



CASNIAV

CENTRO DE ANÁLISES DE SISTEMAS NAVAIS

24th ICCRTS 2019

**Command and Control Interoperability
Middleware Architecture**

24th ICCRTS, 2019

Command and Control Interoperability Middleware Architecture



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INTERC2

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AGENDA

Introduction

Interoperability

C2 Interoperability standards

Patterns and Technology

Interoperability among Simulators

Future Planned Interoperability

Conclusion and Opportunities of Innovation

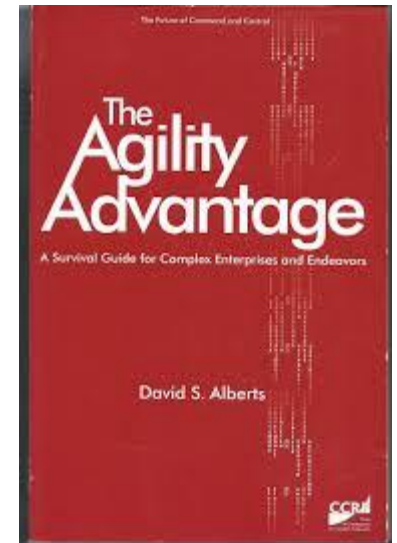
INTRODUCTION

Leading context

Agility, the basis for modern military operations, is a way of dealing with the combined effects of **complexity and uncertainty**.

Modern military operations require precise and timely information shared on a secure and need-to-know basis.

Distributed Command and Control (C2) exchanges from a Country's Forces and its Allies require interoperability among Information Systems (IS).



INTRODUCTION



The Joint Programme Interc2



In Brazil, those concepts were met by the Command and Control Interoperability project (INTERC2).

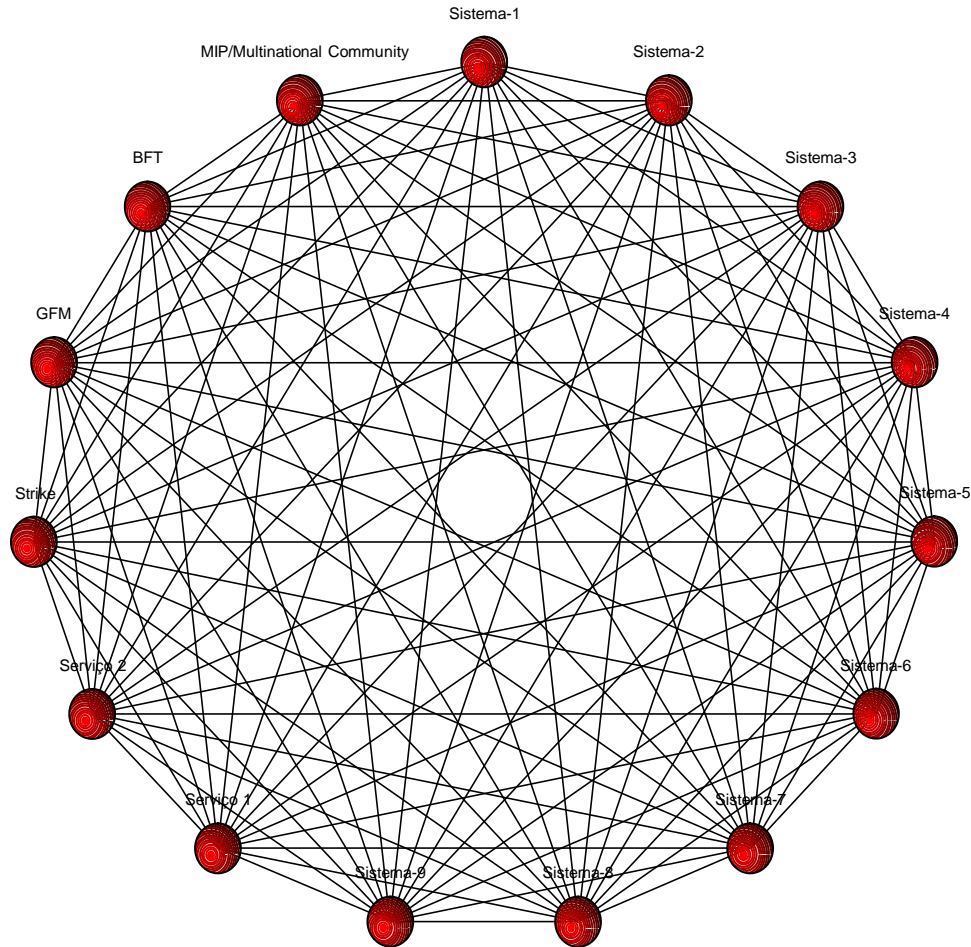
A joint program between Brazil's Ministry of Defense (MD) and Brazilian Armed Forces to achieve C2 Interoperability among C2 Information Systems (C2IS).

MAIN REQUIREMENT

Develop and implement a Service Bus that allows interoperability between the Military Operational Planning System (SIPLOM) belonging to the Ministry of Defense and the C2 information systems belonging to the Military Forces in Joint and Combined Operations.



WITHOUT COMMUNICATION BUS



INTEROPERABILITY

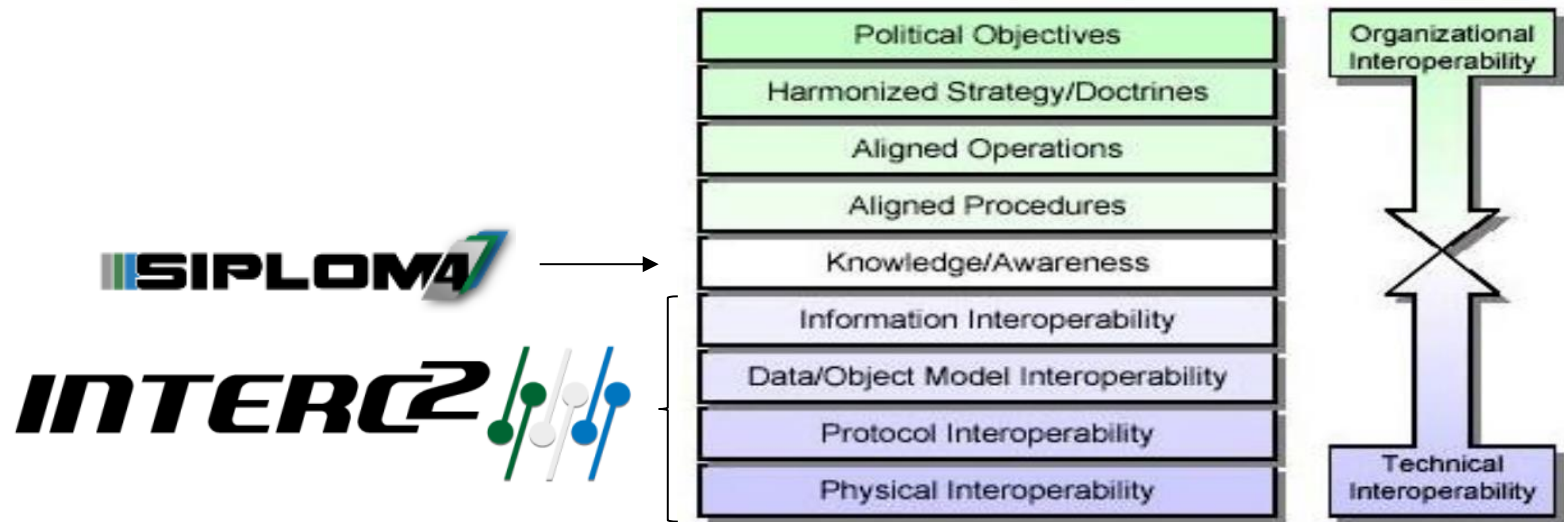
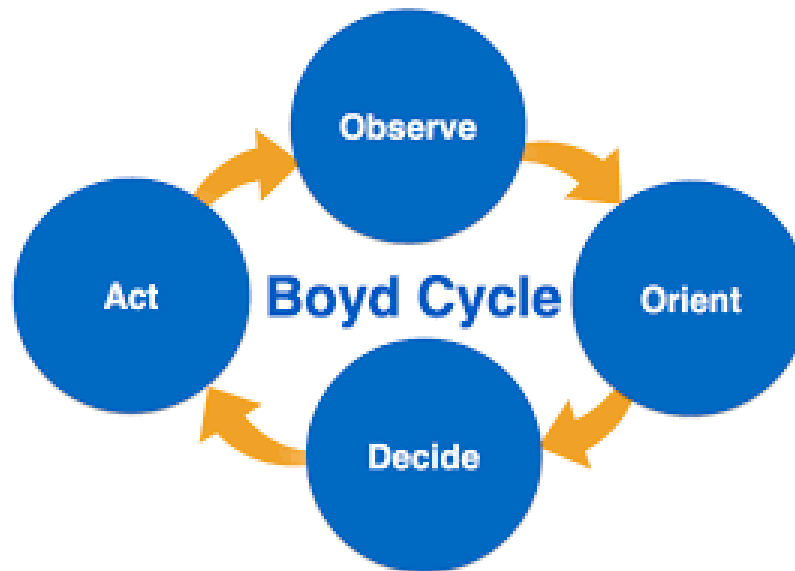


Figure 1— Levels of Organizational Interoperability

Rezaei, Reza, et al. "An Interoperability Model for Ultra Large Scale Systems." *Advances in Engineering Software*, vol. 67, 2014, pp. 22–46., doi:10.1016/j.advengsoft.2013.07.003.

MAIN GOAL

Main goal of Interc2 Project is to seek agility in order to accelerate the OODA cycle!



PATTERNS AND TECHNOLOGY



A D E M
Alternate Development and Exchange Method



PATTERNS AND TECHNOLOGY

The **Multilateral Interoperability Programme (MIP)** is an effort to deliver an assured capability for interoperability of information to support multinational, combined and joint operations.

The MIP goal is to support all levels from corps to battalion. MIP's focus is on command and control systems.

MIP is a consortium of 29 NATO and Non-NATO nations that meet quarterly to define interoperability specifications for the exchange information between their national Command and Control systems.

<https://public.mip-interop.org/sites/mip/Pages/Home.aspx>

https://en.wikipedia.org/wiki/Multilateral_Interoperability_Programme#JC3IEDM



PATTERNS AND TECHNOLOGY

The **Joint Command, Control and Consultation Information Exchange Data Model (JC3IEDM)**, is first and foremost an information exchange data model.

The model can also serve as a coherent basis for other information exchange mechanisms, such as message formats, currently lacking a unified information structure.

<https://public.mip-interop.org/Pages/Default.aspx>

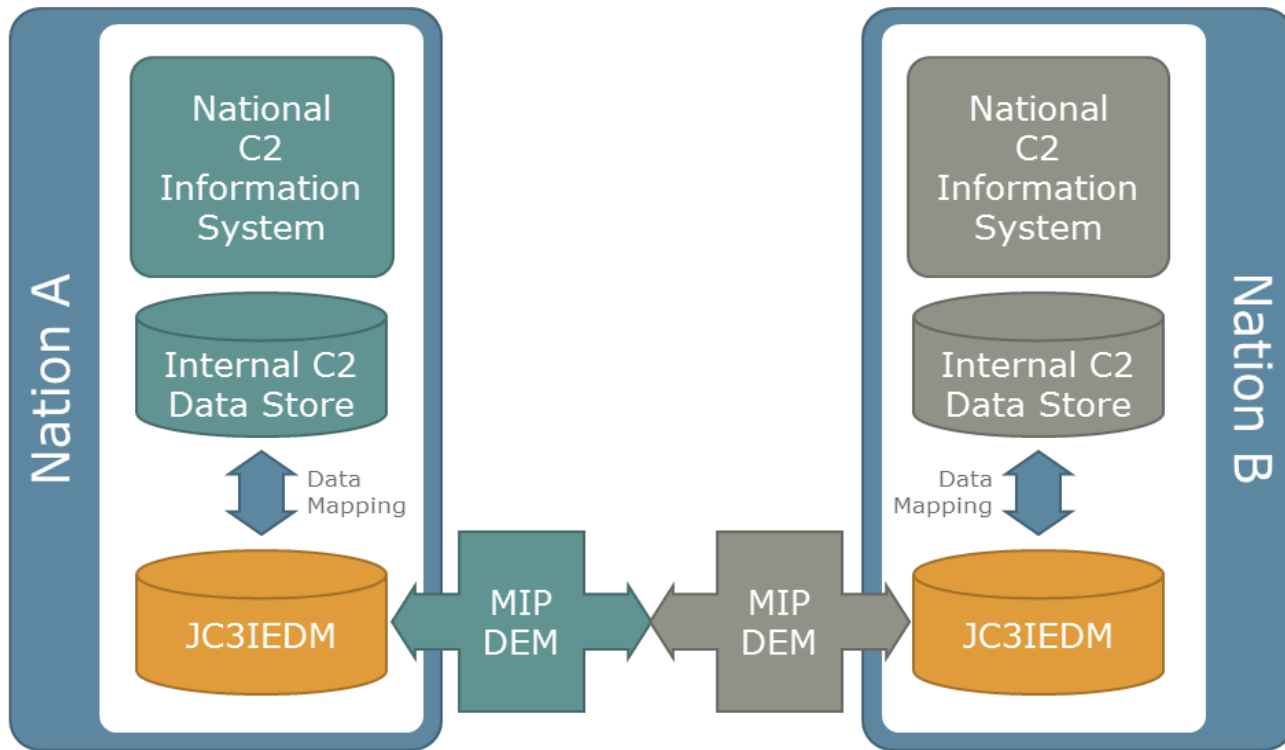
PATTERNS AND TECHNOLOGY

JC3IEDM is intended to represent the core of the data identified for exchange across multiple functional areas and multiple views of the requirements.

Toward that end, it lays down a common approach to describing the information to be exchanged in a command and control (C2) environment.

<https://public.mip-interop.org/Pages/Default.aspx>

PATTERNS AND TECHNOLOGY



NATO degree 4.a interoperability
NATO level 5 interconnectivity

<https://systematic.com/defence/capabilities/c2/interoperability/mip/>

PATTERNS AND TECHNOLOGY

Alternate Development and Exchange Method

The ADEM specification provides the means to exchange the Current Situation using the semantics of the Joint Consultation, Command and Control Information Exchange Data Model (**JC3IEDM**).

ADEM enables simple and extensible information exchange using existing open standards (Web Services) while remaining faithful to the proven utility of the **JC3IEDM** information model



EXAMPLE MESSAGE (DATA)

- Information source: Navy (Brazilian Navy);
- Obj. of interest kind: Surface Vessel (Ship);
- Obj. of interest name: Fragata Defensora;
- Hostility: Friend (FR);
- Color: GREY;
- Hull Nr.: F41;
- Operacional status: OPR;
- Class: Frigate (FFL).



ADEM EXAMPLE MSG (XML)

```
<?xml version="1.0"?>
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/">
  <soap:Body>
    <ns3:SurfaceVessel xmlns="http://mipinterop.org/schemas/ADEM/2014/04/11/Jc3Types.xsd"
      xmlns:ns2="http://mipinterop.org/schemas/ADEM/2014/04/11/Jc3Common.xsd"
      xmlns:ns3="http://mipinterop.org/schemas/ADEM/2014/04/11/Jc3Materiel.xsd"
      xmlns:ns4="http://mipinterop.org/schemas/ADEM/2014/04/11/Jc3Location.xsd"
      xmlns:ns5="urn:br:mil:md:sc1:interc2:types" Source="MB" uri="urn:uuid:17f2d995-fe23-
4cdb-b397-3da2daadb766">
      <ns2:CommentText>test Wed Nov 26 15:32:25 BRST 2014</ns2:CommentText>
      <ns3:NameTxt>F Defensora</ns3:NameTxt>
      <ns3:Hostility>FR</ns3:Hostility>
      <ns3:BodyColourCode>GREY</ns3:BodyColourCode>
      <ns3:OperatStatCode>OPR</ns3:OperatStatCode>
      <ns3:HullNoTxt>F41</ns3:HullNoTxt>
      <ns3:SurfVesselTypeCatCode>FFL</ns3:SurfVesselTypeCatCode>
    </ns3:SurfaceVessel>
  </soap:Body>
</soap:Envelope>
```

COMMUNICATION BUS



SIPLOM USER INTERFACE

The screenshot displays the SIPLOM User Interface, a web-based application for monitoring and managing river patrol operations. The main window shows a map of South America, specifically the Amazon region, with various operational units and their locations marked. The interface includes a sidebar with a tree view of operations, a top navigation bar, and a detailed view of a specific unit.

Árvore Operacional

- Referência: 171.1022/OUT/19
- Atual
- Operações Singulares
 - Brasil
 - Marinha do Brasil
 - Interesse do MD
 - LIBANO XV
 - F 45
 - OPERAÇÃO LIBANO XVI
 - sar sse 048/2019
 - Ações Complementares
 - Controle de Terminas Satelitas MB
 - Ações de Busca e Salvamento
 - Exército Brasileiro
 - Interesse do MD
 - Ações Complementares
 - Ações Internacionais
 - Ações Subsidiárias
 - Força Aérea Brasileira
 - Ações Complementares
 - Defesa Aérea
 - Alerta Defesa Aérea
 - Cobertura Radar
 - Operações Conjuntas
 - VERDE BRASIL
 - Comando Militar da Amazonia
 - Brasil
 - FNC
 - Ag Flu MUTIRUM II
 - AvHoFlu RIO NEGRO
 - AvHoFlu RIO SOLIMÕES
 - Com9º DN
 - ComFlotAM
 - ENRN
 - Esq9HU-3
 - P 21
 - P 31
 - P 32
 - FTC
 - 4º BAVEx

Detalhes do Navio P 21

HPaflu Raposo Tavares		FIC
	Tipo: Navio Patrulha Fluvial	
Mais Imagens	Localização: Lat: 03°08'55.00"S Long: 058°26'56.00"W	Situações Operacionais
Multmídias	Situação: Em Movimento	Danos
	Atualizado em: 141527Z/OUT/19	Sensores
		Armamentos
		Hostilidades
		Localizações
		Tarefas
Observações:		
Não informado		

UTM: 23L 8579980 383166 Lat: 12°50'34.86"S Long: 046°04'35.98"W

ADMINISTRADOR (D01)

SIPLOM RECEIVES A SURFACE VESSEL LOCATION

The screenshot displays the SIPLOM (Sistema de Informação de Posicionamento de Navios) interface. The main window shows a satellite map of the Eastern Mediterranean, including parts of Turkey, Cyprus, Lebanon, Israel, and Jordan. A red location marker is placed in the Mediterranean Sea, with the following details:

- Nome: Fragata União
- Operação: LIBANO XV
- Origem: Marinha do Brasil
- Localização: 33°53'00.00"N / 035°29'00.00"E
- AC: Suwayda

The left sidebar, titled "Árvore Operacional", lists various operational tasks and units, including:

- Operações Singulares
 - Brasil
 - Marinha do Brasil
 - Interesse do MD
 - LIBANO XV
 - F45
 - OPERAÇÃO LIBANO XVI
 - ser sse 048/2019
 - Ações Complementares
 - Controle de Terminais Satelitais MB
 - Ações de Busca e Salvamento

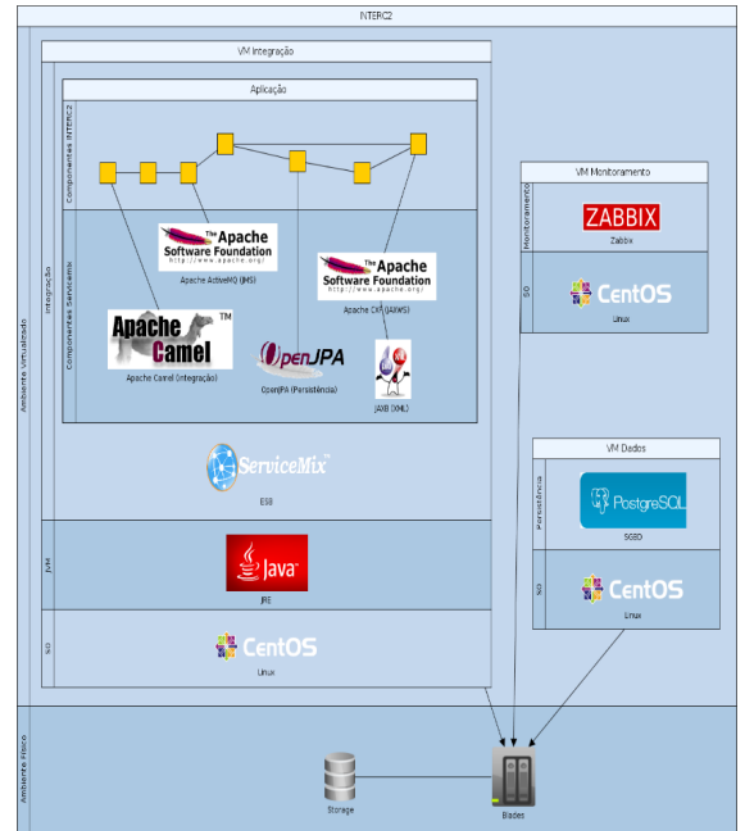
The bottom status bar shows the UTM coordinates: 36S 3753738 732911, and the geographic coordinates: Lat: 33°53'33.94"N, Long: 035°31'07.68"E. The user is identified as ADMINISTRADOR (D01).

SOFTWARE TECHNOLOGY

Open source is the Motto!

In order to fulfill CB requirements without incurring major software infrastructure costs, INTERC2 team adopted:

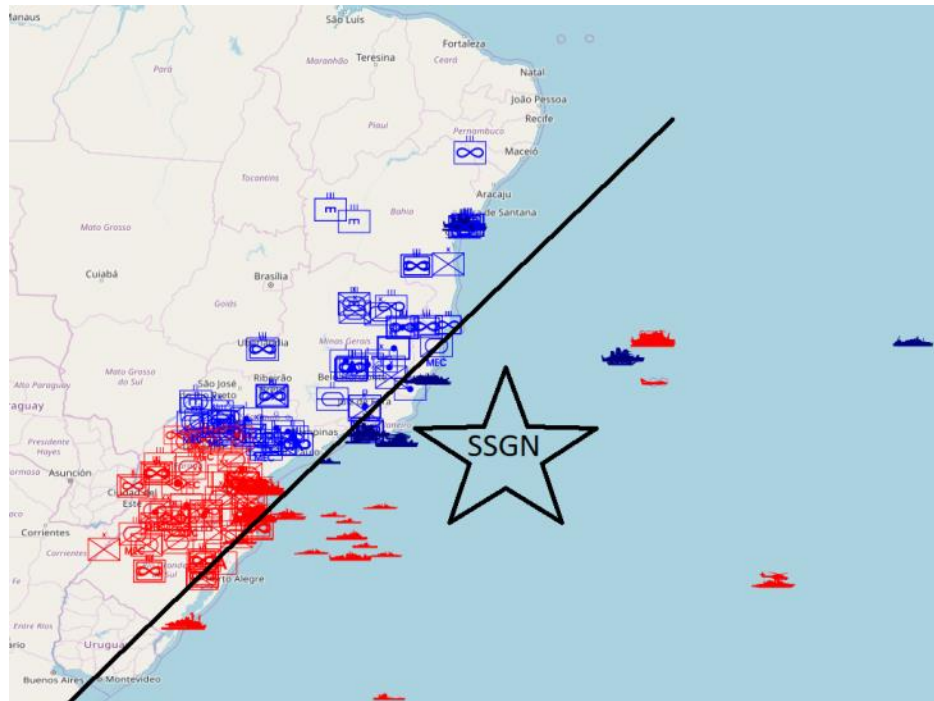
- The Apache ServiceMix Portfolio;
- A SOA-based open source Enterprise Service Bus (ESB) to leverage library requirements.



Software Assets in a Modular View

NAVAL WAR SIMULATION SYSTEM (SSGN)

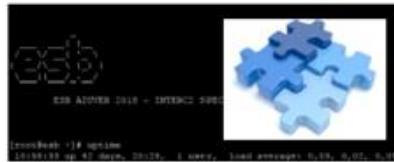
Building on the knowledge gained in project research and development and by determination of the Deputy Chief of Command and Control, a new version of the Communication Bus has been developed to integrate military operations simulators.



NAVAL WAR SIMULATOR SYSTEM



INTERC2



Map



SIPLOMA OK INTERC2 OK SSGN SERVIÇO OK

MD-ROD

EMBEDDED INTEROPERABILITY

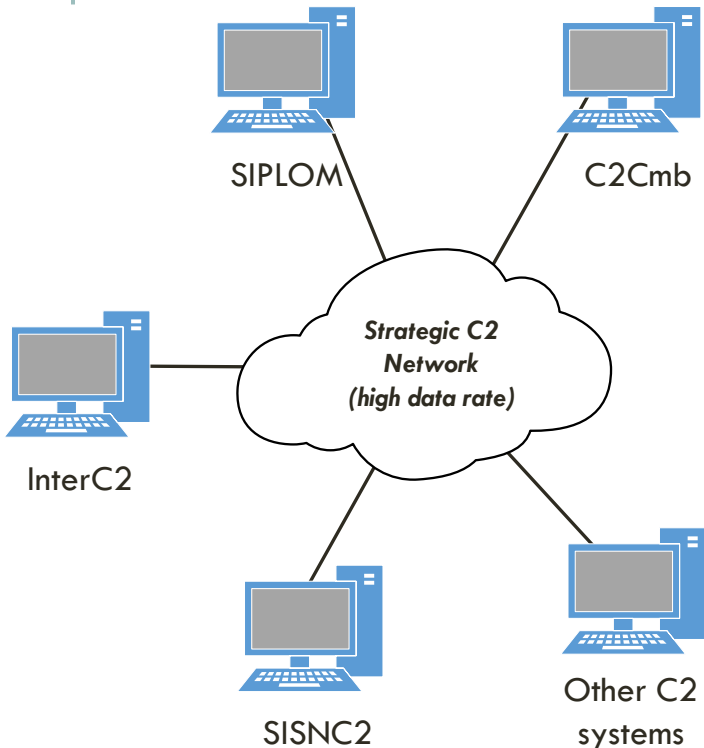


EMBEDDED INTEROPERABILITY



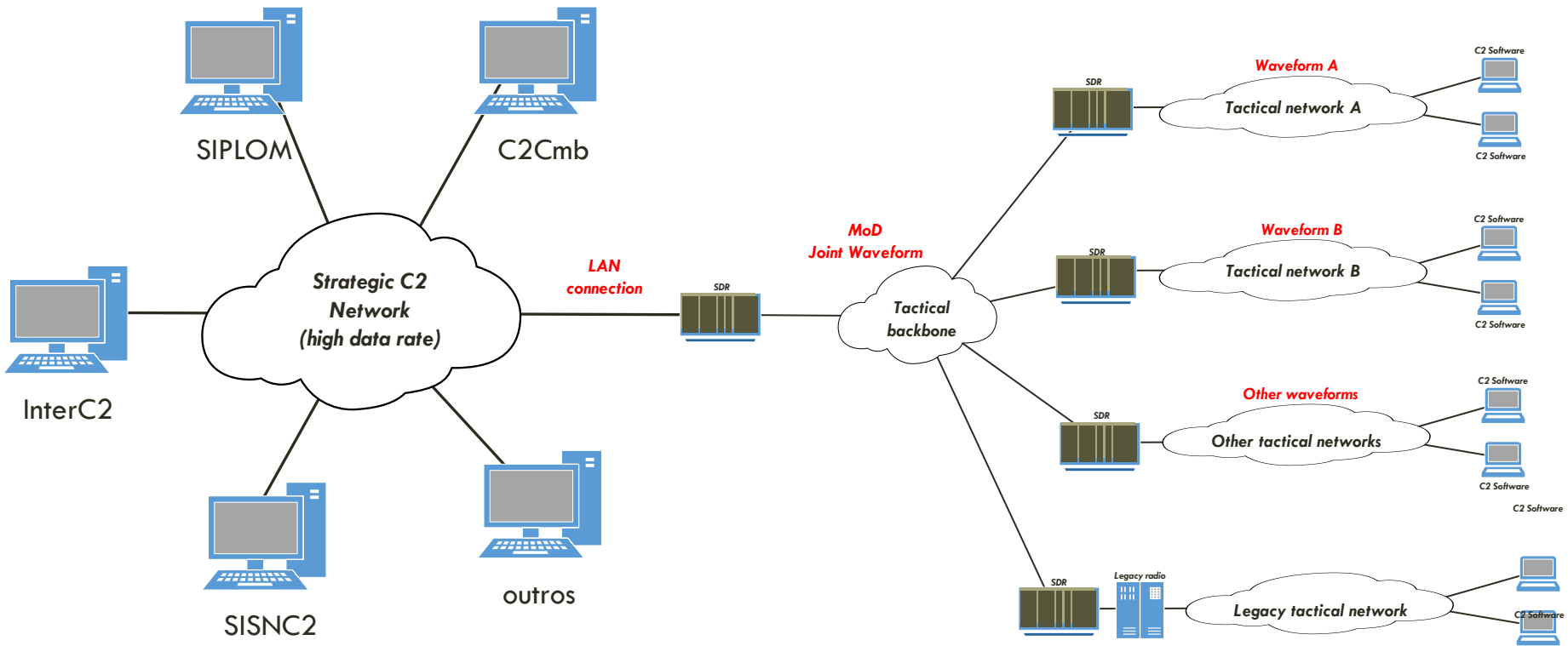
Building on the knowledge gained in the research and development of the project and by determination of the Deputy Chief of Command and Control, a new version is being developed to be employed at the tactical level.

INTEROPERABILITY SDR – INTERC2



- Today strategic C2 Systems are accessed through high data rate networks
- SDR will connect tactical networks between themselves and to the strategic networks
 - high distance data links
 - mobile stations
 - low data rates
 - high delay
 - data loss
 - will connect different tactical networks

INTEROPERABILITY SDR – INTERC2 AND MULTIPROTOCOL DATA LINK



CONCLUSION AND INOVATION OPPORTUNITIES

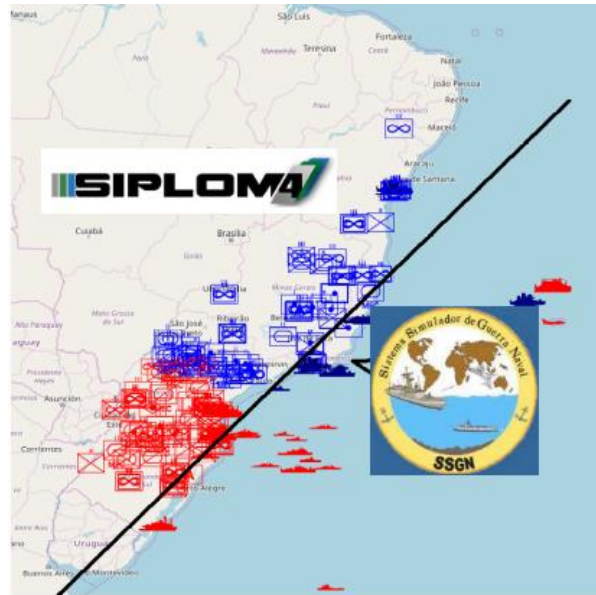


CONCLUSION AND INOVATION OPPORTUNITIES

Mil Ops



Simulation



Tactical - SDR



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