EADS Technology Activities in Communications

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OVERVIEW

Under network centric operations (NCO) a theory becomes practice when it has significant potential to transform traditional approaches not only to improve military operations in effectiveness and efficiency but also to influence the industrial development structure.

From a communications point of view NCO require concepts, network architectures, communications equipment & components, and implementation processes to understand the implications for all of these elements.

The establishment of competences in communications needs to address a wide range of capabilities from concept development to platform/system implementation. To be consistent with NCO development objectives, EADS initiated steps with the aim of satisfying these aspects.

Future military systems will have to exchange information to create a common relevant operational picture in (near) real-time. Communications are one of the fundamentals and consequently EADS has initiated a new technology area addressing communications with the following aspects:

- Network centric communications operational concepts,
- Evolving and future communications architectures, networks, systems & technologies,
- Network management,
- Platform/system communications applications,
- Interoperability,
- Communications simulation, modeling and analysis,
- Digital processing, routing and protocols,
- Communications integration and test,
- Support Tools.

The paper details these areas, describes the specific interest and will explain a common research and development program which is launched.

For research and development EADS has identified the following needs:

- Contribution to NCO capabilities in the subject of communications (including NCO and commercial applications),
- Availability of competitive data links products,
- Participation in standardization bodies,
- Insure interoperability of EADS products in a joint and combined network centric environment.

Interoperability between systems can only be achieved if all parties, military as well as civilian, concerned with the development of systems co-operate to agree on basic design principles. With this article EADS indents to give an overview of the technology activities in communications with the aim to increase the situational awareness.

A demonstrator concept for secure communications links will be presented to meet customer requirements and to be prepared to have concepts, management capacity, technology and development recourses available. The concept is based on the following design principals:

- Ensure functional requirements and performance levels on civilian and military systems operating together,
- Efficient development, manufacture and maintenance of software and hardware,
- Speed up product development,
- Reduce costs by improved production efficiency.

The demonstrator concept can be seen as a common project connecting the different EADS platform/system development programs to show system of systems capabilities and to avoid **no communications, no information, no network-centric operations.**

Finally an outlook will be given for networked communications capabilities needed to migrate in order to provide capacity, stability, reliability and rich connectivity/interoperability options. For this the highly prioritized actions are:

- Study and assess integration of communication systems (data links) into platforms and systems,
- Assess influences on data link equipment, components and tools, including methodology and processes, for development in the area of communications in network centric operations,
- Define and assess network centric operational concepts and architectures,
- Define implementations of architecture solutions and network protocols,
- Define and perform communications simulation.

It should be noted that in this paper civil aircraft specific communications technology development which is also a EADS technology task is excluded in order to concentrate on military network centric challenging communications.

1. COMMUNICATIONS FOR NETWORK CENTRIC OPERATIONS

There is no doubt that in the future, technology for communications in a networking environment will have to consider the role of autonomy, the definition of team co-ordination, co-operation, and collaboration concepts and the role of cognitive decision aids. This also means that new methods and procedures will have to be established to define and assess communications in a networking environment.

The efficiency of today's military information systems, all mainly working independently from each other, and their impact onto operations, can only be enhanced by strong cross-interlinkage of information, intelligence and communication channels. New joint system concepts, architectures, functionalities and operations, leading to a so-called system of systems, are under development inside EADS.

Future successful operational concepts depend on principal functions understanding the operations in a theatre that includes a more varied number and types of actual and potential tasks.

The primary operational task for such system focuses on the strategic level to fulfill the fundamental surveillance and data gathering requirements in military operations. Establishing the complete "big picture" of potential opponents and at the same time building-up and continuously improving detailed track data bases of air, land and sea targets, objects, and potential threats are key issues.

The secondary operational task for the system focuses on the tactical level and is oriented to perform effective support operations in times of peace, crisis, conflict, and war. To achieve information superiority and to attain tactical and operational supremacy, a complete and near real time situational awareness is required. This capability offers a direct support potential to forces in combat situations.

To have all relevant information, starting on strategic planning level, preparation and performing out of area operations and concluding in battle damage assessment and post mission analysis, a combination of as many as possible different and complementary communications systems is necessary. Only the combination of al available information from different sensor types and other sources and the fusion of data in a very general manner allows to gain maximum benefit in military operations. This information is also a must for a consolidated decision process to take the right actions, and thus it is substantial for every C3I[1] or C4ISR[2] process. Beyond this the interoperability of sea, land, air and space systems will enhance the strategic and tactical performance and enable time-critical (near) real time answers.

[1] Command, Control, Communications & Intelligence
[2] Command, Control, Communications, Computer, Intelligence, Surveillance & Reconnaissance

Military organizations have a complex structure with fixed and mobile headquarters, operation centers and command posts spread over wide areas. None of these participants are self-contained; they all depend on information received from others and they nearly all produce information required by others. From this point of view information exchange requirements and interoperability become a central common aspect. Combined joint operations are conducted by different military organizations/services from various nations in numerous locations. The quality of decisions and actions depend on the quality and timeliness of the information on which they are based. Communications and within digital information exchange is a major challenge for future military operations.

The requirements of network centric operations (e.g. concurrent resources, interoperability, command & control superiority, self-synchronization, speed of operations, dominant maneuvers, precision engagement, full dimensional protection, focused logistic) all demand the secure transmission of information (in as near real-time as possible). Especially in joint or combined operations, the continuous and automatic update of secure voice and data between a network of users is fundamental to effective deployment and to the success of the mission.

The new environment will demand multi-mode data transport capabilities, including military and commercial satellite communications capabilities, multiple types of data links and radios, and commercial information services. These data transport capabilities will both provide users with access to appropriate elements of a distributed computing environment, as well as providing the interconnecting for a wide range of sensor coverage data. This operational flexibility will enable commanders to plug and play sensors, shooters, command and control, and support capabilities into task-organized combat packages, including appropriate collections of sensors and weapons. A full sensor spectrum scenario is illustrated in the following picture. Various types of sensors and sensor platforms are operating together.

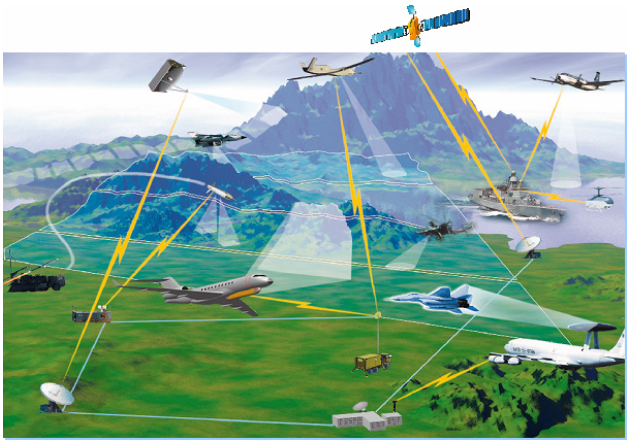

FIG 1: Military communications environment

In the current environment, several types and kinds of independent voice, video, and data networks (e.g., sensor information, tactical information) operate as independent networks for multiple reasons. One of the primary drivers for separate networks was the need to meet required

timelines for information exchange. For future information grids it is the aim of EADS to have tailored data link capabilities in theatre which avoid interface problems inside a global information network.

The objectives and goals of EADS are to derive, based on operational requirements and mission scenarios, architectures for communications system covering the following types of external links:

- Link for tactical data exchange,
- Long range line-of-sight wide band (sensor data) link,
- Radio communications between vehicles and ground stations,
- Wide band (sensor data) Satcom link.

To date, thinking about network centric operations concepts have tended to focus on the tactical and operational levels of warfare, but they are applicable to not only all levels of warfare but to all types of military activity from the tactical to the strategic. At the operational level, network-centric operations first have to provide commanders with the capability to generate precise war-fighting effects at an unprecedented operational tempo, creating conditions for the rapid lockout of adversary courses of action. Tactical data links, especially Link 16, are defined to offer the right answers to allow forces to adapt more quickly to a dynamic environment. The requirements of modern command and control, situational awareness, real-time into and out of cockpit, and network centric operations all demand the secure transmission of tactical data in as near real-time as possible. Especially in joint or combined operations, the continuous and automatic update of secure voice and data between a network of users is fundamental to effective deployment and to the success of the mission.

One of the solutions for network centric operations lies in data link technology – the ability to transmit and receive tactical data, between aircraft, surface platforms and ground stations by sharing data in an effective way. Functionally the requirements can be pooled in the following categories:

- Provides situation awareness
  Data links supports situation awareness through access to other platform sensors and simultaneous information exchange in all combat environments.
- Facilitate command and control
  Data links offer a co-operative engagement capability.
- Aids identification
  Data links reduce the risk of fratricide through battlefield digitization.
- Reduce voice communications
  Data links transfer voice communications in data communications and reduce the crew workload.

2. TECHNOLOGY AREAS

Technology areas addressing communications with the following aspects are:

2.1. Network Centric Communications, Operational Concepts

The EADS Concept of Link Employment (ECOLE) supports the up-growing concepts of network centric operations. It provides an operational analysis of a wide range of applications at all levels of peacetime-, crisis- and war-time operations within the areas designated for NATO and non-NATO forces.

In peace-time operations the primary role is to guarantee the security and territorial integrity. This means to deter any threats against the security of the own nation and to contribute to the stability balance of the international community by maintaining a sufficient and effective collective defense capability. Participation actively in the confidence and security building process, for example in arms/environment control agreements, in international human rights protection, in crime detection, and in crime prevention are new challenges which many nations have to face. ECOLE will contribute to this.

During peace-time, ECOLE contribute to support the purpose to permanently assess the strategic and tactical situation and thereby supports political military security considerations and activities.

The main objective of ECOLE is to equip platforms with a tactical data link to collect and deliver sensor-based information to enable political, environment control and military authorities to develop strategic and tactical defense options and plans.

Under crisis conditions nations are faced with a volatile environment with a wide range of potential security challenges. Uncertainty about where, when and how they could develop into crisis and conflicts are difficult to be determined. Under such circumstances nations are called to have capabilities available ranging from non-combat objectives such as for example humanitarian support to direct combat objectives such as target and threat identification.

Achieving military objectives in crisis- and conflict-operations situations depend primarily on the ability to position the best balanced forces at the right place at the right time. Ground and airspace surveillance and the production of intelligence are therefore a prerequisite. Effective employment and support of the deployed forces is dependent on the command & control (C2) arrangements established from the highest level to the lowest level of an authority. Unity and continuity of C2 also a clear chain of command are requirements which must be taken under consideration for ECOLE. In the event of political crisis, military tension and wartime, ECOLE supports the capability to military commanders to rapidly identify, analyze, assess, target and destroy emerging threats.

The same aspects applicable for crisis operations are taken into account under war-time conditions. Additionally new concepts (for example network centric operations) and recent technology developments allow the rapidly identifying of objects, events and activities. Improved continuity monitoring of areas of interest will increase the ability to infer and assess adversary plans and direct

appropriate actions. This permit focusing the attention on the changes needed to improve timeliness. Timeliness of war-time operations requires to operate in the adversary information and activity cycle.

ECOLE presents an analysis for a plurality of missions being applicable for data link applications. These missions are for example:

- Counter-air,
- Interdiction, (Example see FIG 2),
- Suppression of Enemy Air Defense,
- Close Air Support missions,
- Combat Search and Rescue,
- Special Missions (SIGINT,....).

The ECOLE represents the first comprehensive analysis of how tactical data link systems could be used by the platforms in support of these missions. The concept hypothesize the information to be exchanged, how the information supports each mission, and the data link architecture that will be employed. It considers platforms involved with the missions that have already been equipped with data link as well as the platforms newly planned to receive it. The ECOLE represents a starting point for platform more detailed implementation definitions and mechanization designs. In addition, the analysis can be used to support NCO concepts to co-ordinate the concepts with tactical data link concepts and other services.

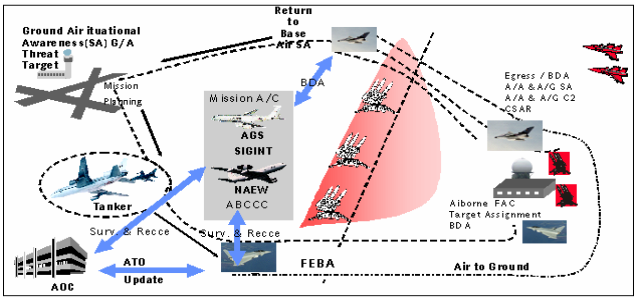

FIG 2: Concepts of Link Employment

There is no doubt, that the first digital data link implemented in various platforms will be a tactical data link on the basis of link 16. Future data links and communications systems will come and will have to be assessed. With continuous user involvement EADS has the experience to offer an ECOLE tailored to the specific environment of the customer.

2.2. Evolving and Future Communications Architectures, Networks, Systems & Technologies

Network centric operations are accepted to be the theory which has significant potential to transform traditional approaches to improve military operations in effectiveness and efficiency. However, these gains will not be realized by simply putting an enabling info-structure in place. Making NCO a reality requires to have concepts, network architectures, communications components, and implementation processes available and to understand the implications for all of the elements or components. Two key prerequisites for success are:

- the development of new and innovative NCO concepts and strategies to meet mission new operational concepts; and
- the ability to transform these embryonic concepts and strategies into real operational capability and to support the customer with tailored products based on the latest technology.

The paper addresses the following elements in order to address the field of secure communications and to initiate a process which is focused on "system of systems" aspects with the aim to

- stop thinking in platform and start thinking in networks,
- stop thinking in equipment products and start thinking in functionalities and capabilities,
- perform system of systems analysis under operational aspects and to stop trying to connect existing components.

2.3. Network Management

Network management is related to the communications network architectures. For all configurations of network architectures network management is necessary. Military networks, especially Link 16, have a huge amount of network management tasks to be solved. Future networks management tasks are moving more and more in the direction that these tasks will be performed automatically in order to have flexible unconstraint access for the user. Nevertheless, network design, network initialization, network security and network monitoring which are subtasks under network management have to be developed. In a multi-level, multi-national security environments this will become a technology as well as a organizational challenge.

Network Management can be divided into off-line management and on-line management.

In order to protect the integrity of an operational network, a network manager has minimize the need for ‘on-line’ management by making every effort to optimize the interface ‘off-line’. This is achieved by maintaining a library of network designs and by the use of a combination of communications modes and functions to establish a robust communications environment capable of graceful degradation of function. The aim of pre-mission planning is to organize all the systems necessary to satisfy the information exchange requirements of a specific force structure in a given operational scenario.

OPerational NETwork (OPNET) management is the real-time, on-line monitoring, control and maintenance of communications operations. The aim of OPNET management is to achieve and maintain optimal network performance and information exchange by monitoring the interface continuously, and responding quickly and efficiently to changes in network utilization. The OPNET management process can be decomposed into 8 main functional areas:

- Network plan,

- Initialization and re-initialization,
- Synchronization and network time,
- Relative navigation,
- Network participation status,
- Connectivity,
- Resource utilization,
- Frequency assignment restrictions.

There are often significant interdependencies between these 8 functional areas, for example: synchronization and relative navigation.

2.4. Platform/System Communications Applications

Assuming a global information grid as illustrated in FIG 1 communications have to be based on a global, generic layer-model combining platforms and command & control systems. The upper layer describes the functional requirements which can be seen as platform and command & control applications. The middle layer represents the "services" which makes the applications independent and which provides the applications with the necessary data and information exchange from the communication layer. This is illustrated in the following figure.

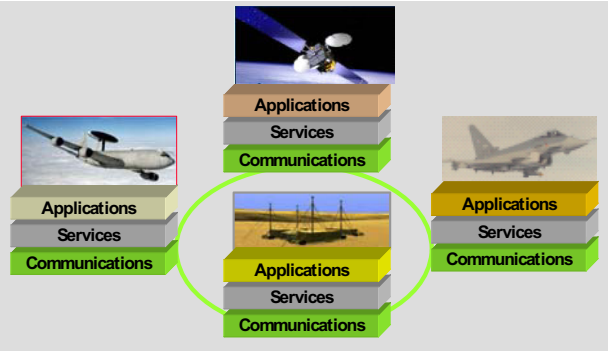

FIG 3: Global, generic layer-model for platforms and command & control systems

The communications layer defines the data and information exchange for a network centric communications architecture, which allows the common, universal connectivity of all participants in joint and combined operations. This is a basic prerequisite for interoperability in network centric operations. The communications layer can be subdivided in an other layer model containing protocol, radio applications, operating system, hardware and antenna elements.

To satisfy future communications requirements, especially in a long term strategy, a closer look on "services" is necessary. In comparison to traditional architectures "services" are a new layer allowing the platform and the command & control system to have access to al necessary information when ever needed. "Services" have to guarantee:

- data and information from the communications layer are available for the applications,
- data and information from the applications can be transmitted to the communication layer,
- performance of networks can be managed,
- distributed processes between platform and command & control systems can be managed,
- data and information security,
- priorities for data and information transfer.

New technology and new procedures are necessary in order to have the right information at the right time and place available. This is one prerequisite to conduct network centric operations. The focus lies on intelligent information management with new platform and command & control communications server technology. The following points are strongly dedicated to communications and command & control platforms/ systems and have to be seen in close relationship to a generic functional software dominant system architecture. The following technology is envisaged:

- Information dissemination management technology with interoperability software and information access and delivery software
- Distributed computing infrastructure with electronic devices and components, networking computing services
- Co-operative processing/decision support technology with sense-making processing, information integration (i.e., fusion & correlation) software, computer-aided reasoning, co-operative software agents, heterogeneity mediation agents and optimization software
- Rapid, distributed modelling and simulation for “what if” analysis and information management with robust stochastic algorithms and processes, automated learning and distributed intelligent agents;
- Adaptive, polymorphic information access with intrusion detection, assessment, and response
- Human-machine interface
- Information representation technology with processes, data, metadata, architectures, policy and semantic relationships
- Security technology with network security software and protocols and network security hardware

2.5. Interoperability

Under changing circumstances NCO provide a theory to enhance military efficiency and effeteness with latest information technology. NCO require a consistent approach for interoperable information exchange in system of systems operations. Nations and NATO investigate a wide range of efforts to guarantee interoperability (i.e. Overarching NATO IO Policy, NATO Policy for NC3S IO, NATO C3S IO Directive, and test effort JWID, CWID, TDLITS, SIMPLE-Tests)

Traditional programs for already procured or envisaged platforms and systems often show that only a technical oriented approach is started. Necessary investigations for interoperability resulting from the NATO combined joint task force (CJTF) concept have not been considered, especially:

- Establishment of national joint communications management organization,
- Preparation of concepts of operations and

concepts of communications employment for information management,
- Preparation of national concepts for communications employment to meet NATO requirements and to define the national contribution to CJTF Operations,
- The definition of generic communications specification for derivation of communications interface specifications,
- The build-up of data bases to perform interoperability assessments as basis for paper based testing,
- Development of networks which consider interoperability requirements and interoperability constraints,
- Performance of interoperability rig (laboratory) and field tests,
- Establishment of cross service training and education programs.

In order not to favor isolated communications solutions, EADS approach is to initiate technology capabilities satisfying the above mentioned points.

2.6. Communications Simulation, Modeling and Analysis

Under concept development and experimentation communications simulation, modeling and analysis become an important issue. The process starts with an analysis as a concept for a mission capability identifying the

- concept for way the operation will be conducted;
- the command & control approach to be employed,
- the relevant organization and doctrine, collaborative arrangements, and information flows,
- the specification of the forces and assets.

The important thing to note is that this initial version of the concept is only a point of departure for a series of discovery simulation experiments that will help to explore ways to make the basic idea behind the concept work. Out of this series of discovery simulation experiments will come a set of preliminary hypotheses that will serve as the drivers for a series of experiments designed to test them. Several series of experiments may be necessary to sort out all of the issues involved. Ultimately, a successful concept (as modified and refined) can be demonstrated by simulation. Along the way some concepts and processes will be eliminated. Others will be found applicable only under some circumstances. Once the concept has been successfully simulated, it is ready for following on phases. Depending on the results different activities could be necessary. If dedicated new functionality with new software/hardware has to be developed the concept development and experimentation process identifies a demonstrator and prototype development. The advantage of this spiral process is that all development steps serves as an integral part of a co-evolution (customer and industry) towards fielded mission capability.

Another aspect of simulation and modeling is the fact that under system of systems aspect integration and testing will become a tremendous and cost intensive issue. Therefore simulation and modeling support the developer to test and validate a system under system of systems conditions in a way that for corresponding systems the information exchange is simulated. During the development phase this is a cost saving practice.

2.7. Digital Processing, Routing and Protocols,

Communications systems, especially data links can be considered as:

- Weapon control data link,
- UAV control data link,
- Tactical data link,
- Sensor data link,
- Telemetry data link,
- ATC/Civil data link.

All these data links are very similar in their functional and physical structure. Consequently they can be structured in smaller components like interface, radio and antenna. The radio can also be subdivided in elements like processing element and RF Front-end element. Under system integrator aspects the management of different radio systems and the interdependences with the host system are of interest. Therefore the network and communication management element is included. The structuring of the elements follows FIG 4.

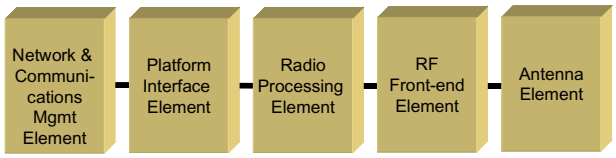

FIG 4: Elements of a generic communication system

Digital processing, routing and protocols concentrate on the radio processing element with

- Definition of suitable formats,
- Techniques for error correcting codes, spread spectrum,
- Modulation: definition, performances, optimisation, adaptation.
- Data flow compression for transmission,
- Techniques of access and multiplexing,
- Encryption, security and protection of communications,
- Protocols and communication standards: existing protocols, constraints,
- Fault tolerance, availability, multiplexing, performances Inter protocols compatibility and networks connectivity (e.g. Ground – Satellite).

Therefore the EADS concept is to concentrate on the core radio processing element and rely on standard COTS systems for the computer and the user data interfaces. The big advantage of the concept is to get rid of obsolescence problems for the computing system, enormous flexibility concerning the user data interfaces, the use of standard telecom equipment and the flexibility of a software configurable system. This flexibility leads to the use of physically identical radio processing elements for a wide variety of applications by changing software and firmware.

2.8. Communications Integration and Test

Communications come into the major manned aircraft programs at the same pace in which these platforms are enabled for network centric operation. For existing programs like Eurofighter, Tornado and F-18 these activities go along with upgrade programs. Basically for manned aircraft secure communications mean tactical data link, encrypted audio radios (e.g. SATURN radios) and data link modems (e.g. inter-flight data modem, IDM) which make use of existing radios. For UAVs communications become a completely different meaning because in these platforms the command and control of the air vehicle depends on wireless secure communications. Future UAVs will see tactical data links, encrypted audio radio (e.g. for Air Traffic Control communications), telemetry / tele-command links, sensor control, weapon control, sensor data downlink – all of them with a need for security, because wireless communication is a system interface which – in physical terms - is open to the world. In addition, the integration into networks is required.

Test and integration require new technologies and new processing to make sure that sensor data, track data (including command and control data), information and intelligence will transmitted, received and processed correctly. Expanding the idea towards system of systems test and integration new developments are required which incorporate test and integration methods and services to guarantee among distributed users a common understanding in order to initiate coordinated measures. This includes:

- Requirements for generic radio integration with platform/system independent interfaces,
- Interference measurements,
- Infrastructure for communications tests,
- Platform/system independent procedures for communications integration and tests network tests and analysis technology.

This leads to cross platform and system available test and integration support tools.

2.9. Support Tools

Also in EADS technology focus is the use of existing on the market available tools, there adaptation and modification and the development of new tools with the aim to support test and integration

- on communications equipment level (i.e. RF scenario generators),
- on subsystem level (i.e. radio/terminal farm),
- on system level (i.e. Standard Interface Multiple Platform Link Evaluation (SIMPLE) product),
- on system of systems level as well as in-service level to guarantee interoperability in terms of technical, procedural and operational interoperability.

For communications necessary tools can be summarized:

- Tools for information exchange requirements assessments based on consolidated concepts of operations,
- Spectrum management and radio network planning tools for network-centric architectural concepts (including capacity planning),
- Network test and analysis tools,
- Support tools for test and communications integration,
- Software development tools for communications applications with the aim of platform/system independent software development.

3. COMMUNICATIONS NEEDS

In previous chapters the EADS communications / data link technology areas in order to satisfy NCO have been described. The wide range of activities aims to

- Contribution to NCO capabilities in the subject of communications (including NCO and commercial applications),
- Availability of competitive Data Links Products,
- Participation in standardization bodies,
- Insure Interoperability of EADS products in a joint and combined network centric environment.

A communications demonstrator is initiated under the impressions to increase system know-how on communications. In order to show the feasibility, a communications demonstrator is essential for technical discussions and to benchmark reachable technology for competitive prices. The definition of concept development & experimentation (CD&E) activities is a first step for a continuous development and essential for EADS communications technology strategy in the area of network centric.

4. COMMUNICATIONS DEMONSTRATOR

The demonstrator focuses on communications essential to cover the platform process chain (Sensor → Mission Management → Communications Equipment → Antenna as well as Flight Control System or Combat Direction System → Communications Equipment → Antenna).

There are several aspects for demonstration:

- Laboratory/rig communications demonstrations focused on equipment,
- Platform data link test and integration including flight/field trials,
- Operational interoperability and performance demonstrations.

Today the technology community in the subject communications is moving towards the direction based on Software Defined Radio (SDR) and Software Communications Architecture (SCA). In US the Joint Tactical Radio System (JTRS) is a very concrete program following this ideas.

The cornerstone for a new secure communication system is the development and deployment of SDR technology through a standardized, open software architecture. SDR is a complex communication system. Potential contractors and integrators shall have proven capabilities and skills in the field of both communications technology and system integration and retrofitting. Furthermore the high complexity of the system requires especially the co-operation between contractors / integrators according to a

common architecture to achieve the military requirements.

For example power consumption and associated heat dissipation are crucial. They depend on the platform a radio terminal is to be integrated in. Also a contradiction could appear between on a side modularity and flexibility of use, and, on the other side the stiffness of antennas and amplifiers. This potential difficulty will have to be the subject of a further risk analysis.

Current SDR research about ad-hoc networking is generating a vast amount of information about new networking routing and management protocols. Networking solutions for the current SDR project could be based on the results of the research addressing networking with

- IPv6/Mobile IPv6,
- Efficient routing protocols,
- Self-healing techniques.

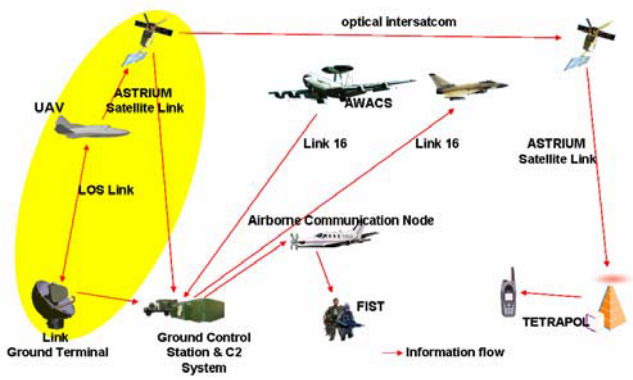

FIG 5: Demonstrator Scenario

In communications EADS has to focus on platform and system aspects which defines the overall functions and which give the characteristics of "being network centric". as shown in FIG 5. This means to have common laboratory and test facilities and to have common demonstrator projects able to connect different platforms and command & control systems in a networking operational and technical environment. The demonstrator aims to set up a infrastructure as an instructional tool by the different departments to facilitate learning, developing, testing and integration in the area of wireless communications for a wide range of data link applications (such as weapon data link, UAV data link, tactical data link, sensor data link and ATC/Civil data link). All these data links are very similar in their functional and physical structure. Consequently they can be structured as shown in FIG 4.

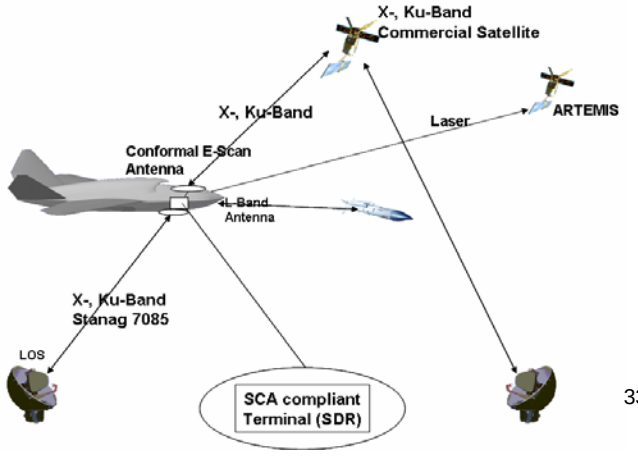

FIG 6.: Scenario the demonstrator focus on

Under system integrator aspects the management of different radio/terminal systems and the interdependences with the host system are of interest. Therefore the network and communication management element is included.

The demonstrator shall demonstrate the near real-time secure transmission of multi-media products between command & control systems, space- and airborne platforms, vessels, and vehicles. A specific application platform will be the Barracuda UAV.

The communications scenario (see FIG 6) assumes a UAV platform operating in a Reconnaissance Surveillance and Target Acquisition (RSTA) mission with a sensor payload producing i.e. SAR, MTI, EO/IR and ESM information, a missile for weapon data link demonstrations and two ground stations one Line-Of-Sight (LOS) and one Beyond-Line-Of-Sight (BLOS) with satellite connectivity. Central point of the demonstration is the UAV platform with two conformal e-scan antennas for X- or Ku-band communications with ground and satellite. For both secure communication links, ground and satellite, one radio processing element which is SCA compliant is planned. The technology challenge is the SCA compliant radio element which can perform different loadable waveforms. Additionally a optical data link for communications with satellite (ARTEMIS) is included.

In Step 1 the specification phase defines the concept, the design and the simulation. Simulation will be set-up in order to detail concepts of operations, communications architecture, platform requirements, simulated data links and Quality of Service including security. Also the necessary laboratory test environment will be specified. Additionally this step includes the definition of necessary UAV platform modifications.

In Step 2 the laboratory environment (test benches) will be build-up and prototypes of the above mentioned elements will be developed and integrated. Demonstrations on laboratory level of beyond line-of-sight data links, line-of-sight data links and quality of service will be performed.

In Step 3 the platform integration with necessary UAV platform modifications and flight tests will be performed to integrate a tested communication subset from the laboratory. Ground test, carrier flights and finally flight tests follow.

5. CONCLUSIONS

A lot of activities addressing communications in order to improve the EADS position in the defense market are identified. Again, there is no doubt that communications are one of the keys for network centric operations and also for network centric development. Today's traditional development is based on platform or system specific aspects and does not take into account the system of systems communications requirements. Consequently EADS has to focus on platform and system aspects which defines the overall functions and which give the characteristics of "being network centric".

Competence in communications (demonstrator capabilities), improvements for products, new products with new functionality, product modifications/ modernizations under system of systems aspects, platform upgrades and new platform communications concepts, interoperability, shorter development cycles and systems and service provider capabilities are in EADS focus. This is not a task which can only be originated under the umbrella of technology research and development, this is a task which must be performed under strategic business considerations. The technology demonstrator following a bottom-up approach to create competences on engineering level and to improve cooperation between departments dealing with different platforms and systems is a first step in this direction.