



**Simulation Interoperability
Standards Organization**

"Simulation Interoperability & Reuse through Standards"

Directed Interactions when mixing HLA 4 and HLA Evolved federates

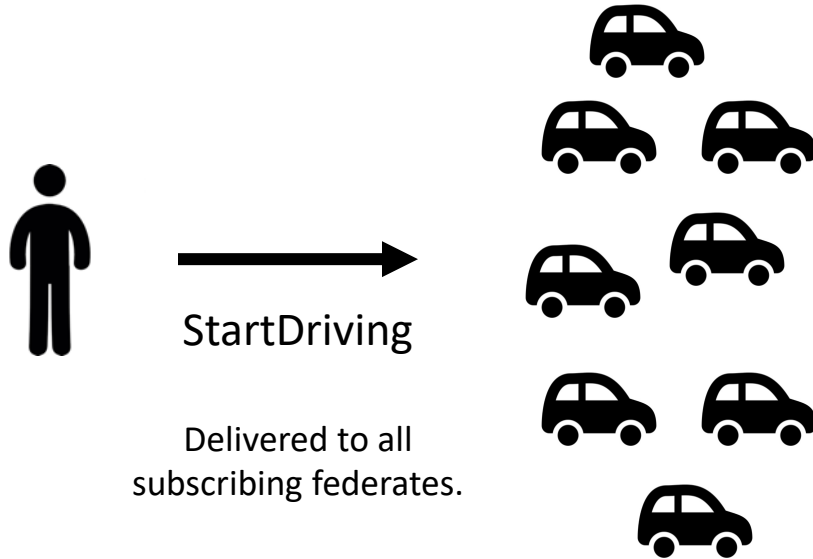
2024-SIW-Presentation-11

Fredrik Antelius, Pitch Technologies, Sweden

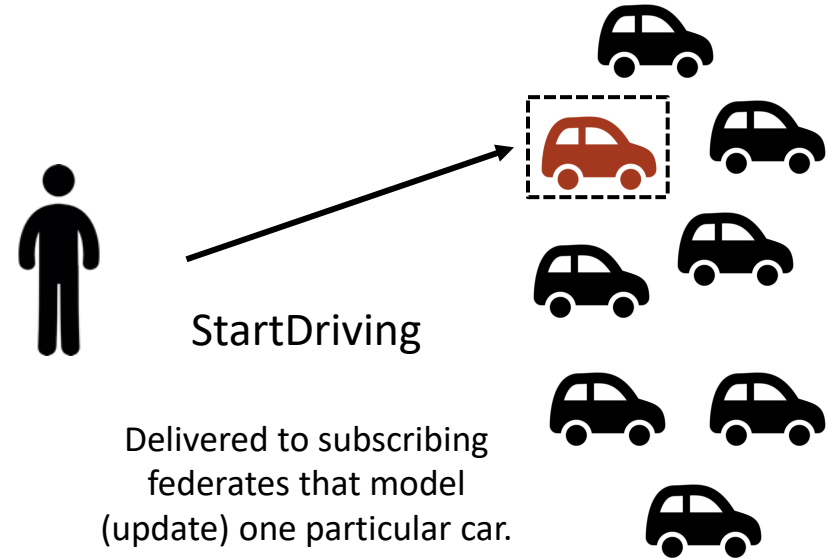


Directed Interactions Overview

Classic “Global” Interactions

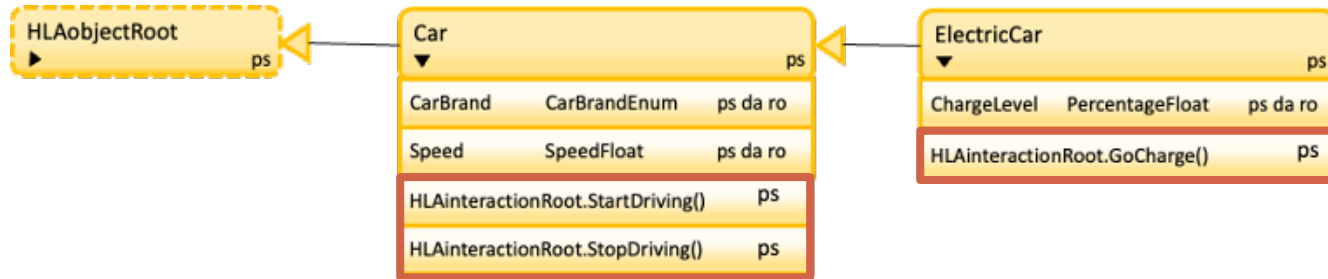


Directed Interactions





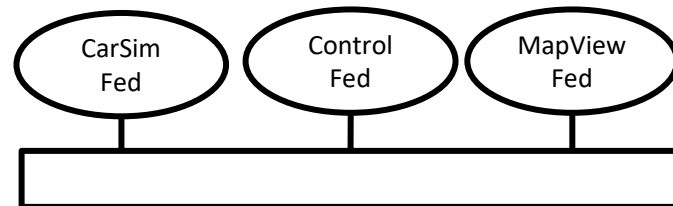
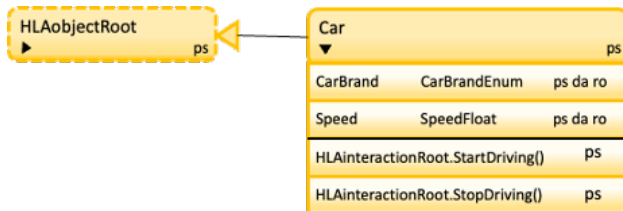
Directed Interactions in the FOM



- **Directed Interactions are specified for each Object Class in the FOM**
- **Directed Interactions are inherited, like attributes**
 - The object class **ElectricCar** has three available Directed Interactions
- **Any interaction class specified (like “StartDriving”) needs to be specified in the Interaction Class table**



Sending and Receiving Directed Interactions



- **Directed Interactions are sent and received using dedicated HLA services with a target object instance**
 - Send/Receive Directed Interaction (Interaction Class, **Object Instance**, parameter values)
- **To receive an interaction a federate must**
 - Know the targeted object instance
 - Be subscribed to the Directed Interaction for the object class of the targeted instance
 - Own at least one attribute of the targeted instance



When should Directed Interactions be used?



- **The event is related to one instance**
- **Only the responsible model is affected**
 - Let's look at some examples



Fire and Detonation from RPR FOM?

WeaponFire	
▼ ro ps	
EventIdentifier	EventIdentifierStruct
FireControlSolutionRange	LengthMeterFloat32
FireMissionIndex	UnsignedInteger32
FiringLocation	WorldLocationStruct
FiringObjectIdentifier	RTObjectId
FuseType	FuseTypeEnum16
InitialVelocityVector	VelocityVectorStruct
MunitionObjectIdentifier	RTObjectId
MunitionType	EntityTypeStruct
QuantityFired	UnsignedInteger16
RateOfFire	UnsignedInteger16
TargetObjectIdentifier	RTObjectId
WarheadType	WarheadTypeEnum16



No (multiple models affected)



Radio Signal from RPR FOM?

RawBinaryRadioSignal		ro ps
HostRadioIndex	RTIobjectId	
DataRate	BitRateBitPerSecondU...	
SignalDataLength	BitsUnsignedInteger16	
SignalData	SignalDataLengthless...	
TacticalDataLinkType	TacticalDataLinkType...	
TDLMessageCount	UnsignedInteger16	



No (multiple models affected)



Start Driving from Fuel Economy FOM?



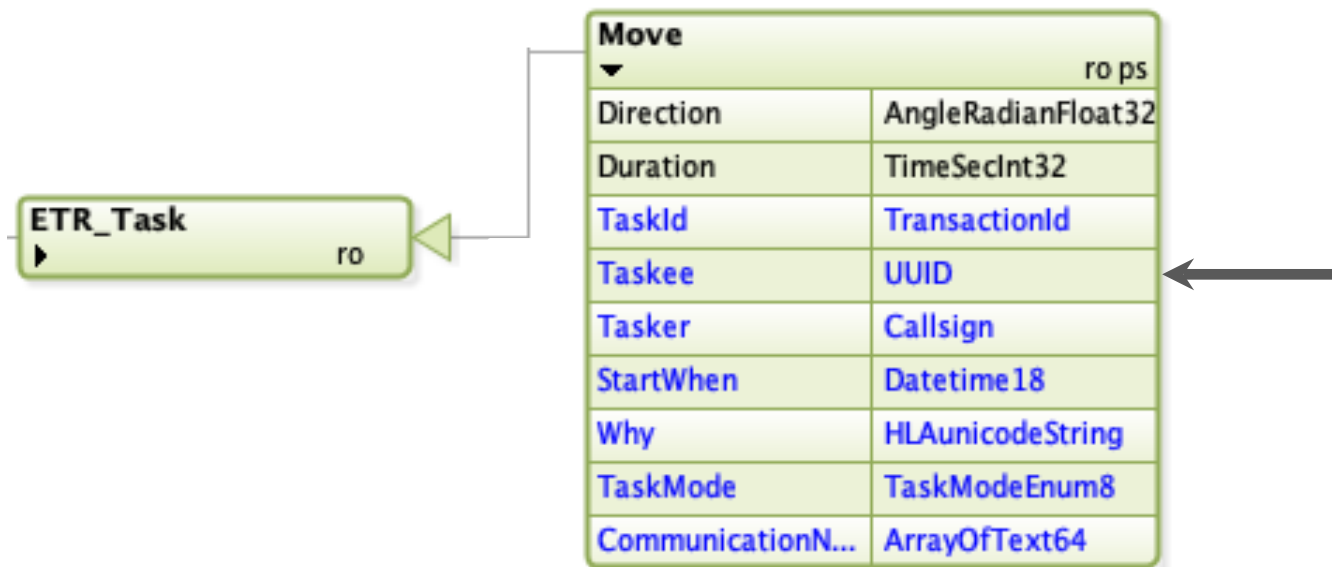
No (to all instances)



Yes



Move Task from NETN FOM?



Yes



Mixing HLA 4 and HLA Evolved simulators?

- **Can we take advantage of Directed Interactions without rewriting or updating all federates at once?**
 - Do we need to update all federates to HLA 4?
- **Build one federate that supports both HLA 4 and HLA Evolved?**
 - Can take part in both HLA Evolved and HLA 4 federations
 - Need “compatible” HLA Evolved and HLA 4 FOMs
 - How are Directed Interactions handled?
- **Mixing HLA versions supported by some RTIs**
 - Sometime called “multi-API support”
 - Federates using both HLA Evolved and HLA 4 API can exist in the same federation
 - How are Directed Interactions handled in HLA Evolved API?



Strategies for using Directed Interactions when mixing HLA versions

1. Don't

- Don't use Directed Interactions

2. Ignore

- Directed Interactions are only available in HLA 4 federates

3. Fallback

- Send Directed Interactions and fallback to “global” depending on simulators
 - *Configure or detected at runtime the need to fallback*

4. Duplicate

- Send both “global” and Directed Interaction, receiver subscribes to “global” or both
 - *Might as well only use “global” interactions*

5. Convert

- Convert between “global” and Directed Interaction depending on HLA version



How to Convert?

- **Conversion between a “global” and Directed Interaction need targeted instance information**
 - HLA Instance Handle
 - *Matches HLA 4 API*
 - HLA Instance Name
 - *Easier and may be stable between simulation runs*
 - Unique identifier for an instance
 - *Use in most existing FOMs*
 - *Could be a Reference datatype to a Required attribute*



When to Convert?

- **Convert when creating the FOMs?**
 - Makes it possible to use Directed Interactions in FOMs that support several HLA versions
- **Convert at runtime in the RTI?**
 - Makes it possible to use Directed Interactions in a "multi-API" federation
- **Convert in a bridge between federations?**
 - Only the bridge needs to be changed
 - Depends on how the FOMs are created
- **Convert in middleware or in each simulator?**
 - Change (or update middleware) in all simulators
 - Depends on how the FOMs are created



Recommendations

- **Use Directed Interactions were possible in HLA 4 FOM**
 - Keep parameter to identify target instance
 - *Useful for receiving federate and easily added by sending federate*
 - *Can be converted to a “global” interaction without more parameters*
- **Create converted HLA Evolved FOM**
 - Keep all Directed Interactions in the Interaction table
- **RTI converts in “multi-API” federation**
 - HLA 4 federates can exchange Directed Interactions
 - Directed Interactions are delivered as “global” to and **from** HLA Evolved federates
 - *HLA 4 federates need to handle these “global” interactions as if they were Directed Interactions. Use target instance parameter to identify targeted instance.*



Conclusion

- **Many good use-cases for Directed Interactions**
 - Consider DDM to filter or target “global” interactions
- **May need to support a mix of HLA Evolved and HLA 4**
 - The transition will not be instantaneous for some use-cases
- **Opportunities for tools to ease the migration**
 - Recommendations affect RTI and OMT tools
 - *Simulators and middleware are also affected*
- **Prepare for using Directed Interactions**
 - Identify potential Directed Interactions in HLA Evolved FOMs
 - *Will make the object model stringent and easy migration*



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Q&A / Discussion