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Introduction to SAGC^{4}ISR, New Software Architecture For Smart Grid Computing Networks

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Abstract: This paper is proposed new software architecture to incorporate Smart Grid and AGC^{4}ISR architecture. Smart Grid incorporates has many benefits of distributed computing and communications to deliver real-time information and enable the near-instantaneous balance of supply and demand at the device level. AGC^{4}ISR architecture is Organize with Autonomic Grid Computing and C^{4}ISR (Command, Control, Communications, Computers and Intelligence, Surveillance, & Reconnaissance) Architecture, this software architecture is base on an autonomic grid computing networks proposed by military C^{4}ISR architecture by latest version of this architecture as "Department of Defense Architecture Framework" (DoDAF) v2.0.

Key words: Autonomic Grid, Software Architecture, C^{4}ISR, AGC^{4}ISR, SAGC^{4}ISR.

INTRODUCTION

Software architecture has emerged as an important sub-discipline of software engineering, particularly in the realm of large system development. While there is no universal definition of software architecture, there is no shortage of them, either.

The software architecture of a program or computing system (R. Grinter, 1999) is the structure or structures of the system, which comprise software components (J. Magee, N. Dulay, S. Eisenbach, J. Kramer, 1995), the externally visible properties of those components, and the relationships among them. By “externally visible” (D. Garlan , 2001) properties, we are referring to those assumptions other components can make of a component, such as its provided services, performance characteristics, fault handling, shared resource usage, and so on (Bass, Clements, Kazman,1998)

In this paper we should explain these topics:

1. Smart Grid
2. C^{4}ISR Architecture
3. AGC^{4}ISR Architecture

Then we try discusses every item and finally we introduce SAGC^{4}ISR.

1.1. Smart Grid:

The term “Smart Grid” (D. Dollen, 1994) refers to a modernization of the electricity delivery system so it monitors protects and automatically optimizes the operation of its interconnected elements. It incorporates into the grid the benefits of distributed computing and communications to deliver real-time information and enable the near-instantaneous balance of supply and demand at the device level. This means that the Smart Grid will be characterized by a two-way flow of electricity and information to create an automated, widely distributed energy delivery network.

1.1.1. Smart Grid Benefits:

The Smart Grid provides a reliable power supply and self-healing power systems, through the use of digital information, automated control, and autonomous systems. The Smart Grid is “green”. It means that with reduce greenhouse gases and with supports renewable energy sources, and enables the replacement of gasoline-powered vehicles with plug-in electric vehicles. The Smart Grid continuously monitors itself to detect unsafe that could detract from its high reliability and safe operation. Higher cyber security is built in to all systems and operations including physical plant monitoring, cyber security, and privacy protection of all users and customers.

1.1.2. Understanding the Risk:

Additional risks to the grid include:

- Increased use of digital information and controls technology to improve reliability, security, and efficiency of the electric grid. (D. Dollen, 1994)
- Increasing the complexity of the grid could introduce vulnerabilities and increase exposure to potential attackers and unintentional errors; (G. Locke, P. Gallagher, 2010)

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- Dynamic optimization of grid operations and resources, with full cyber security; (D. Dollen, 1994)
- Increased number of entry points and paths for potential adversaries to exploit; and Potential for compromise of data confidentiality, including the breach of customer privacy. (G. Locke and P. Gallagher, 2010)

1.1.3. Information Networks:

Additional information network requirements include: (G. Locke and P. Gallagher, 2010)

- Ability to uniquely identify and address elements in the network and devices attached to it;
- Routing capability to all network end points;
- Network management functionality, network activities, and network devices, including status monitoring, fault detection, isolation, and recovery; and
- Quality-of-service support for a wide range of applications with different bandwidths and different latency and loss requirements.

C^4ISR Architecture:

If a project has not achieved system architecture, including its rationale, the project should not proceed to full-scale system development. Specifying the architecture as a deliverable enables its use throughout the development and maintenance process. (B. Boehm, 1995)

Architecture commands a price (the cost of its careful development), but it pays for itself handsomely by enabling the organization to achieve its system goals and expand its software capabilities. Architecture is an asset that holds tangible value to the developing organization beyond the project for which it was created. (Len Bass, Paul Clements and Rick Kazman, 2005)

Architecture defines software elements. (Len Bass, Paul Clements and Rick Kazman, 2005) The architecture embodies information about how the elements relate to each other. This means that it specifically omits certain information about elements that does not pertain to their interaction. Thus, an architecture is foremost an abstraction of a system that suppresses details of elements that do not affect how they use, are used by, relate to, or interact with other elements. In nearly all modern systems, elements interact with each other by means of interfaces that partition details about an element into public and private parts. (B. Boehm, 1995)

The definition makes clear that systems can and do comprise more than one structure and that no one structure can irrefutably claim to be the architecture (Len Bass, Paul Clements and Rick Kazman, 2005).

The definition implies that every computing system with software has software architecture because every system can be shown to comprise elements and the relations among them.

The behavior of each element is part of the architecture insofar as that behavior can be observed or discerned from the point of view of another element. (Len Bass, Paul Clements and Rick Kazman, 2005)

Finally, the definition is indifferent as to whether the architecture for a system is a good one or a bad one, meaning that it will allow or prevent the system from meeting its behavioral, performance, and life-cycle requirements.

In the approach presented here, service-based C4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance) but for this architecture we want desire to have latest version of this architecture as Department of Defense Architecture Framework (DoDAFv2.0) solutions for Autonomic Grid computing base on self-* (IBM, 2001; P. Horn, 2001; M. Parashar, S. Hariri, 2001) properties:

•Self-managing
•self-protecting
•self-configuration
•self-healing
•self-optimizing
•self-tuning

The assessment of C^4ISR systems in support of military operations is an art form that has evolved substantially over the last thirty years. Prior to that period, national security assessments were generally insensitive to C^4ISR system issues. (Stuart H. Starr, 2006)

1.3. AGC^4ISdR Architecture:

In (Ericsson, 2010) paper use C^4ISR for network- oriented defense, in this paper try to use SOA properties for networks but in AGC^4ISR we need this solution and support self-* properties for autonomic grid computing networks, then in any node we need all self-* properties.

There are four dimensions of architecture integration (US DoD, 1997) that represent varying degrees of integration scope. Figure 1 illustrates these four dimensions in context with a global, hierarchical view of war fighter operations and support. Note that the need to integrate multiple architecture views and descriptions is certainly not limited to Joint or cross-organizational considerations. The Framework is intended to facilitate all four integration dimensions.

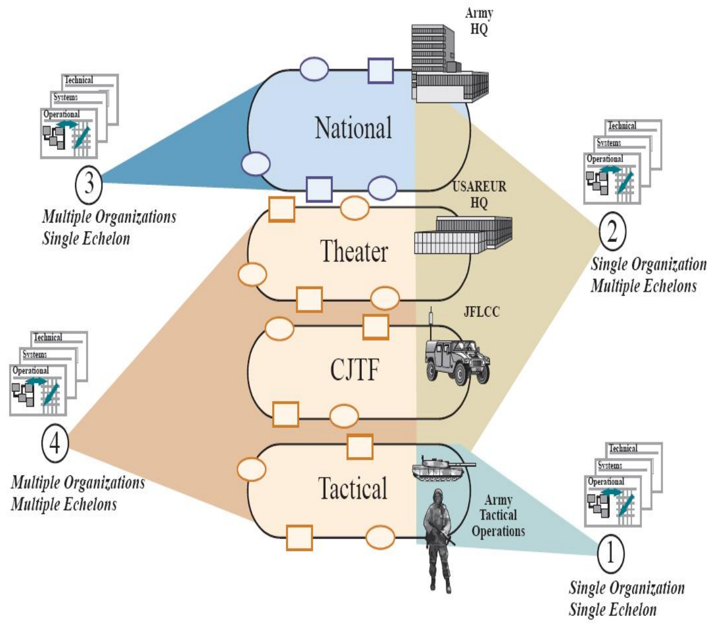

Fig. 1: Four Dimensions of Architecture Integration (US DoD, 1997).

A first dimension involves a single organization and its operations within a single "echelon." In the example shown, the focus is on Army operations at the tactical level (echelon). In addition to the obvious need to interrelate the three views (and associated products) of an Army tactical architecture, in this case there may be multiple architectures - at the same echelon- that cover different functional areas or viewpoints that need to be interrelated, depending on the purpose and scope of the initiative. For example, the Army may be investigating more cost-effective means of providing logistics support to troops in the field. This may involve integrating the architecture views that reflect a war fighting perspective with the views reflecting a logistics-support perspective to assess tradeoffs between C^4ISR and logistics investment options. We can use this dimension on autonomic grid by tactical architecture for manage as hierarchy in grid networks because some time we need mange autonomic node on the network.

A second dimension illustrated in figure 1 still involves a single organization (Army), but the integration scope expands vertically to include Army operations across multiple echelons. In this particular case, the organization may be examining opportunities to streamline its operations or investments from top to bottom.

A third integration dimension involves architecture initiatives that cross-cut multiple organizations (U.S. And/or multi-national) horizontally, within a single echelon. An example of this dimension is an architecture whose objective is to investigate opportunities for the various components of DoD to exploit or leverage National information infrastructure capabilities and in grid computing so.

A fourth dimension of integration involves multiple organizations and multiple echelons, where vertical and horizontal Joint relationships need to be articulated and examined. An example of this dimension is an architecture whose focus is on assessing the effectiveness of intelligence information support to the war fighter. This could involve examining tradeoffs between hierarchical support policies and practices, e.g., theater- based Joint Intelligence Center dissemination to lower-echelon users and direct dissemination from collectors to forces.

Why AGC^{4}ISR architecture?:

The reason and answer to this question is:

This architecture base on agent oriented architecture (M. Bahrami, A.M.Rahmani and A. Faraahi, 2010) similar to any node in grid networks (Giampapa, 2005).

The AGC^{4}ISR solutions for network oriented defense (M. Bahrami, P. Arebi, H. Bakhshizadeh, H. Barangi, 2011) are based on a Service-Oriented Architecture (SOA) (Ericsson, 2010).

As illustrated in section 1 and 2 then any agent can have a service for others and have self-* for any node as autonomic grid computing networks.

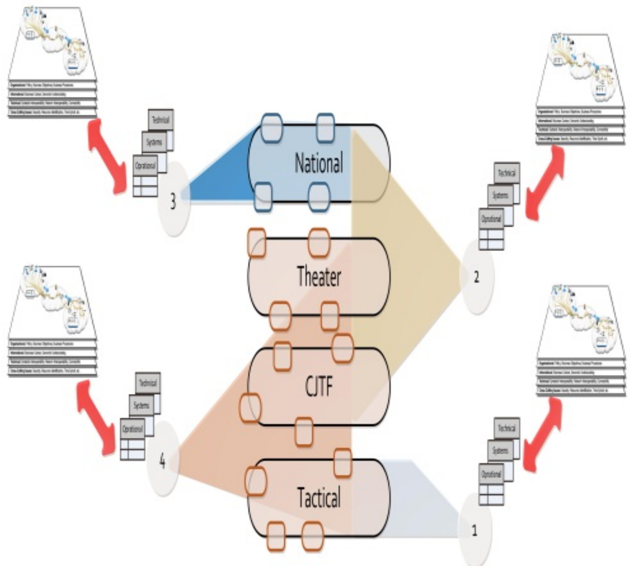

Fig. 2: Four Dimensions of AGC^{4}ISR.

SAGC^{4}ISR Architecture:

In last part explain using autonomic grid in C^{4}ISR and create AGC^{4}ISR architecture as illustrate in figure 2 and 3. Now add smart attribute to the last trait and explain SAGC^{4}ISR architecture with use Smart Grid architecture.

For description this architecture spots an organization that covered with autonomic grid. In this organization all parts connected with grids but organized with people.

Now we try to use Smart Grid in this organization:

First dimension take decisions like echelon from top to bottom in every organization. This decision need to some primary information that after hoarding and spent more time, people can take decision. But now if autonomic grid has smart affection or using smart grid in autonomic grid can be send knowledge to grid and take decision without risk or with few risks at least.

Second dimension is connected with different systems that say in last part. But in this dimension after that smart grid can take decision, find the best grid for doing the next part. It means that, every work doing by specialist grid.

Third dimension is computing part. In this part smart grid can be get the knowledge and computing them and sent to next and specialist grid. This part Except for saving time makes the calculations to ensure accuracy improve.

Fourth dimension is comported merging and sharing organization that how to survey connect this organization to another organization or even different nationality. This relation is possible vertically with the same organization or horizontally with top or button organization.

Naturally, use of Smart grid is need to high cyber security that with used of security techniques can be create a very safe cyber and smart grid.

Now we can use this architecture for C^{4}ISR. It means that we can match every four parts of AGC^{4}ISR architecture with smart grid and create a new architecture that named SAGC^{4}ISR architecture.

Conclusion:

To the best of our knowledge, very little research contributions have been published toward applying Smart Grid in autonomic computing principles in the context of software architecture in autonomic computing networks and introduces this architecture who used AGC^{4}ISR architecture.

In AGC4ISR architecture we trying to use many model of Smart Grid on the network then we have best mapping for any solution in this topic and related information.

As other artifact in this architecture we proposed use of smart grid in AGC^{4}ISR, then in this paper we can found many items and material related to use of smart grid in SAGC^{4}ISR.

As proposal for related work we can offer extend and find many problems for mapping Smart Grid networks on AGC^{4}ISR architecture.

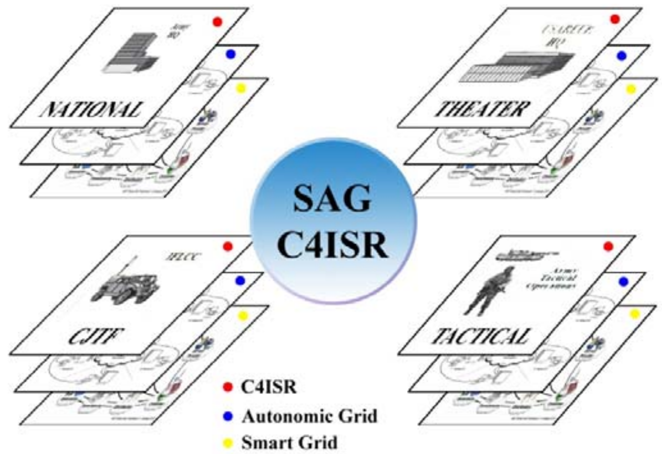

Fig. 3: SAGC4ISR Software Architecture.

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