ROK, Russia, India, China, Brazil, Taiwan**

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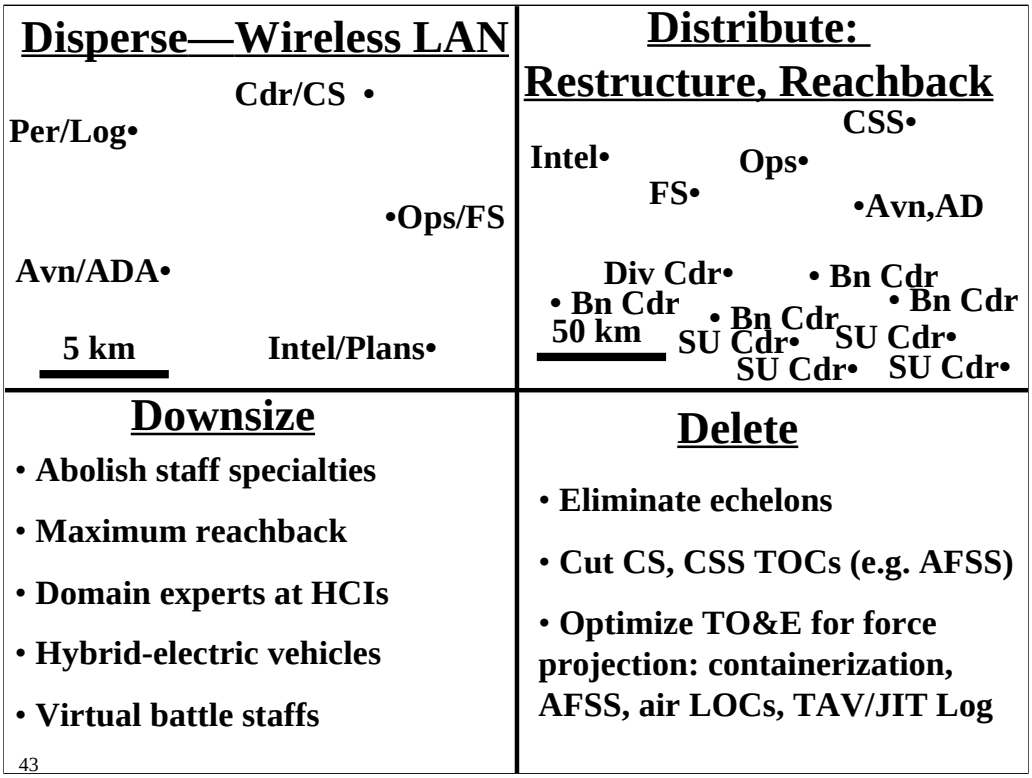
Hyperspectral imagery takes less expensive collectors, and processing of the imagery will eventually be automated.

While not a threat in 1999, it seems certain to be available to adversaries in 2009.



Here are four approaches to reducing vulnerability.

"Dispersal" entails spreading a Tactical Operations Center over a larger area to make the components easier to hide and harder to find. Dispersal requires some sort of broad-band wireless LAN. As the experiments described in the paper A Command Post is Not A Place showed, digitization is not a prerequisite for dispersal, and virtually any TOC can (and should) be dispersed. In a dispersed TOC, briefings are on demand, and all staff sections can "eavesdrop" on the transactions between the division and brigade commanders.

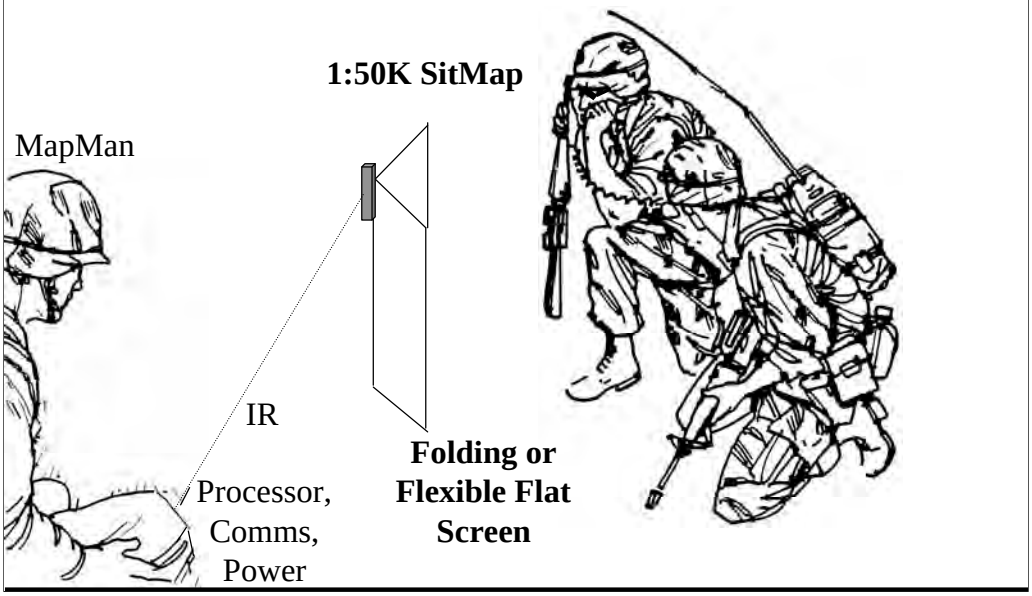
The question obtrudes whether dispersal is dysfunctional for teamwork, depriving staff members of contact with others, and denying them periodic updates on unit operations. After Action reviews of all exercises during the experiments established that the technologies adopted actually improved teamwork, broadened contacts, and improved staff understanding of both the commander's intent and the division's performance.

"Distribution" is dispersal over longer distances, plus reorganization to eliminate unit TOCs altogether. This configuration allows commanders to operate forward supported by functional staff groups to the rear. The latter can each include a personal representative of supported commander. If reliable, robust and fast communications are provided, this arrangement could potentially facilitate networking.

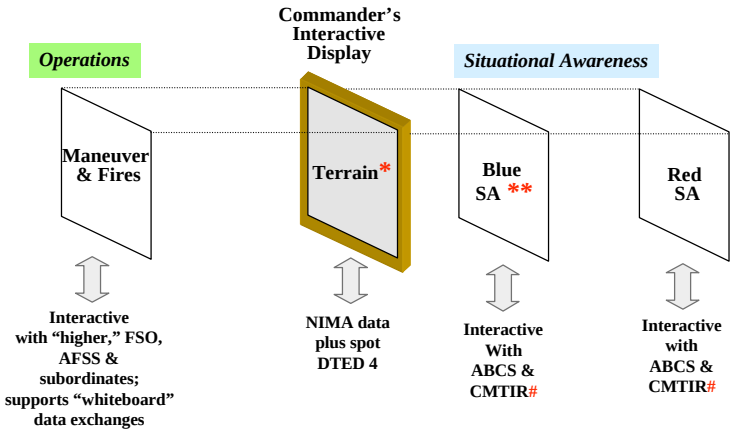
"Downsizing" entails personnel policies that reflect the information age, and are aimed at minimum manning of whatever C^2 architecture may be adopted.

"Delete"means to introduce technology that obviates the need for certain TOCs, particularly those that now perform CS and CSS functions that can be automated.

"FBCB2" for Close Combat Afoot?



Information Tailored by the Decision Maker



Foreground: Display control & input by commander & subordinates

Background: Automatic input

 # Options: portrays see, sense, shoot

** Includes all engineer and NBC obstacles*

*** Iconographic personnel and logistics status*

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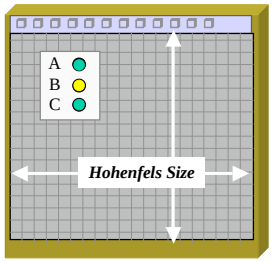
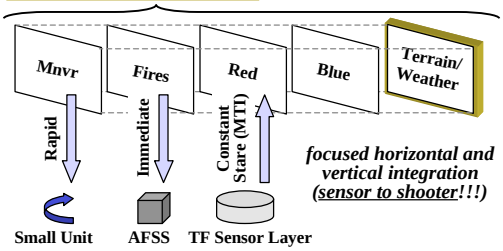
Technical Potential:
Commander's Interactive Display (CID)

Radical innovation in C4 for close battle untethered, distributed, responsive

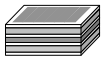


- **20 x 18 km @ 1:50,000 (variable)**
- **17 x 16 x 1 in @ ± 7.5 lbs (less wt if internal components off loaded onto cmdr's belt pack or RTO backpack)**
- **Stylus (Icon selection & drawing) and voice Input**

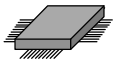


focused horizontal and vertical integration (sensor to shooter!!!)

Emerging Enabling Technologies



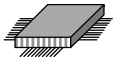
•Triple Stack Reflective Cholesteric Liquid Crystal Displays ?
- **Zero power images (no refresh)**
- **High resolution-full color**
- **Plastic substrate**



Tunneling Magnetic Junction Random Access Memory ?
- **Retains stored data when shut down**
- **Ultra-fast; starts instantly**
- **Consumes very little power**

•Fuel Cell ?
- **Operates 16 to 32 times longer than batteries**
- **Non-polluting**

•Contrawound Helical Toroidal Antenna (CHTA)?
- **2 MHz to more than 2 GHz**
- **3 inch dia, 1/2 inch tall**
- **300% greater range**

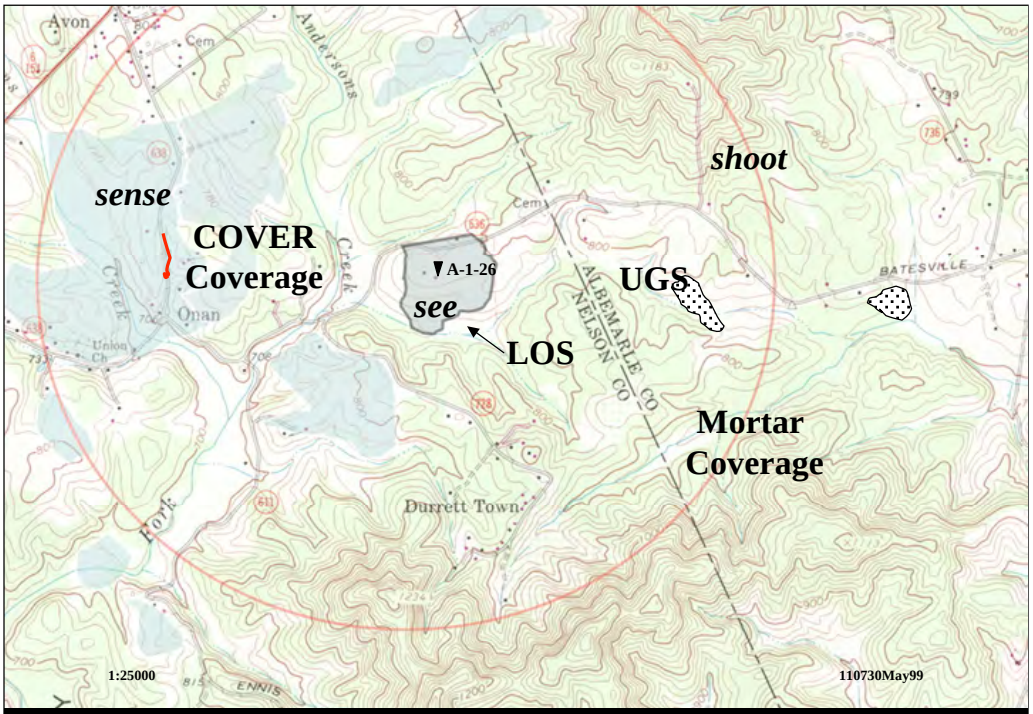


•Sony PSX Processor ?
- **128 bit; order of magnitude beyond existing LSI Logic chip**

•SUO SAS Radio?

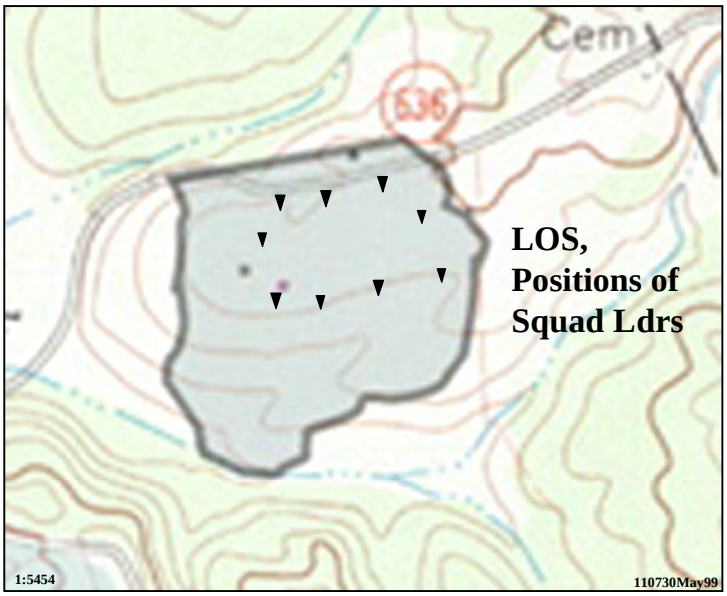
Not to scale

•Other???



Terrain Display with Automated Terrain Analysis

Automated Display Disaggregated to Squad



Locus + See + Sense + Shoot

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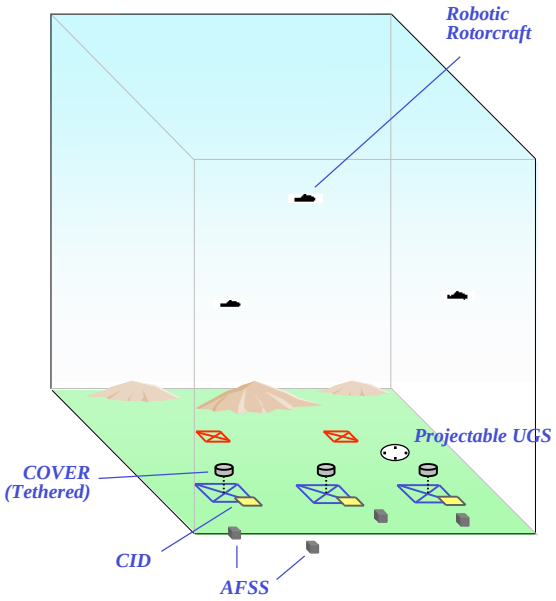
Close Battle Integration System (CBIS)

- Blue SA: locate, track, identify, and access status of U.S combatants in zone
- Red SA: locate, track, classify enemy forces, building all-source file on each
- Locate and interpret reports from UGS and mines
- Map and display SA as individuals or units showing locus or center of mass, or portray “see, sense, shoot”
- Collect spot DTED 4, prepare and present automated terrain analyses
- Target and synchronize AFSS, manage target deconfliction, post strike assessment, and re-supply
- Enable broad-band comms with over-head comm relay
- Support force-on-force training and operational rehearsal, with AAR



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