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BRINGING C2 CLOUD SOLUTIONS ON THE MILITARY FIELD

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Abstract*: There is a permanent demand from the operational military echelons to have C2 systems up and running in terms of hours from the moment of request. Even more, complementary C2 systems should be available in real time, all the time. The areas of specializations of different BOSs that a C2 system should integrate or make use of the exchanged data put a high pressure on the software architecture and the technological stack the C2 solution should be based on. We develop C2 software solutions that offer core services to military organizations, from tactical echelons to tactical-operational echelons. Deploying the same solution on several nodes is not an easy task. Maintaining, but improving with new functionalities a software solution already deployed on the field is a complex tax, requires a sophisticated logistic process, long planning and execution phases. In time, discrepancies could appear among different installed versions and is hard to maintain such configurations. Aiming to offer to Romanian Army a C2 software solution that is fast, modern, scalable, easy to deploy, capable to run online 24/24h we switched to a cloud technological stack for our C2 solution and we intend to have the same C2 base platform on all our future deployments.*

Keywords*: Command&Control (C2); cloud architecture; web services; C2 core services; specialized applications and tools; inter-operability.*

Context

Since 2005, INTERACTIVE continuously developed and upgraded a suite of innovative, interoperable command and control products named "Battle Command and Control Application" – short name BC2A. The solution covers the core C2 functionalities from deployed soldier up to tactical-operational level, validated at FMN SP2. The maintenance process of the software solution is a permanent one, based on the requirements we receive from the military organizations, standard requirements from NATO, exploring and development new capabilities using the existing subject matter experts we have access. But there is also and additional driver that push it hard to develop new software solutions that fit better on the operational environment. And this diver is the technological factor that is pushing the entire IT industry. Secondly, we really want to bring our C2 solutions as a daily basis tool for the people that are working in the Romanian Army, from the educational levels, tactical and operational field till the strategic echelons. It is beneficial that people who use IT tools in their educational training should find similar solutions in the operational field. And these tools should be by themselves modern, easy accessible, secure, scalable, easy to use.

A C2 solution that runs on cloud

BC2A Portal represents the new technological vision of INTERACTIVE regarding C2 applications based on web technologies and it is intended to address FMN SP3-SP6 requirements. The initiative started this year and has several fundamental elements:

- The C2 solution should address the operational and strategic level, including Joint Operational level;
- The C2 solution should be designed for multi mission, multi organization, providing operational support to all military forces (Combat, Combat Support, Combat Service Support) up to strategic levels;

- The product should be a modular one, developed using web technologies, running on a cloud on premises deployment, having a SOA architecture, based on a set of core C2 services that implements specific features to all BOSs (Battle Operation Services);
- It should support and automate staff activities at the strategic, operational and tactical levels;
- It should be able to handle in the same instance one or several military organizations;

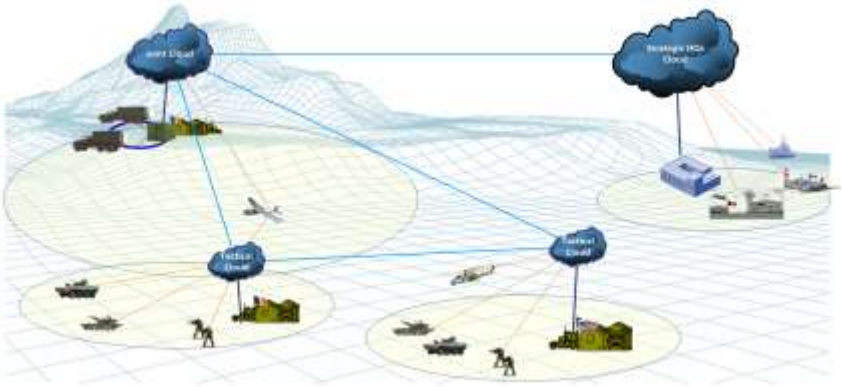

Figure 1 – The vision concept of a product that fits several echelons at once

The C2 solution should offer the right services to the selected echelons, but all deployments should share the same technological infrastructure, that can be easily interchanged or upgraded in case of missing functional communication nodes or physically destroyed.

Main capabilities

To be able to have a software that brings value from the tactical level to the strategic one is not an easy task because of the very different kind of data and information the systems should process at those echelons. Still, it is known that there are several things that cannot be missed, whatever echelon would be, whatever theater of operations or mission. These basic building blocks of software that are essential to military to conduct their activities are at least the followings:

- Capability to handle one or several military organizations at once, with their user permissions, missions and/or theater of operations;
- Capabilities to construct the Recognized Pictures (RGP/RMP/RAP);
- Capability to manage ORBAT and TASKORGs;
- Capabilities to make assessments, reviews, making plans and issuing orders;

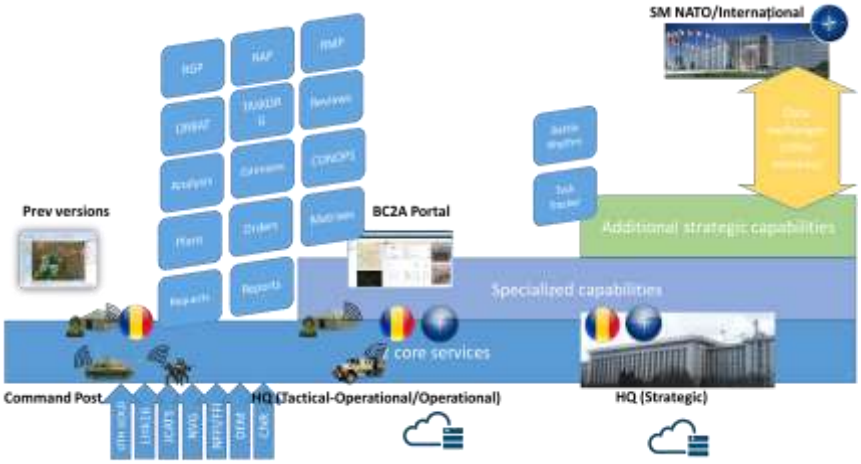

Figure 2 - Basic building blocks of C2 system

These capabilities should work together with previous version of C2 software and from an interoperability point of view, the new C2 system should be able to make use of standard military communication, like DEM, NFFI/FFI, Link16 and others.

Main architectural aspects

The new web based C2 system will be based on a TRL3/TRL4 proof of concept solution compliant with a cloud on premises (governmental) deployment. The software will run on a normal browser, where the server side is based on an open stack cloud technologies. The new product will contain specialized C2 applications that can be used at all echelons, in a collaborative or individual manner. These C2 products are:

- Recognized Picture tool: C2 application that permits visualization of relevant data using military symbology;
- OrgChart tool: C2 application that helps military officers to manage ORBAT (including national ORBAT) and TASKORGs for specific missions and theater of operations;
- C2IP Explorer: C2 application that facilitates the exchange of C2 Information Products between systems , organizations and users;
- MilDoc Editor: C2 application that helps officers to develop standard military documents, like plans and orders;
- COA Manager: C2 application that handles different Course of Actions for a specific contexts;

As mentioned earlier these results will be obtained switching from the traditional architectural pattern, like the client-server, but to a cloud based approach, using containers, micro services, backing services and making use of the automation services of the cloud.

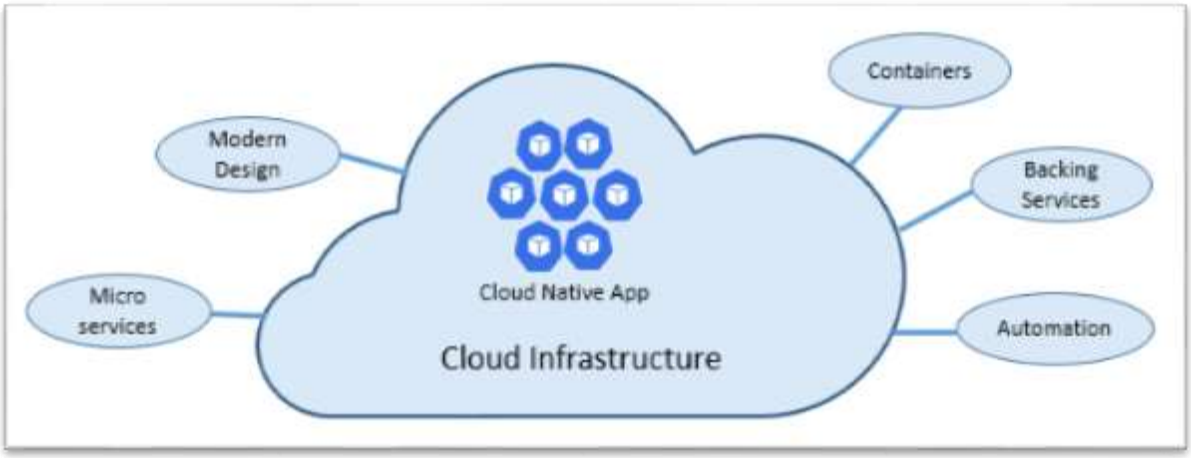

Figure 3 - Architectural elements of the C2 system in cloud

Adopting cloud technologies we benefited from the start of the followings:

- A modern design: responsive, resilient, elastic and message driven;
- Containers: provide portability and guarantee consistency across environments; we use docker and kubernetes;
- Backing services: Data Stores, Distributed Caching, Message Brokers, Monitoring and Identity Services;
- Automation: Infrastructure as Code – the management of infrastructure (networks, virtual machines, load balancers, etc.) in a descriptive model;
- Embraced Technologies&Frameworks: Angular/React with TypeScript, GraphQL, Apache Kafka/RabbitMQ, Redis, Powershell DSC&Puppet, Elastic Stack.

The actual deployment of our C2 proof of concept solution is using three kubernetes nodes that contain an image consisting of three docker containers:

- One Docker container for the NGINX load balancer + the Angular App – BC2A web client App;
- One Docker container for the RabbitMQ queue notification service;
- One Docker container for the REDIS storage mechanism + the Server App – BC2A Server App.

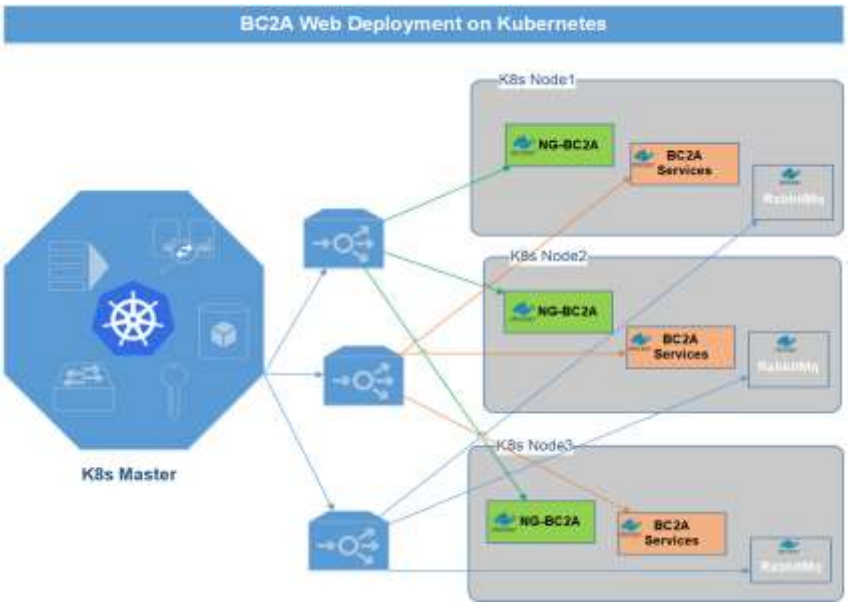

Figure 4 - Actual deployment of existing C2 system

Conclusion

Developing with cloud in mind brings several challenges and benefits: the challenges are related to the technological stack chosen to support the architecture of the solution, learning new tools and frameworks, but the benefits are substantial: a software solution that is easy to deploy, easy to maintain and upgrade.

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