2019 NATO MODELLING AND SIMULATION GROUP SYMPOSIUM

Development of an Air Operation eXtension with the (Future) C2SIM Standard

Bruno Gautreau

AIRBUS

Magdalena Dechand

Lukas Sikorski

Irmtrud Trautwein

Fraunhofer FKIE

Eric Bouvier

DIGINEXT be visionary

Lionel Khimeche

DGA

Development of an Air Operation eXtension with the (Future) C2SIM Standard

Overview

- **COMELEC**
- **The C2SIM Context**
  - The Role of Ontologies
  - From Ontologies to Schemata
- **Air Operations in C2SIM**
  - Specifics of Air Operations
  - Ontological Representations
  - Exchanging TDL Messages
- **Lessons Learned**
- **Conclusion**

Fraunhofer FKIE

Project COMELEC

COMELEC

(Commission Electronique)

is

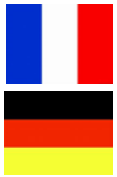
a) the abbreviation for
   a German-French C2SIM
   working group;

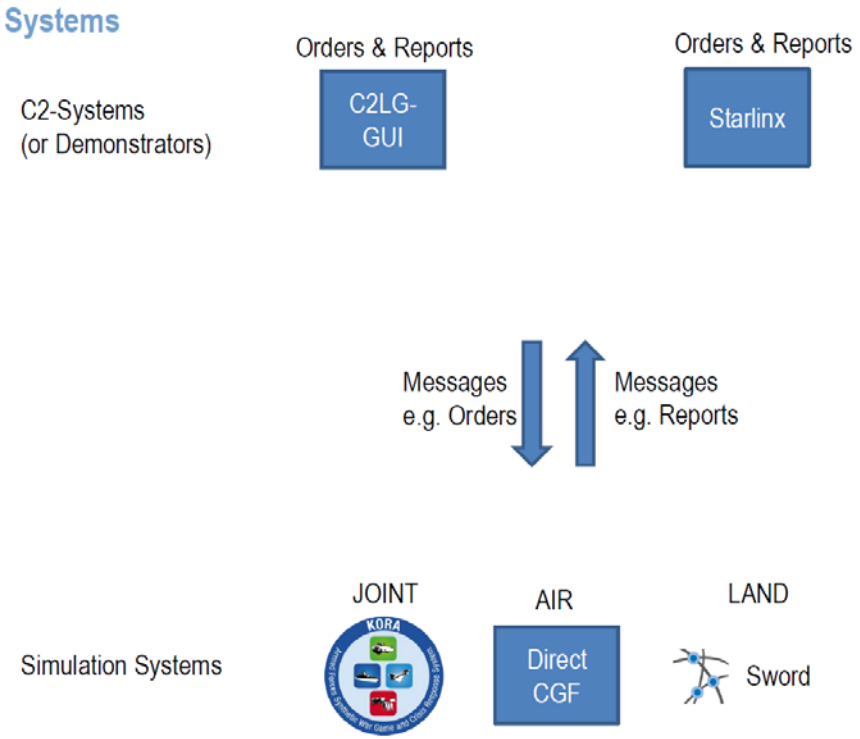
b) the short term for the
   current project of that group.

Members are

DGA, Airbus, DigiNext

iABG, FKIE





Fraunhofer FKIE

preliminary remarks

- This is work in progress. However, we already can present experience with the forthcoming C2SIM standard we judged as important.
- We plan to present an updated version of our work at the next SIW (10-14 February, Orlando, Florida).
- This presentation has a focus on the work done by FKIE.
- The scenario, however, had been developed by DigiNext. Therefore pictures show mostly French platforms.
- In the current COMELEC project, we also discuss a second scenario, developed by iABG, but as that scenario is about ground operations. Thus, it is not topic of this presentation.

The C2SIM Context

SISO C2SIM PDG is developing a C2SIM standard.

The SISO C2-Simulation interoperation has always been supported by NATO activities, currently by NATO MSG-145.

Existing standards are

- the MSDL standard (SISO-STD-007-2008) for initialization and
- the C-BML standard (SISO-STD-011-2014) for the exchange of military communication (reports, requests, orders) during simulation runs.

The C2SIM Context – the Role of Ontologies

Currently, SISO develops a new C2SIM standard since

- the cooperation of MSDL and C-BML turned out to be difficult and the goal is an integrated solution;
- the new standard is supposed to be extensible.

To these ends, an ontology will serve as the C2SIM main representation.

Extensibility is granted by the development of a core ontology to be supplemented by extensions. This talk is about the air operation extension.

The C2SIM Context – from Ontologies to Schemata

Ontologies represent knowledge; schemata allow the exchange of messages.

Good ontologies represent the knowledge correctly. → Semantics

Good schemata transmit their messages in a correct form. → Syntax

Nevertheless, the receiver of a message should understand the message's meaning as intended by the sender.

Therefore, in the C2SIM case, schemata need to refer back to ontologies: We generate the schemata automatically out of the ontology, as is explained in Blais et al. (2018).

Evaluation criterion: can the schema generated out of the ontology (core plus air operation extension) handle the message exchange as intended?

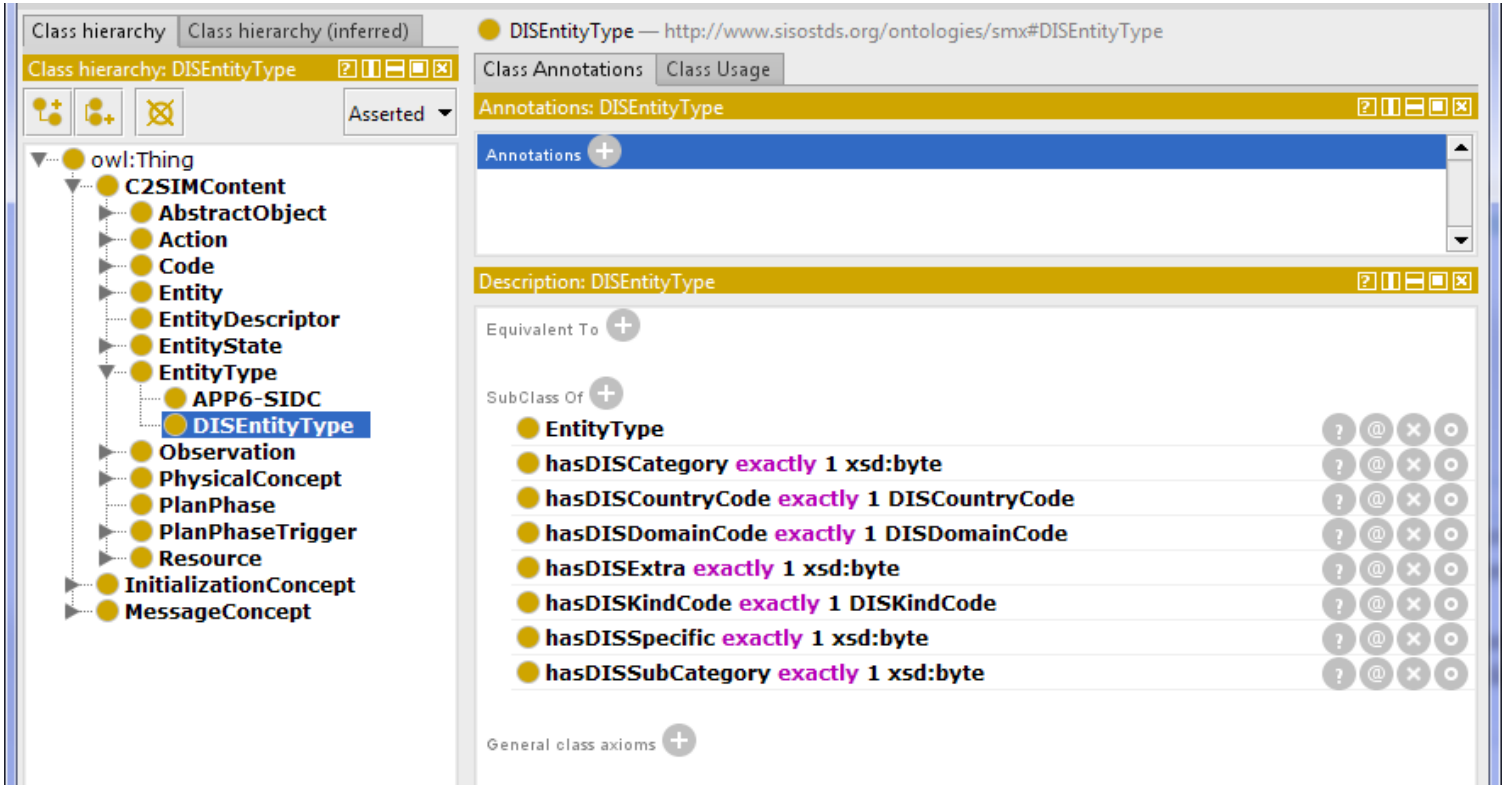
Air Operations in C2SIM – Specifics

Airborne entities move fast. → Automated position updates are generated by an airborne radar picket system, like an AWACS. These data form tracks. → Units are referred to by track numbers.

Messages are exchanged as TDL messages. (TDL = tactical data link, e.g. link 16).

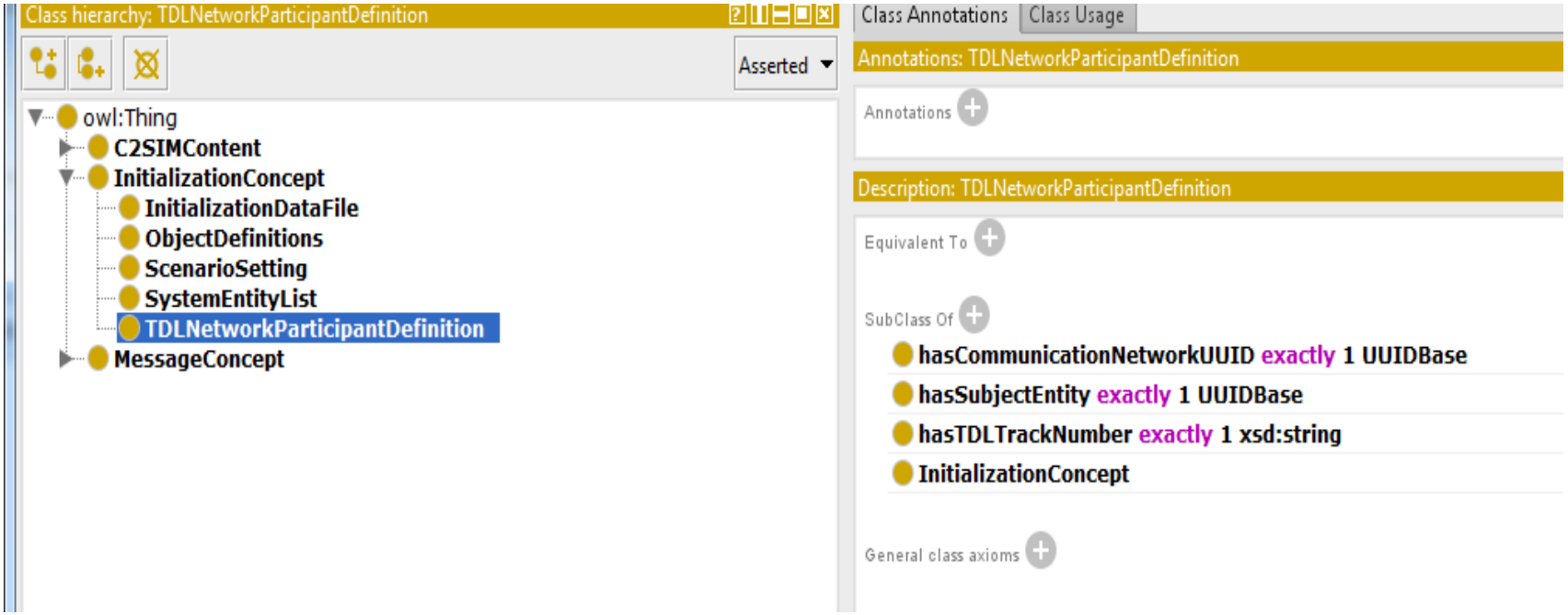
A secure data network allows the exchange of TDL messages.

Air Operations in C2SIM – Ontological Representations



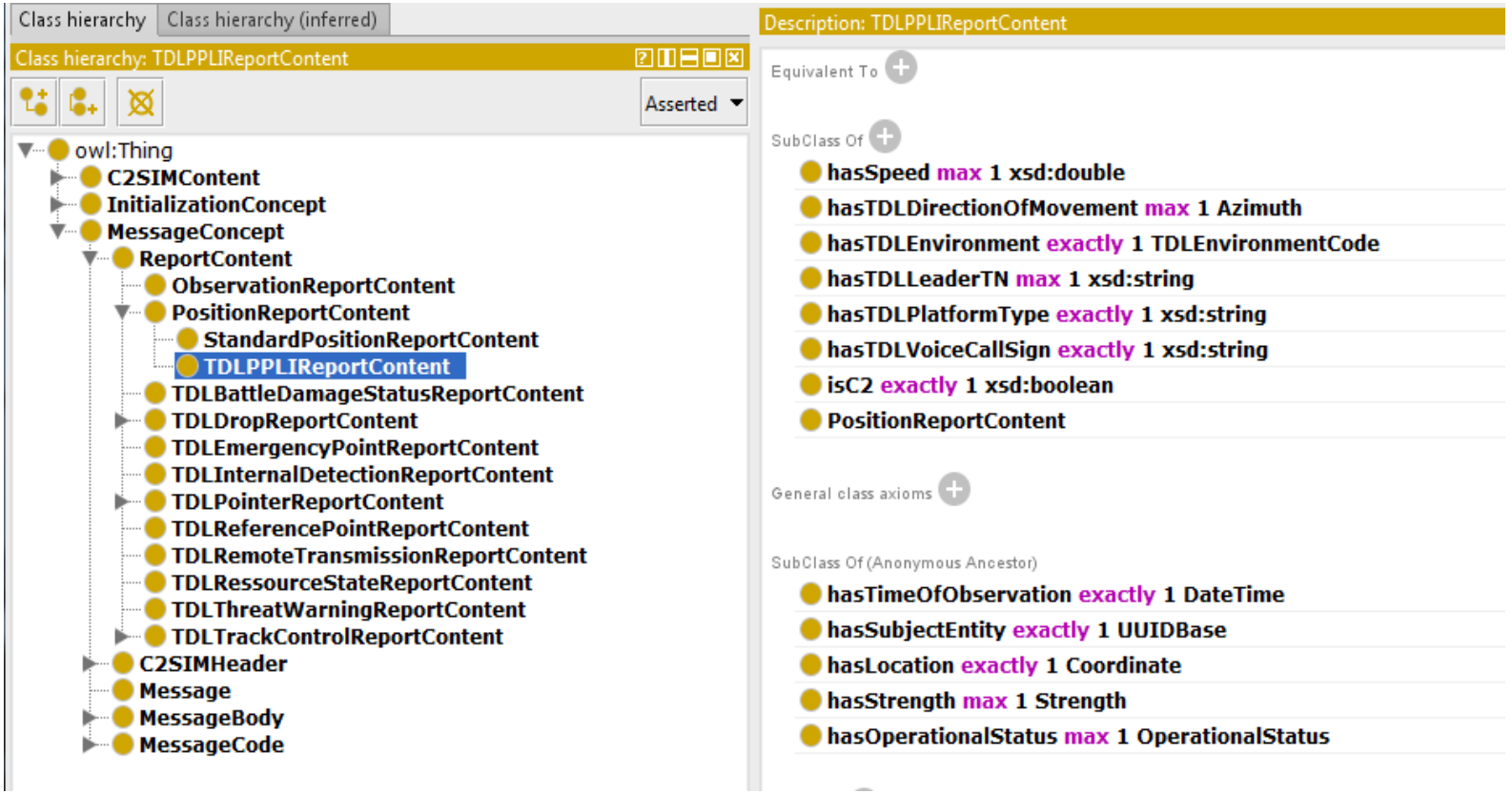
Initialization: define airborne entities

Air Operations in C2SIM – Ontological Representations



Initialization: define the secure data network and its participants

Air Operations in C2SIM – Ontological Representations



Message Exchange: define TDL messages (example PPLI)

Air Operations in C2SIM – Exchanging TDL Messages

The SISO PDG found that representing information in an ontology and also exchanging that information in a standard way with a schema requires compromise. They agreed to constrain C2SIM ontology features somewhat in order to

- allow the schema resulting out of a transformation (ontology into schema) rendered possible by the tool developed by Curt Blais,
- achieve a workable standard in a reasonable time.


```
<?xml version="1.0" encoding="UTF-8"?>
<Message xmlns="http://www.sisostds.org/schemas/C2SIM/1.1" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.sisostds.org/schemas/C2SIM/1.1 file:///C:/C2SIM/Comelec/Airbus/C2SIM_SMX_LOX_TDL.xsd">
	<C2SIMHeader>
		<StandardC2SIMHeader>
			<CommunicativeActTypeCode>Inform</CommunicativeActTypeCode>
			<MessageID>cd1d895f-ea3e-4858-906d-6abc93907a5d</MessageID>
			<Protocol>C2SIM</Protocol>
			<ProtocolVersion>1.1</ProtocolVersion>
			<SendingTime>2019-07-30T13:36:30:Z</SendingTime>
			<FromSendingSystem>C2LG</FromSendingSystem>
			<ToReceivingSystem>DirectCGF</ToReceivingSystem>
			<ConversationID>d10f9a43-e4ea-4edc-9ede-ebde7d5e1eb2</ConversationID>
		</StandardC2SIMHeader>
	</C2SIMHeader>
	<MessageBody>
		<DomainMessageBody>
			<OrderBody>
				<FromSender>00000000-0001-0001-1000-000000000000</FromSender>
				<ToReceiver>00000000-0000-0001-2000-000000000000</ToReceiver>
				<Task>
					<TDLTask>
						<TDLMissionTask>
							<TaskNameCode>ATTACK</TaskNameCode>
							<PerformingEntity>00000000-0000-0001-2000-000000000000</PerformingEntity>
							<UUID>cd1d895f-ea3e-4858-906d-6abc93907a5e</UUID>
							<Name>TDLMissionTask_1</Name>
							<TDLMissionType>ATTACK</TDLMissionType>
							<TDLTargetType>AIR_DEFENSES</TDLTargetType>
							<TDLAttackAxis>
								<Angle>90</Angle>
							</TDLAttackAxis>
							<TDLClearanceAxis>LEFT</TDLClearanceAxis>
							<TDLTargetPosition>
								<Latitude>50.397138</Latitude>
								<Longitude>9.862633</Longitude>
							</TDLTargetPosition>
							<TDLArmament>missiles</TDLArmament>
							<TDLTargetTN>501</TDLTargetTN>
						</TDLMissionTask>
					</TDLTask>
				</Task>
				<IssuedTime>
					<DateTime>
						<IsoDateTime>2019-07-30T13:36:30:Z</IsoDateTime>
					</DateTime>
				</IssuedTime>
				<OrderID>cd1d895f-ea3e-4858-906d-6abc93907a5f</OrderID>
			</OrderBody>
		</DomainMessageBody>
	</MessageBody>
</Message>
```


TDL mission order as completed schema

Lessons Learned

Since this is a project in which different members have different expertise, we learned from each other. We also learned a lot from other colleagues from the SISO C2SIM PDG and the NATO MSG-145.

Our FKIE group, for example, learned a lot about air operations, TDLs, tracks, and how to represent all this ontologically.

We also learned some specifics on ontologies and how to build an extension to an already existing core. Here is an example:

Lessons Learned – Example

If a class inherits a property from its superclass,
it might happen that the range for that property is restricted more closely in comparison to the property's range in the superclass.

For example, class "Task" has the property "hasTaskNameCode".
Its range is an enumeration of the codes for all assumed tasks.
"Task" has the subclass "TDLTask".
"TDLTask" inherits "hasTaskNameCode" but is supposed
only to use codes that are codes for TDL tasks.

Lessons Learned – Example

Adding a (“new”) restriction to the subclass

results in two lines in the schema (after transformation).

In order to achieve a working prototype, we currently have not added restricted restrictions to respective subclasses.

Instead, we trust the users to only generate messages that are meaningful.

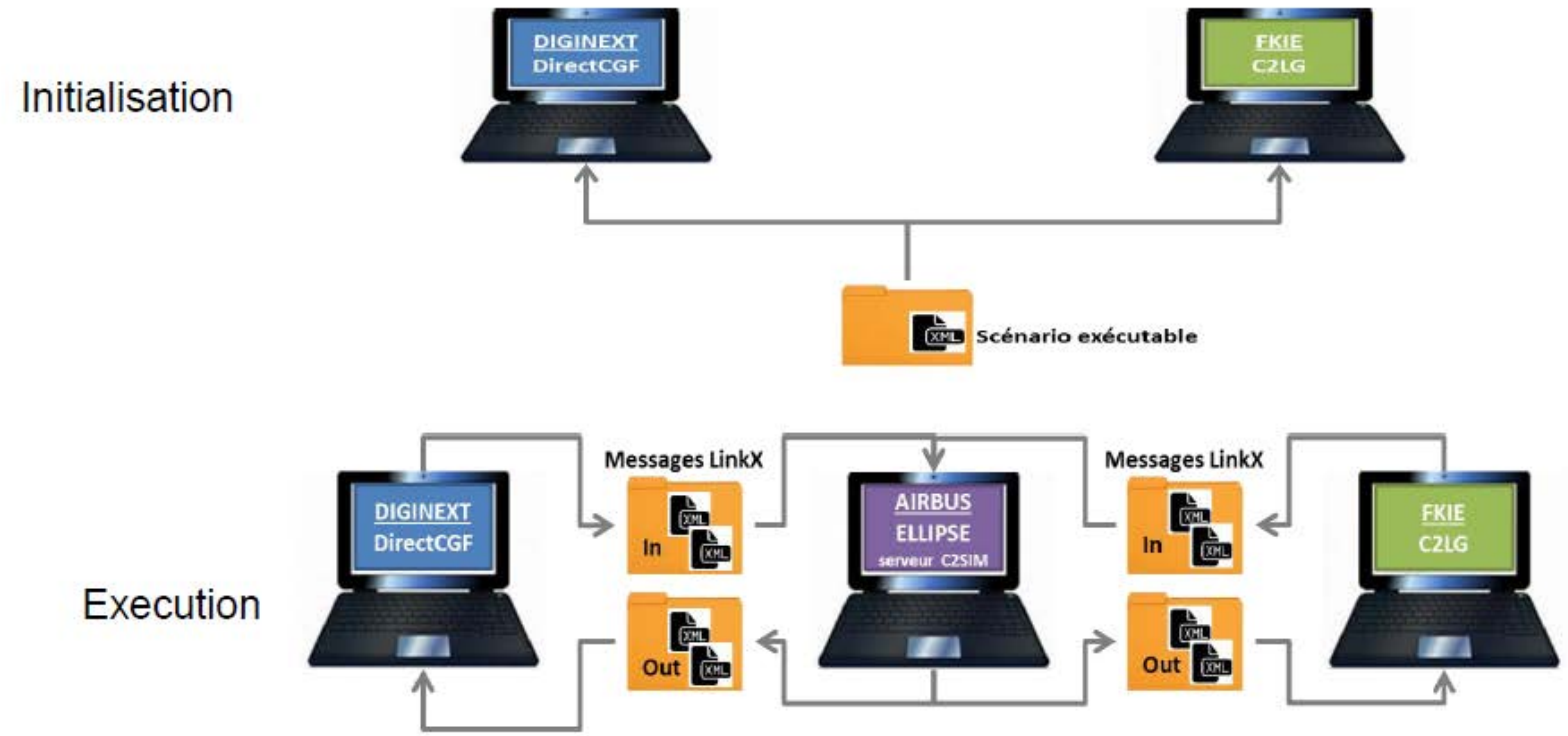
Conclusion

Guided by a scenario, an Air Operation extension of the C2SIM core ontology had been fleshed out. After that the transformation tool provided by SISO's C2SIM PDG had been applied to the ontology (core plus extension) to generate the corresponding schema.

The schema is valid for initialization and message exchange during C2SIM demonstrations that include air operations.

The validity has successfully been evaluated in the French German demonstration.

Conclusion – The Demonstration's Architecture



Thanks for Your attention!

Questions are appreciated.