Variants of Military Communications

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ABSTRACT

In present world as the methods of warfare is changing along with it communications are also changing to stay in contact with the military units fighting scattered all over the world. In this paper we will discuss the different possibilities for military communications and their pros and cons in war or war-like environment.

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Keywords :

1) INTRODUCTION

If we study the history of conflicts we will see that in early days emphasis was made on the number of soldiers in an army, larger the army more effectively they will strike fear in the hearts of their enemy and in-turn will have an increased chances of victory. As the time progressed communications become the most integral part of military. Initially in tribal environment the drums were used to convey message to allies, this communication was later altered by using fire beacons at the top of mountains or elevated positions to send messages to longer distances, slowly the evolution of communication for military purpose increased and usage of semaphore flags were used to transmit encoded messages.

Today's warfare has come a long way, now large armies are not used to invade countries rather precise and accurate attacks are carried out to paralyze one's opponent, for precise and accurate attack a system of highly sophisticated communications are needed through which pin point co-ordinates and location can be sent to army, navy and air force. In this paper we will discuss several possible methods that can be used in different military environments.

2) MILITARY COMMUNICATIONS USING CELLULAR NETWORKS

Cellular Networks are growing day-by-day first from 1G to 2G and now we are using 3G and 4G technologies. The use of military communications using cellular networks can be in an environment where we have to fight terrorism or militancy, its practical use can be in countries like Iraq and Afghanistan, specially in Iraq where the government is supportive of invading army, here the inherent cellular network of the country can be used to offload low priority and low bandwidth data by using IPSEC layer to improve security (Robertto,2002). One of the advantage of using civilian network is that we can start communications very quickly in hostile environment (Where government is supportive but not the people) example Iraq and Afghanistan. This whole process is also fruitful for that country economically because the invading army will pay them for using their resources (like America paid Pakistan for using its airfields to attack Afghanistan). This concept of introducing IPSEC layer to deploy low priority data is also useful for fighting terrorism in one's own country, military can use it to hide low bandwidth and low priority data from rogue militia like that are present in Northern parts of Waziristan in Pakistan. Cellular concept is evolving and from 2.5G and 3G we are now moving towards 4G even in third world countries like Pakistan 4G services are now surfacing. One of the advantages of using 4G is "Increase number of user's in a cell". According to (Bauer) improved cellular range and capacity supported by wi-fi and wimax network is vision of 4G, this concept of 4G can be blended with Digital video Broadcasting (DVB) which is a global standard for delivering digital TV services (dvb.org) by using DVB with 4G important information like maps, Satellite pictures and solution to the problems related to strategy and tactics can be sent battle fronts. There is also an alternative of wi-max called wiBro (wireless Broadband) which can offer mobility of 60KM/hr up to 1KM (wibro.or.kr), beside that there is 802.16e (Mobile wimax) and 802.20, 802.16e adds concept of vehicular mobility (ieee802.org/16/tge/) and 802.20 talks about network access from high speed trains both of these are useful as they can be used in fast moving commando actions.

3) MILITARY COMMUNICATIONS USING COMMERCIAL SATELLITES

Satellites have proved themselves over a period of time; they were used in desert storm (Iraq) in Cuba missile crisis in Vietnam and still it is the most formidable way of communications for military. One of the advantages of using satellite is availability of very high data rates ranging from 64Kbps to 90,000Kbps this massive range can accommodate almost all types of data from voice to video, by using satellite a military is totally dependant on itself and jamming of satellite communications is almost impossible the reason is that each satellite transmits signals using two frequencies both using L-band these frequencies are designated as L1(1575.42Mhz) and L2(1227.60Mhz)(Huan,2002), each satellite also transmits two types of modulation one is coarse acquisition (C/A) code which is fully predictable by anyone who has read open signal specification., from C/A a more accurate code named P(Y) can be obtained. C/A is transmitted on L1 frequency where as P(Y) uses both L1 and L2 frequencies (Jay.R.Skla). Military GPS receiver uses C/A codes before switching to P(Y) code and as long as a satellite is working on C/A code it is in danger of getting jammed by the presence of C/A code Jammers. (O.Hoering,1999) talks about portable trailer mounted ground station which can be utilize by military the advantage of such such ground station is that they can be easily moved from one location to another.

4) HIGH ALTITUDE PLATFORMS FOR MILITARY COMMUNICATIONS

High altitude platforms are either airships or airplanes they fly somewhere in the region of 20KM altitude, they can be unmanned or solar powered they can have an advantage in military operations because they can be deployed rapidly and their re-configuration is easy as compared to satellite. An added feature of using HAPS for tactical military communications is that the user terminal needs only to transmit with very modest power due to the close range of the HAP. This in turn yield significantly lower probability of interception (and LPE-probability of exploitation) than achievable with Satcoms (Tim.Tozer.If long duration communication needs to be done then in that case airships(balloons) can be used such vehicles will operate in stratosphere for long duration and keep sending the surveillance information to ground stations. Another option that can be used is that of unmanned aircraft that can also use solar energy for power they can be much faster but not as long lasting as airships such aircraft will need to land from time to time for maintenance. Some of the examples of UAVs are Hermes 450, Eagle UAV and Zephyr. DARPA has proposed an un-manned spy plane that has the capability to remain airborne for five years straight this aircraft named "Vulture" is like a satellite operating at an altitude of 60,000ft (18.2KM) to 90,000ft (27.4KM) in stratosphere operating as pseudo-satellite and not low earth orbit would provide 65dB improvement in communication capability (gadgettastic.com/2008/03/06darpa-vulture/). As the technology of making communications possible is evolving so is the art of destroying it, one such method for sabotaging such airborne communications is to destroy its very source and for that purpose the armament that comes to mind is missile, Missiles encounters the maximum resistance at low altitude and as they climb up they start losing energy some of the missile with respect to their countries and altitude are given in table:

Table 1
Depicting some of the Surface-to-air Missiles

Country	Missile	Altitude
1) China	HQ-2Y	7 to 30 KM
2) Egypt	Ain Sakr	4.4 KM
3) France	Mistral	6 KM
	Crotale	5- 10 KM
	Aster 15	1.7 to 15 KM
4) Israel	Barak-1	10 KM
5) Pakistan	Anza MK1	1.2 to 4 KM
6) India	Akash	Around 15
7) USA	Stinger	KM
	Hawk	3 KM
	Patriot	13.7 KM
8) Russia	SA-3 GOA	24 KM
	SA-15	12 KM
	Panzir-S1	6 KM
		10 KM

Aster 30 SAMP/T has a capability to intercept targets at an altitude of 50m to 20 KM with speed of 1.4KM/sec(army-technology.com). Russian surface-to-air missile SA-15 Gauntlet 9K331 tor has an altitude up to 6KM (fas.org).HAPs operate in stratosphere which is an

atmospheric layer that starts from 18KM above the earth's surface. Figure 1show is the graphical representation of some of the surface-to-air missiles along with their altitudes and the countries to which they belong.

Fig 1
Graphical representation of Different SAMs a Along with their altitude and Countries.
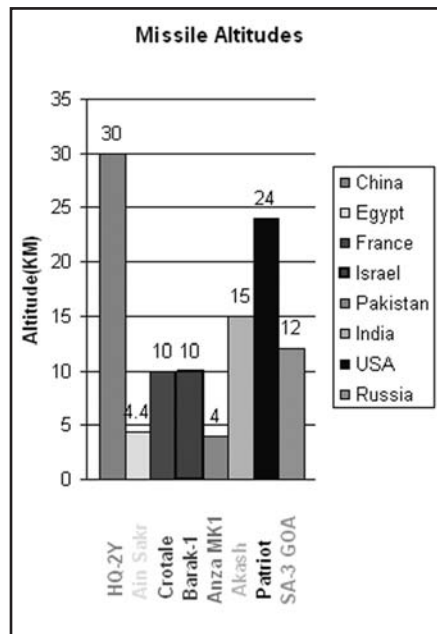
5) MILITARY COMMUNICATIONS USING CLUSTERED MANET

Clustered MANET is so called because it has nodes that are arranged in form of Clusters, these clusters are assigned different frequencies to avoid interference with neighboring clusters. The concept of clustered MANET is that of co-existence of heterogeneous systems, we can apply it where we have large number of users in communication range with each other. Mobile nodes that exist in different clusters can communicate with each other through a node called FN "Forwarding Node" these are the nodes that bridge the gap between nodes of two different clusters by connecting with them simultaneously, the decision about cluster formation can be made either on an ad-hoc basis or via use of central controller .In Second World War famous German General and Panzer Leader named "Hans Gudarian" (germanyinworldwar2.com), Employ the concept of "Blitzkrieg" meaning "Lightning war "(K.oikonomou). In this warfare he used armored forces with massive air support from Luftwaffe (German airforce) to over-run his opponents, if such a scenario is implemented today and we consider Tanks as nodes then ad-hoc architecture can be implemented between hundreds or even thousands of tanks rolling across the battle field with forwarding node being the tank of unit leader. That way whole tank battalion will be connected together through there respective unit leader (Forwarding Node) ensuring controlled and reliable communication throughout. Such communication which we talked about is very important to discriminate friend from foe. There are systems like CANA(K.oikonomou) and CAMA(B.Bhargava) that work in clusters as well. Ultra wide band (UWB) systems is another type that uses the cluster type architecture, a UWB system has the transmission distance of around 10 meters with data rates of up to 100Mbps. Figure2 shows tanks as nodes the small arrow is depicting communications to and fro within a tank regiment

where as the Large arrow shows communication between two lead tanks of different regiment (Forwarding nodes).

Figure 2
Diagram depicting the concept of clustered MANET between battle tanks
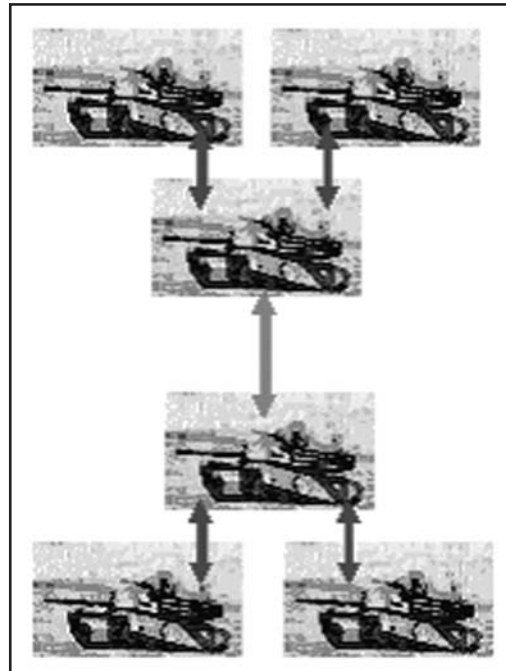
6) DIRECTED ENERGY WEAPONS

As the name suggest directed energy weapons are used concentrate energy that is in form of sound laser or electromagnetic pulse. Some of such evolving weapons are given below:

6.1 LRAD

LRAD stands for "Long Range Acoustic Device" (en.wikipedia.org/wiki/long_range_acoustic_device). The concept of LRAD is generation of sound which is directed un-like loud speakers this concept can be used to generate high decibel sound signals which can prove to be very irritating, they are called directed because they will only affect the target without effecting those in the surrounding the intensity of these devices is so great that it will persuade the attackers to either go away or surrender. LRADs are already been tested at preliminary stage in Afghanistan and Iraq. 300 LRADs were recently sent to Iraq and some are also given to Turkey.

6.2 EMP

EMP is short for "Electro-Magnetic Pulse" it can be used to neutralize electrical components and electricity, a short burst of EMP would take out Satellite, Cellular and all sorts of communications and will paralyze the enemy. This phenomenon was first discovered during the early testing of high altitude airburst nuclear weapons (abovetopsecret.com/pages/ebomb.html). Where it was realized that nuclear detonation

also results in release of EMP that disables the electronic equipment. Still work is in progress on such devices that could only radiate EMP at White Sands missile range, New Mexico. Such weapons are very destructive as they have the capability to cripple the whole nation without any loss of life.

6.3 Super Charge Lasers

Super charge lasers are capable of delivering around 100KW of energy in a specific direction, test are being done in Albuquerque, New Mexico. A super charge laser moves with 86,000miles per second and can be used for interception at speed of light, they can be used as airborne laser interceptors for intercepting ICBM(Intercontinental Ballistics Missiles) and Fighter planes can also use it to strike ground targets. This concept of super charge lasers can be employed to take out satellites.

7) COMPARISON

In this section we will compare the earlier discussed methodologies of communications for military purpose. If we look at military communications using cellular networks then this kind of communications can be used where we want to communicate low priority and low bandwidth data it is fast to setup and requires less military resources for communications. In case of Iraq and Afghanistan we have an example of vanishing line between peace and war and no existence of battle front (Lina, 1989), in Iraq government is supportive of peacekeeping force here we can use military communications over cellular network because it would be more cost effective, though in Afghanistan the government is also supportive of the invaders but here in this case their cellular network does not cover the whole country and satellite communications is more feasible another option could be HAPs ,because HAPs combines the best features of satellite and terrestrial communication service delivery. Advantage of using HAPs is fast deployment and low cost as compared to satellites. The track record of satellite communications is excellent they were extremely successful in desert storm, Iraq and in Somalia. Recently China and America tested their anti-satellite missiles which is a prove that satellites are "Touchable" and can be destroyed. A satellite can detect many missile launches at a time but if a missile is directed towards the satellite then it won't be able to protect its self. In this paper we also discussed EMP which has got the capability to take out all such communications we also looked at Super Charged Lasers which can be used to destroy Satellites and High altitude Platforms. EMP can be used in form of a bomb called "EMP Bomb" or "E-Bomb" and such a bomb if detonated 300 miles above South America than it has the ability to affect an area of 7 million sq miles which is almost whole of South America this would lead to destruction of all communications in that area. Here we will compare in table 2, the technologies on the basis of following parameters:

1) Coverage Area
2) Dependability
3) Cost
4) Deployment
5) Data rates
6) Quality of Service
7) Life time
8) Fade margin
9) Vulnerability
10) Probability of jamming
11) Probability of Damage
12) Effects of Electro-Magnetic Pulse

Table 2
Comparing the Four Technologies

Comparison Parameters	Cellular Network	Satellite communications	High Altitude Platforms	Clustered MANETs
1) Coverage Area	Absent in Remote Areas	Global	Present in Remote areas up to 1000 KM	Over short ranges
2) Dependability	Average	Excellent	Good	Average
3) Cost	Low	High	Cheaper than satellite	Low
4) Deployment	Easy	Complex	Rapid deployment	easy
5) Data rates	Low	High	2Mbps uplink10Mbps Downlink	low
6) Quality of service	Good	Excellent	Excellent	good
7) Life time	Up to 15 years	Around 15 years	5- Years	Short lived
8) Fade Margin	High	Low	Medium	High
9) Likelihood of Jamming	High likely	Difficult to Jam	Exist	High
10) Damage probability	High	Rare	Chances exist	High
11) Effects of EMP	Will cause failure	Will cause failure	Will cause failure	Will cause failure
12) Vulnerability	High	Low	Low	High

8) SUGGESTION

In this paper we discussed some of the variants for military communications that can be used in different military scenarios, along with that we also saw the pros and cons of those communications and vulnerability that exist while using them, Table 3 we have arranged our communication methodologies and threats that might threaten their existence.

Table 3
Methodologies at Threats

Military Communications	Threats
1) Using Cellular Networks	Jamming
	Eaves dropping
	Suicide attacks against Base Stations
2) Using Commercial Satellites	Anti-satellite Missile
	Suicide attacks against Ground stations
3) Using High Altitude Platforms	Surface-to-Air missiles
4) Using Clustered	Malicious Node
MANETS	Destruction of forwarding Node

Threat 1:
One of the threats that exist is jamming of communications.
Solution:
Usage of anti-jamming devices that could neutralize the jamming signals.

Threat 2:
Eaves's dropping is one of the threats that is silent but more dangerous and destructive than eaves dropping because here sensitive and crucial information can be caught by your enemy resulting in disclosure of classified information.
Solution:
Solution to this problem is IPSEC as discussed in (Roberto, 2002) by using IPSEC low bandwidth and low priority data can be communicated.

Threat 3:
Threat to base-transceiver stations against suicide attacks.

Threat 4:
Sabotage of satellite trailer-based ground stations through suicide attacks.
Solution to Threat 3 & 4:
 Earlier we discussed LRADs which direct high decibel sound towards the threat. We can install LRADs at base station sites and along with trailer-based ground stations in case of unauthorized movements towards BTS or ground station an initial level low decibel sound will be generated towards the threat if the threat doesn't go away then increased intensity sound will be generated this sound is so intense that the menace either goes away or it surrenders

Threat 5:
Destruction of HAPs through Surface-to-Air Missiles.

Threat 6:
Destruction of satellite via Anti-Satellite missile.
Solution to Threat 5 & 6:
Solution of above problems could be super charged lasers as we discussed earlier that super charged lasers have a capability to generate 100Kwatts of energy and can be send in a specific direction. We can install such devices on HAPs and HAPs along with detecting the movement of enemy can also take them out by using its super charged lasers. We also saw how satellites are vulnerable to anti-satellite missiles we can also amalgamate these super charge lasers with our satellites , a satellite can detect several missile launches at a time and if one of the launch is meant for the satellite then it could simply fire low powered laser in the direction of the missile, this laser after reflecting back through the surface of missile will give the speed with which missile is traveling and also its structural specifications after knowing these credential another high power laser beam can be fired eventually toasting the missile this process will take few seconds (as super charged lasers moves with 86,000 miles per second) depending on the distance between satellite and missile.

9) CONCLUSION

We discussed different possibilities for different environments, in general satellite communications seems to be the best and the most reliable way of communication as it has less vulnerabilities against attacks and sabotage. We also saw another alternative that is High Altitude Platforms(HAPs) which operates in stratosphere and only limited number of Surace-to-Air missile exist that could destroy it also when compared with satellite it is much cheaper easily reconfigurable and can be deployed rapidly when required, another advantage of HAPs is that it can be used as a complement to satellite communications. Now let's move toward the concept of secure communication over cellular networks using IPSEC, the options of satellite and HAPs are for those countries that have the technological

expertise and have the capability to launch and control their devices (Satellite and HAPs) as for the emerging countries the concept of secure communications of low bandwidth and priority data is a sigh of relief. Then the concept of clustered MANET on battle field is beneficial for all we only discussed in this paper how it can be used in Tank regiments along with that this concept can also be used to connect soldiers so they can keep in touch with each other during the battle even if they don't have visual contact, Para-troopers can also use it to guide each other in enemy territory in short each the communications we discussed have their significance according to nature of military missions.

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