



ISaGRAF

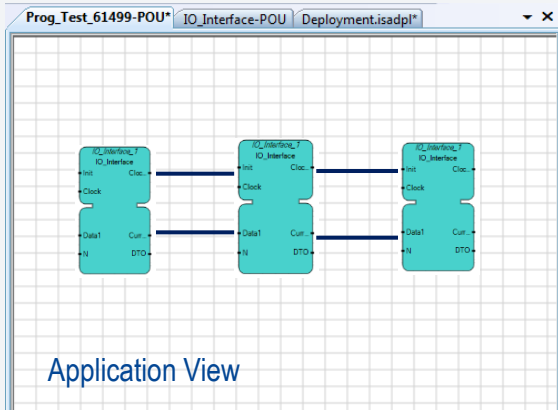
Distributed systems development with IEC 61499 in ISaGRAF

Julien Chouinard, Managing Director, ICS Triplex ISaGRAF

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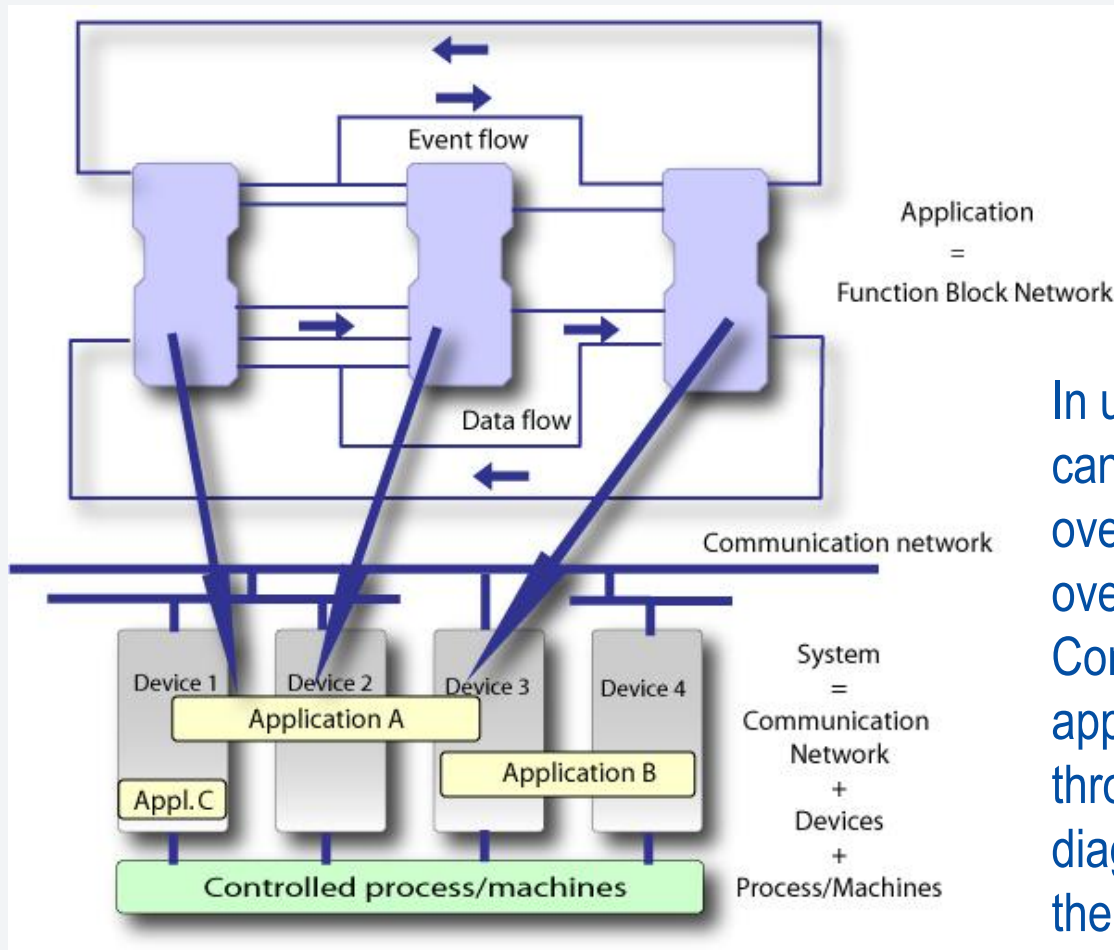


IEC 61499 is a complement to IEC 61131, not a replacement



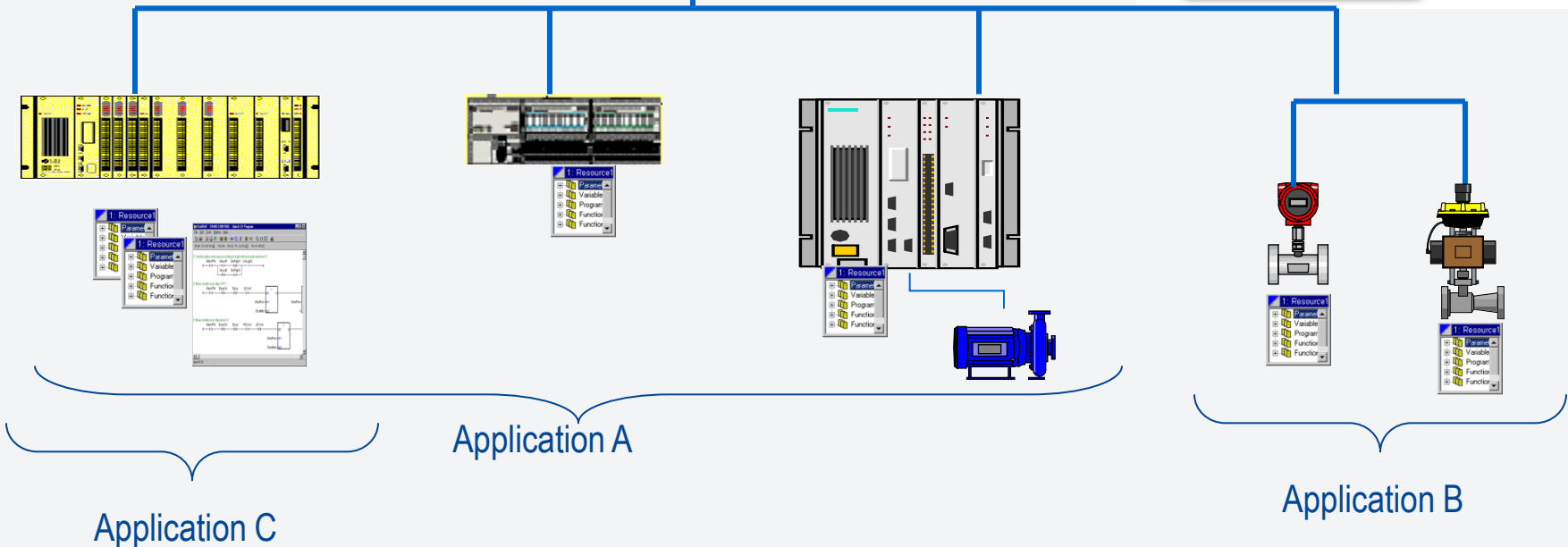
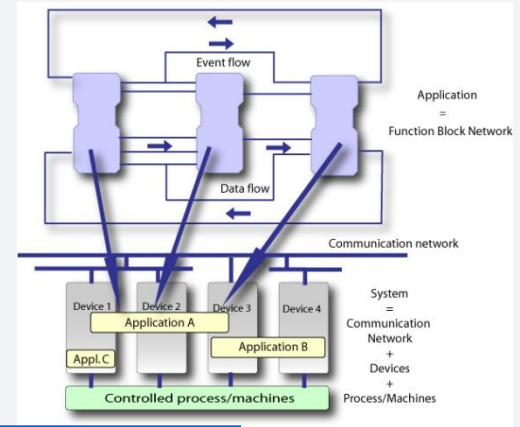
Symbol	Data Type	Element 1	Element 2	Element 3	Default Value	Declaration	Visibility	Address
IO_Power_Out	BOOL					PowerOut	Public	
IO_Power_In	BOOL					PowerIn	Public	
IO_Speed_Out	REAL					SpeedOut	Public	
IO_Speed_In	REAL					SpeedIn	Public	
IO_Torque_Out	REAL					TorqueOut	Public	
IO_Torque_In	REAL					TorqueIn	Public	
IO_Pos_Out	REAL					PosOut	Public	
IO_Pos_In	REAL					PosIn	Public	
IO_Velocity_Out	REAL					VelocityOut	Public	
IO_Velocity_In	REAL					VelocityIn	Public	
IO_Acceleration_Out	REAL					AccelerationOut	Public	
IO_Acceleration_In	REAL					AccelerationIn	Public	
IO_Position_Out	REAL					PositionOut	Public	
IO_Position_In	REAL					PositionIn	Public	
IO_Velocity_Setpoint	REAL					VelocitySetpoint	Public	
IO_Position_Setpoint	REAL					PositionSetpoint	Public	
IO_Velocity_Min	REAL					VelocityMin	Public	
IO_Velocity_Max	REAL					VelocityMax	Public	
IO_Position_Min	REAL					PositionMin	Public	
IO_Position_Max	REAL					PositionMax	Public	
IO_Velocity_Min_Setpoint	REAL					VelocityMinSetpoint	Public	
IO_Velocity_Max_Setpoint	REAL					VelocityMaxSetpoint	Public	
IO_Position_Min_Setpoint	REAL					PositionMinSetpoint	Public	
IO_Position_Max_Setpoint	REAL					PositionMaxSetpoint	Public	
IO_Velocity_Min_Max	REAL					VelocityMinMax	Public	
IO_Position_Min_Max	REAL					PositionMinMax	Public	
IO_Velocity_Min_Max_Setpoint	REAL					VelocityMinMaxSetpoint	Public	
IO_Position_Min_Max_Setpoint	REAL					PositionMinMaxSetpoint	Public	
IO_Velocity_Min_Max_Setpoint_Max	REAL					VelocityMinMaxSetpointMax	Public	
IO_Position_Min_Max_Setpoint_Max	REAL					PositionMinMaxSetpointMax	Public	

- IEC 61499 is a complement designed to address different needs
- IEC 61499 can and should coexist with IEC 61131



In using the IEC 61499 standard, one can design an application distributed over multiple resources and spread over multiple devices (known as Configs under IEC 61131). These applications would be regulated through IEC 61499 function block diagrams and their collaboration is then clearly and rigorously defined.

The devices could be PLC's, micro-controllers or even intelligent field instrumentation such as flow meters or valves.





70 low cost NetBurner MOD5272-100CR (with Motorola ColdFire 5272 microprocessor) . These controllers have an Ethernet RJ45 connector and run the μ C/OS operating system. The ISaGRAF firmware was ported to these controllers and all communications are handled with TCP/IP.



assembled in groups of 3 with each

- 2 push buttons,
- 2 toggle switches as inputs
- 2 green led
- 2 red led connected to their TTL input and output lines.



- 24 assemblies were used
- TCP/IP connections are handled by two DLink 48 port 100Mb Ethernet switches linked by their 1Gb/sec RJ45 uplink.
- 2 DELL Inspiron 6400 laptops running Windows XP pro were also connected and part of the test bench.

3 applications were developed. All three applications are deployed on the same hardware platform (the 70 controllers).

- 1st Application : This applications is used to measure the event and data propagation in an application.
- 2nd Application : This applications is used to demonstrate the use of basic and composite function blocs to simulate a real world application
- 3rd Application : It demonstrates the power and flexibility of IEC 61499 in addressing real time constraints..

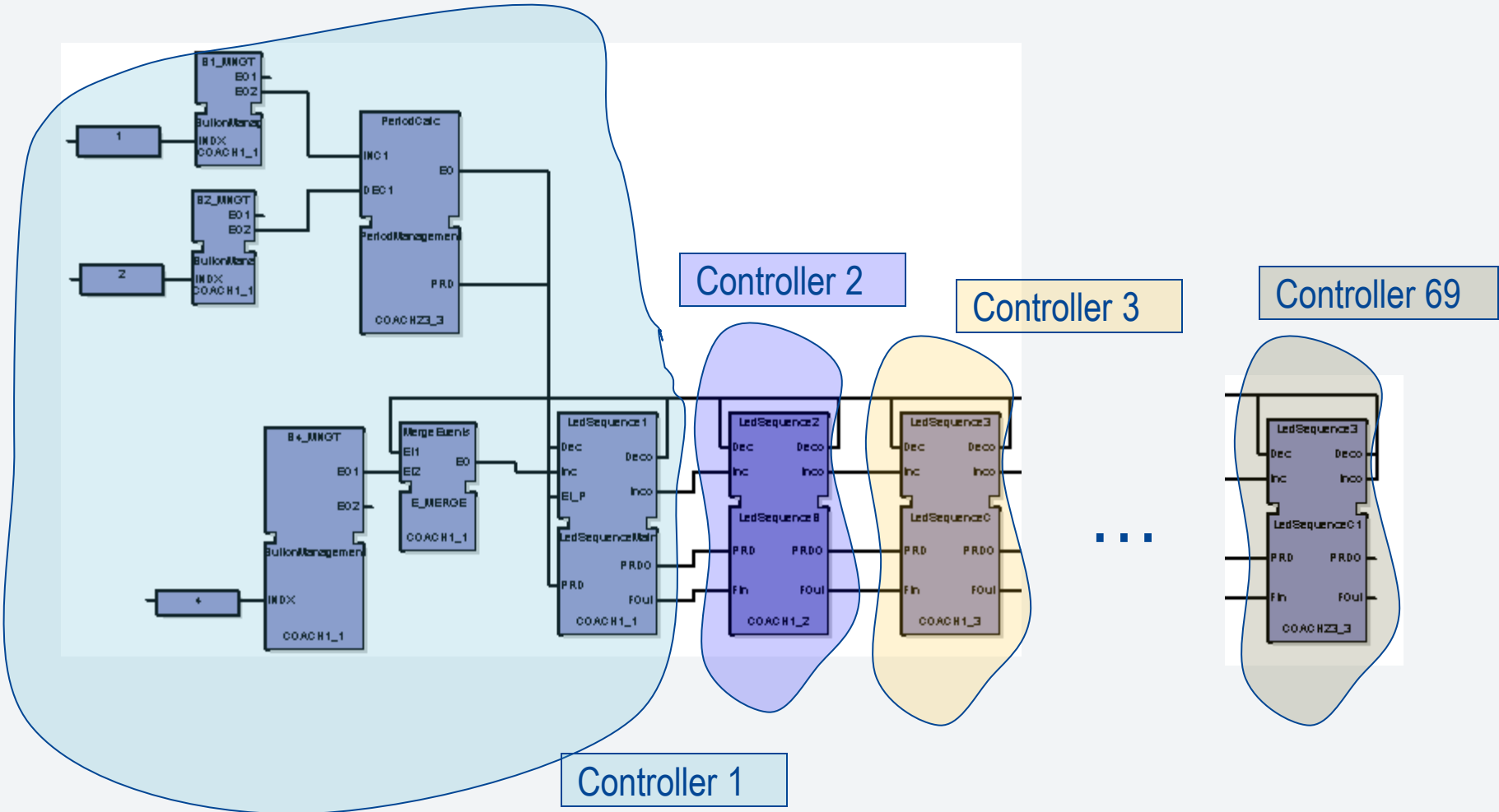
- **Demonstrate the powerful implementation of IEC 61499 standard in ISaGRAF**





15 ms



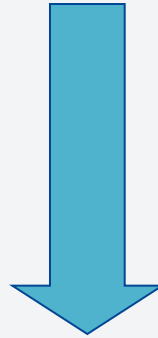


Use of 4 IEC61499 Basic FB

3x	ButtonManagement	Basic FB
1x	PeriodManagement	Basic FB
1x	E_Merge	Basic FB
69x	LedSequencer	Basic FB



- Demonstrate the powerful implementation of IEC 61499 standard in ISaGRAF

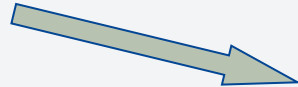




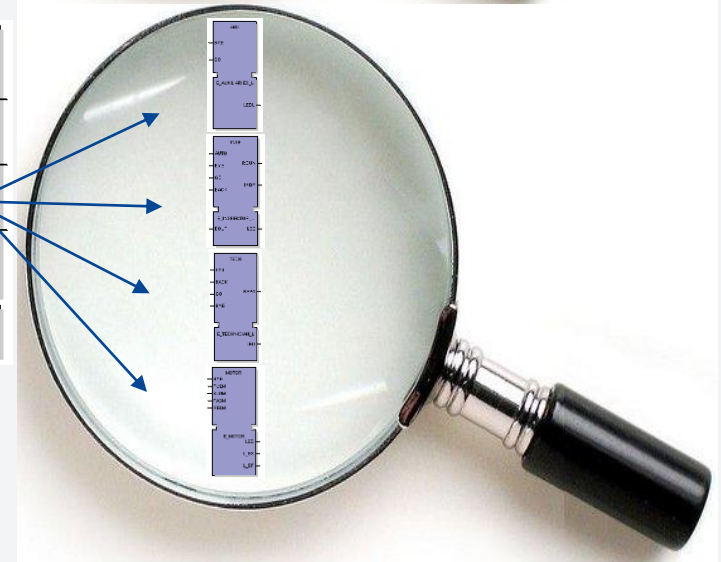
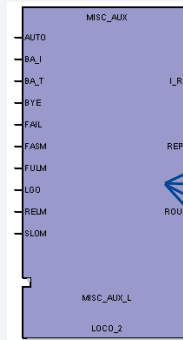
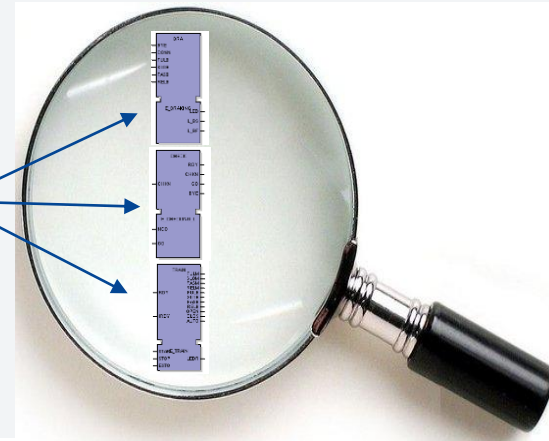
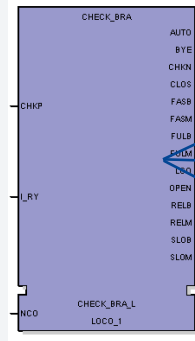
Brakes
Coaches checking
Train functioning

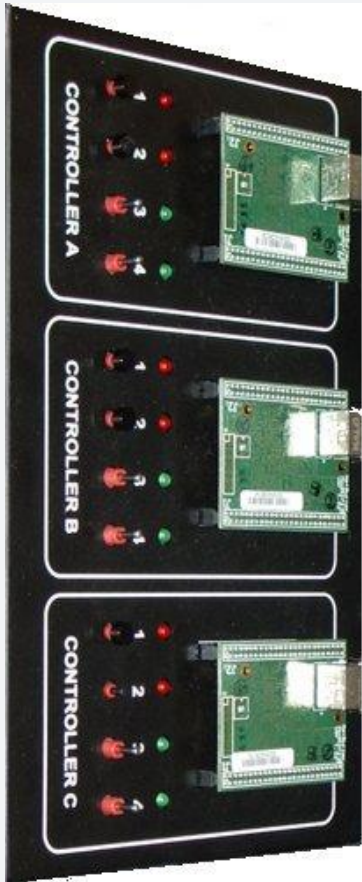


Light
Ticket inspector
Maintenance technician
Motor



Locomotive

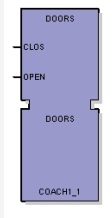
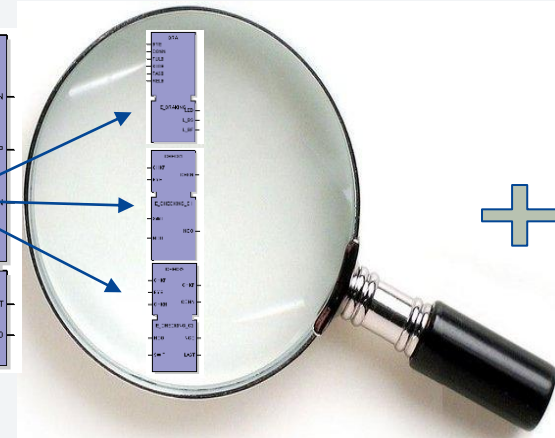
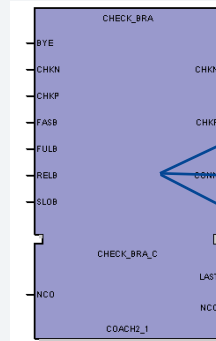




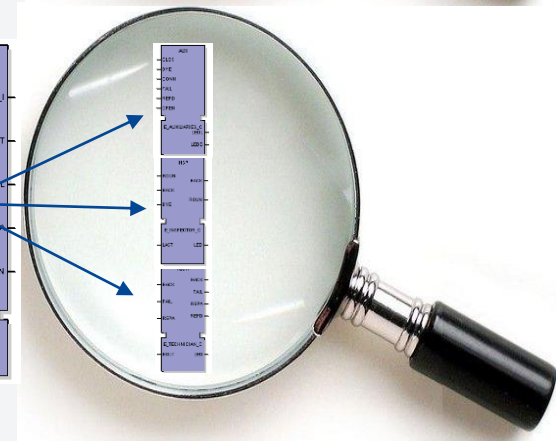
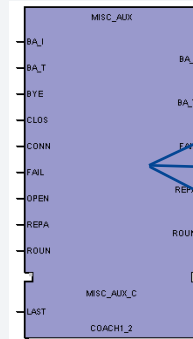
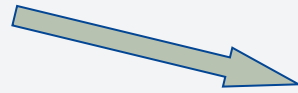
Coaches

15 ms

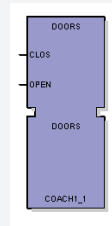
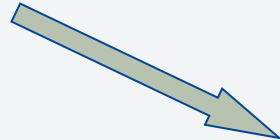
Brakes
Coaches checking
Opening of the door 1

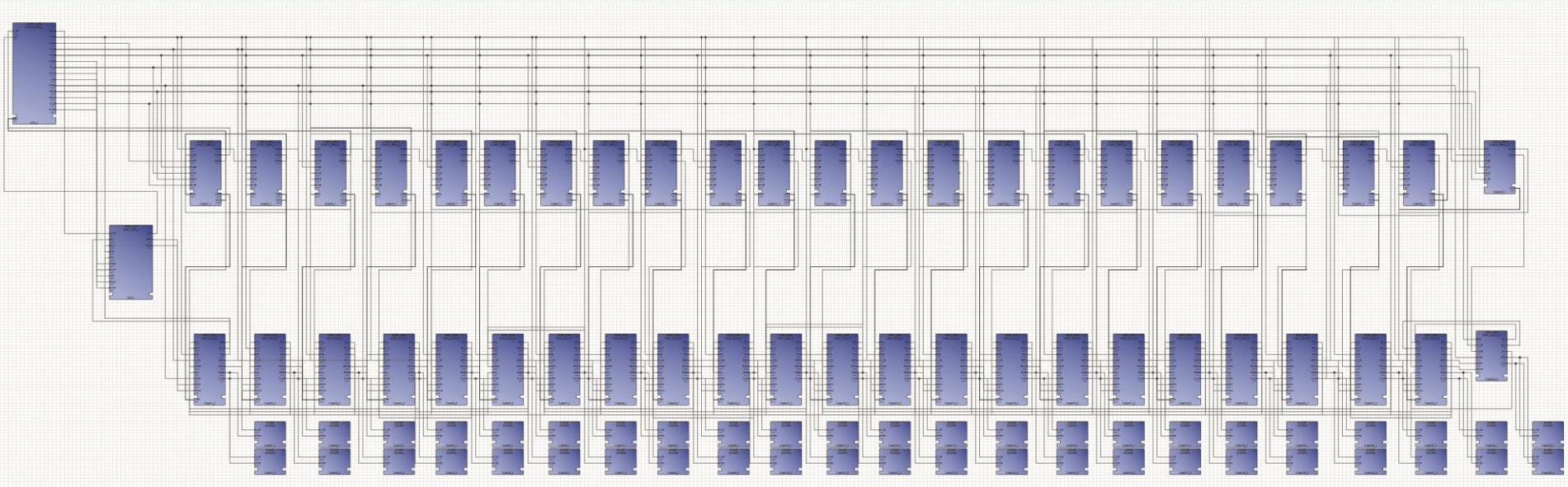


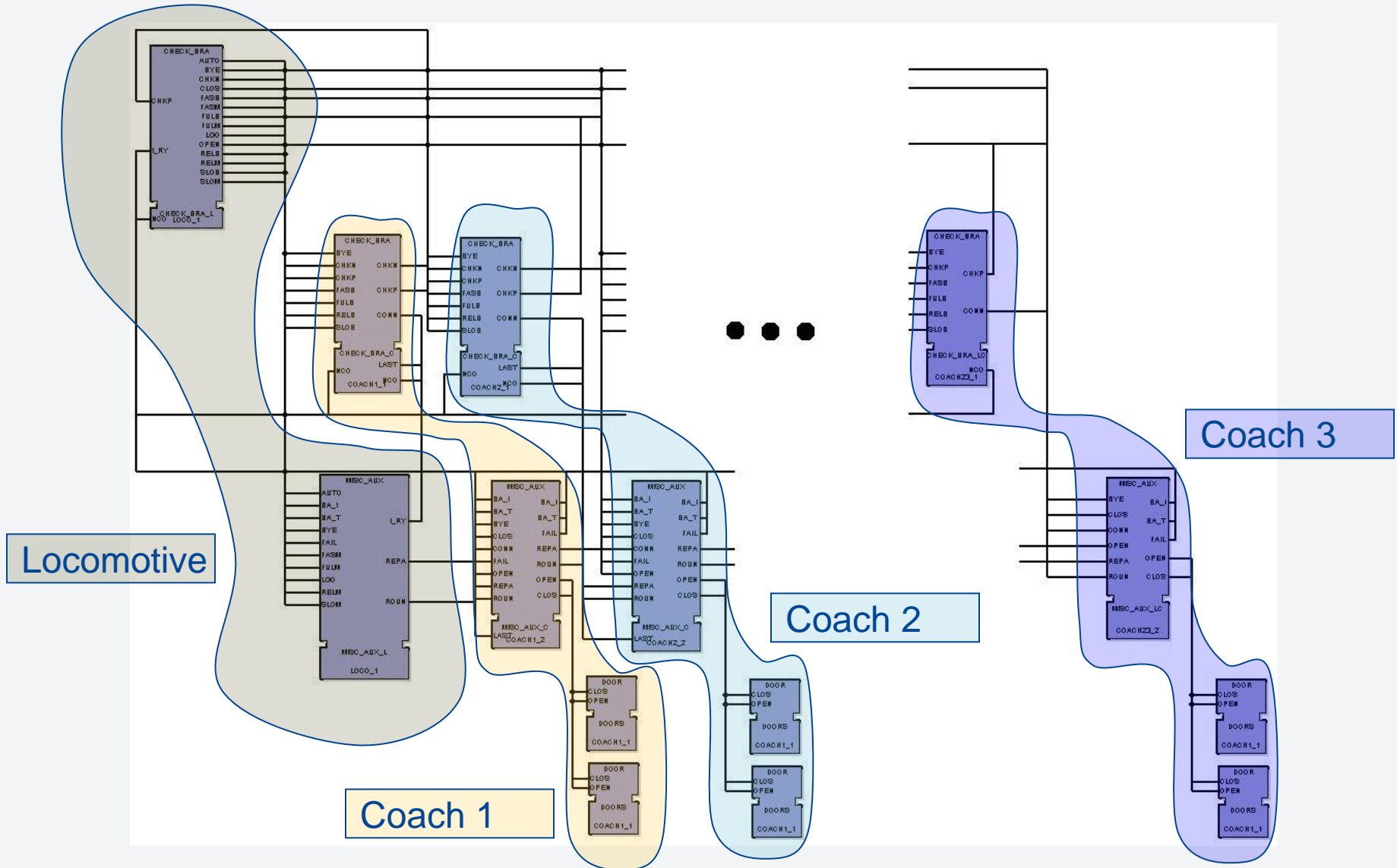
Doors and light
Ticket inspector
Maintenance technician



Opening of the door 3



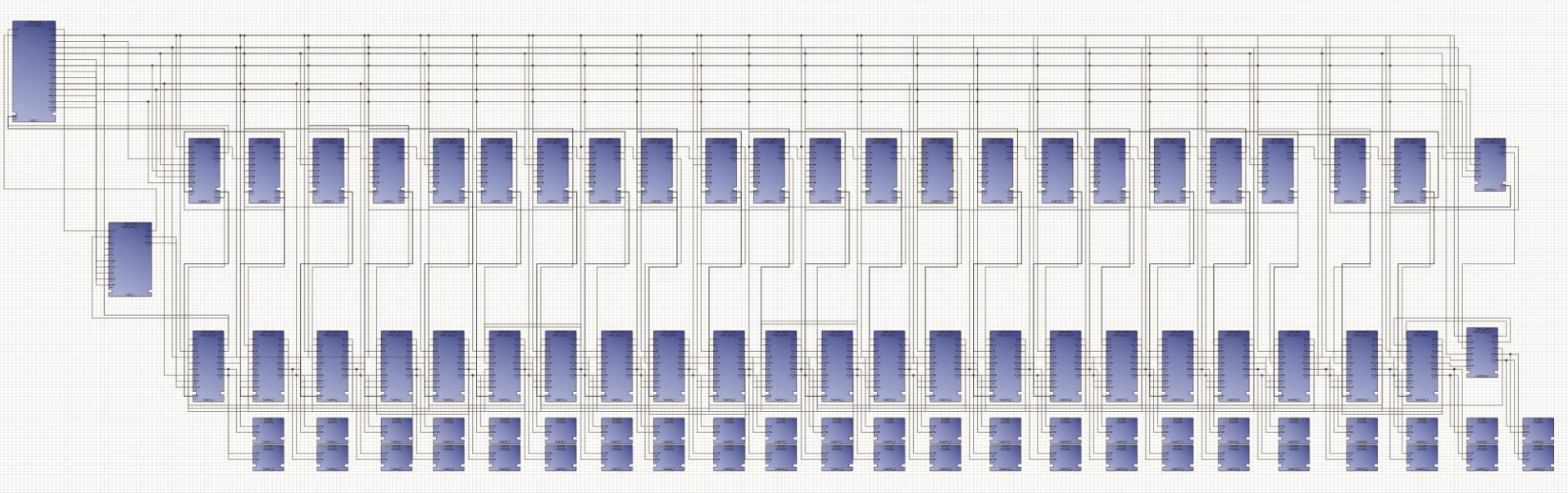




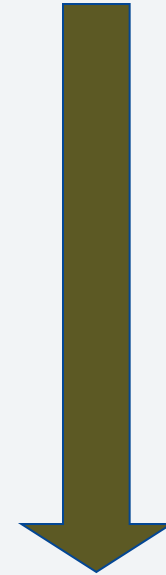
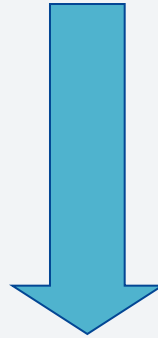
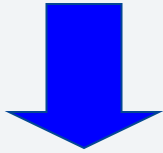
Use of 6 IEC61499 Composite FB and 8 IEC61499 Basic FB

1x	Check_Brake_L 1x E_Train 1x IO_L 1x E_Braking 1x E_Checking	Composite FB Basic FB Basic FB Basic FB Basic FB
22x	Check_Brake_C 1x E_Train 1x IO_L 1x E_Braking 1x E_Checking	Composite FB Basic FB Basic FB Basic FB Basic FB
1x	Check_Brake_LC 1x E_Train 1x IO_L 1x E_Braking 1x E_Checking	Composite FB Basic FB Basic FB Basic FB Basic FB
1x	Misc_Aux_L 1x E_Auxiliaries 1x E_Motor 1x E_Inspector 1x E_Technician	Composite FB Basic FB Basic FB Basic FB Basic FB
22x	Misc_Aux_C 1x E_Auxiliaries 1x E_Motor 1x E_Inspector 1x E_Technician	Composite FB Basic FB Basic FB Basic FB Basic FB
1x	Misc_Aux_LC 1x E_Auxiliaries 1x E_Motor 1x E_Inspector 1x E_Technician	Composite FB Basic FB Basic FB Basic FB Basic FB

L : Locomotive, C : Coach

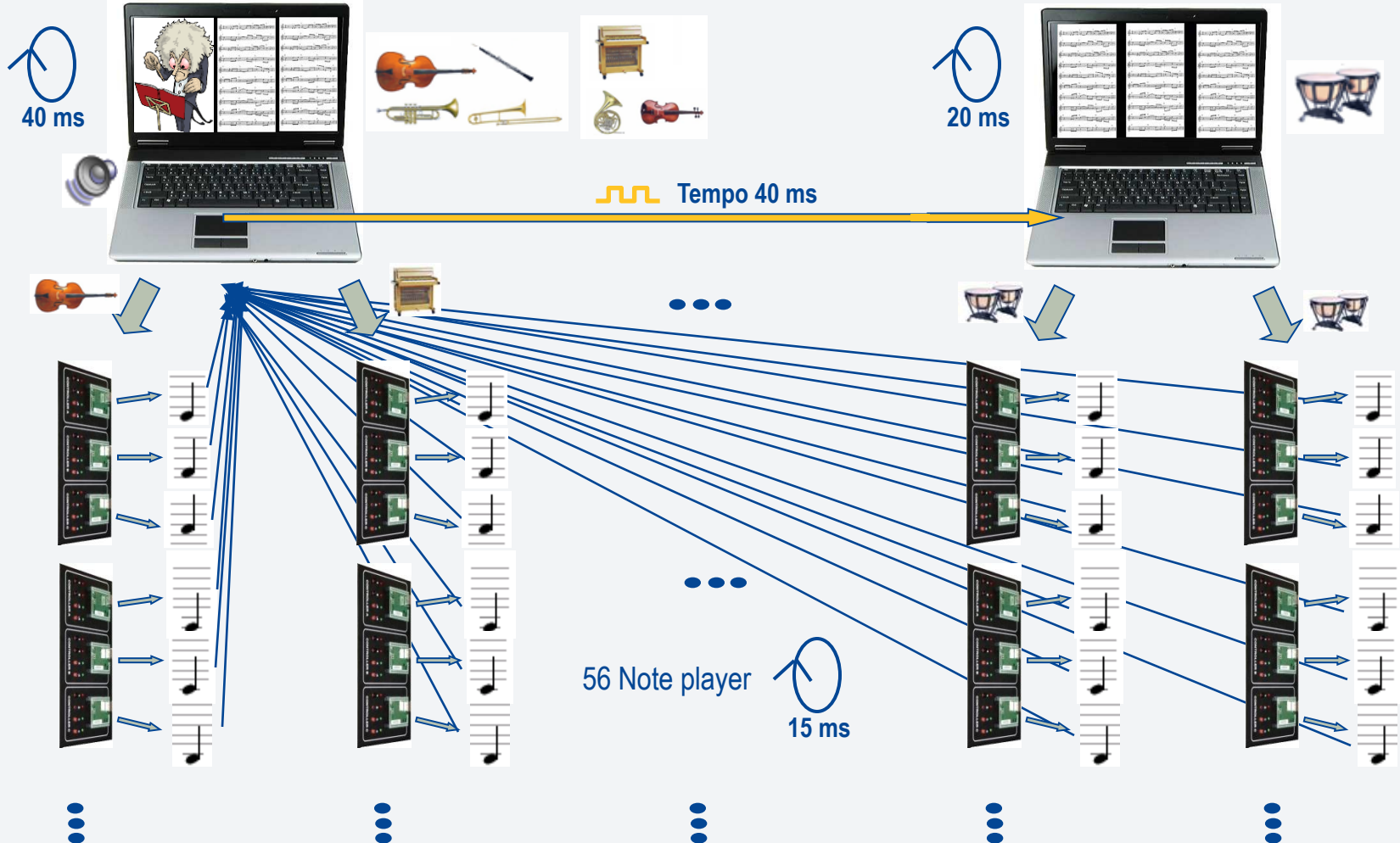


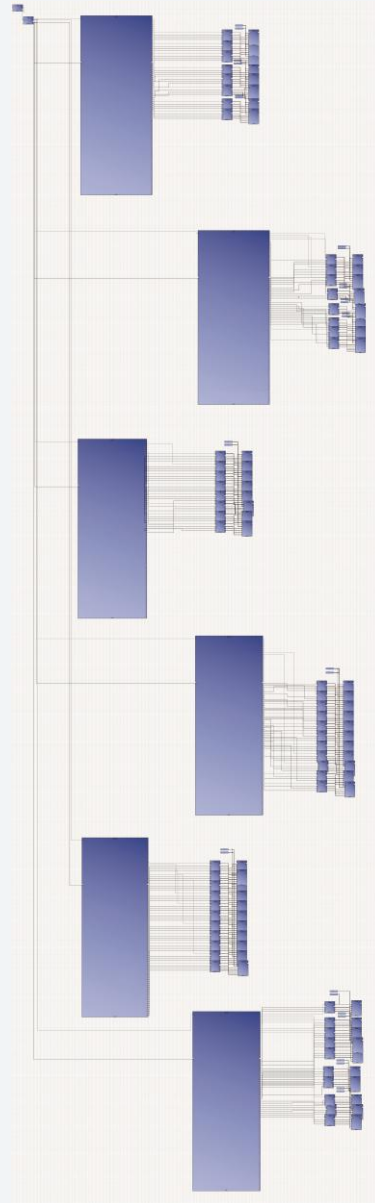
- Demonstrate the powerful implementation of IEC 61499 standard in ISaGRAF

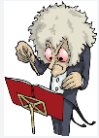


Conductor + midi player +
3 Score readers for 12 instruments

2 Score reader for 2 instruments (drums)

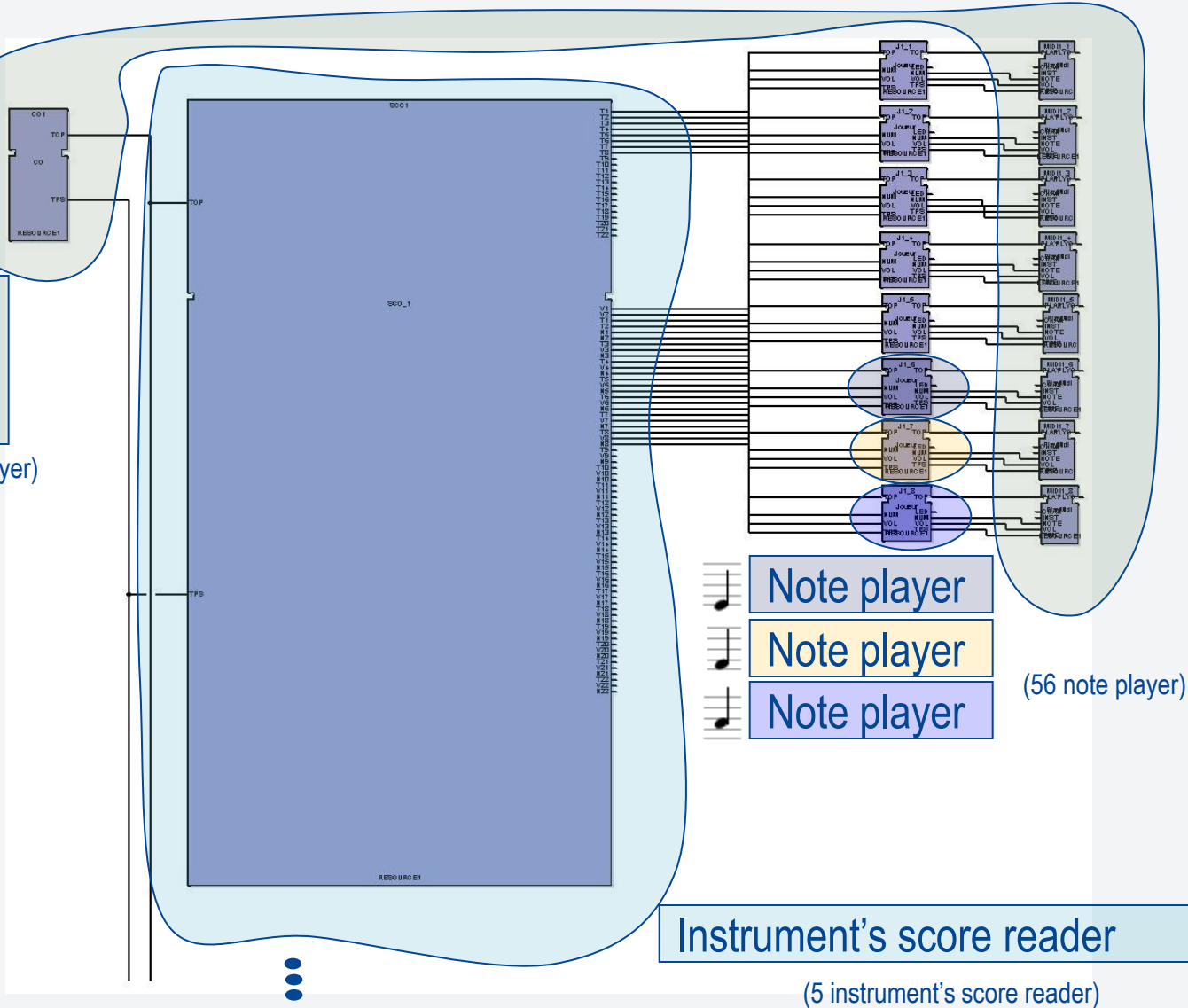






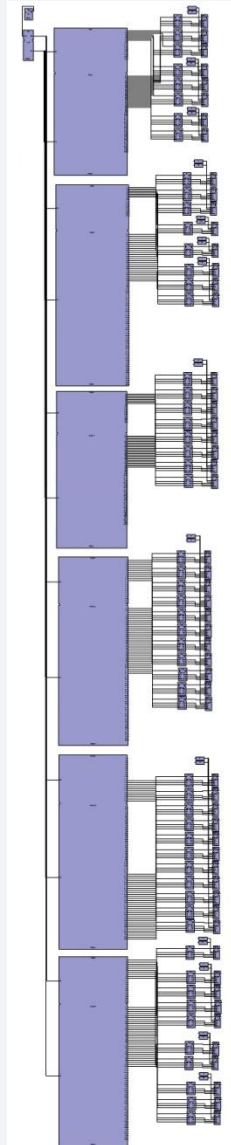
Conductor & Midi player

(1 conductor and Midi Player)



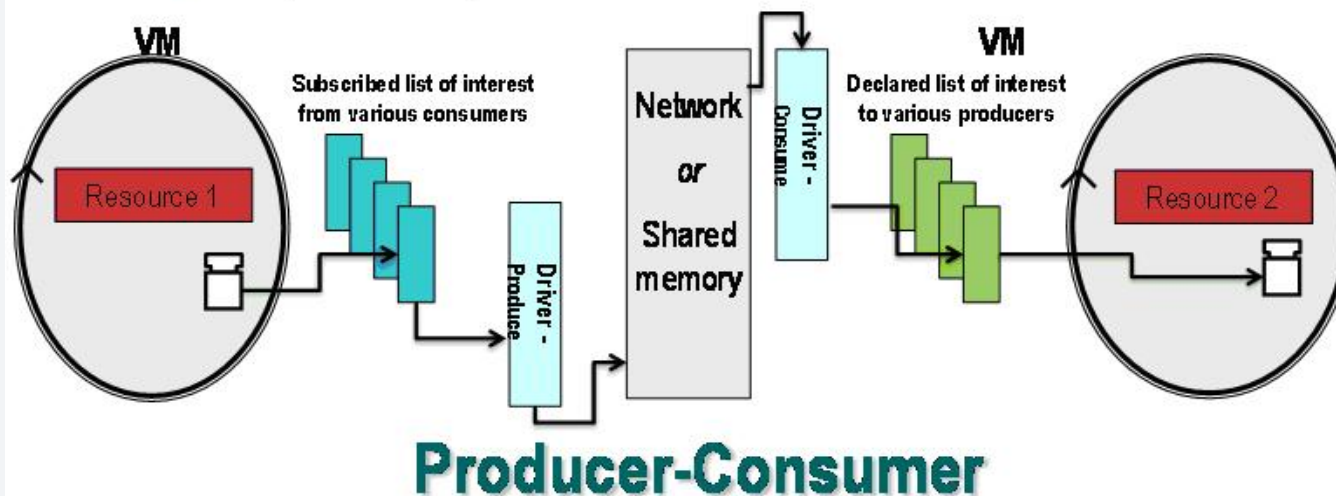
Use of 1 IEC61499 Composite FB and 5 IEC61499 Basic FB

50x	PlayMidi	Basic FB
50x	E_Musician	Composite FB
1x	IO_LED	Basic FB
1x	Musician	Basic FB
5x	ConductorAssistant	Basic FB
1x	Conductor	Basic FB



Binding

- ❑ Used for exchanging data between Resources
- ❑ Either locally within the same Configuration, or through the network
- ❑ Producer-Consumer model
- ❑ Each VM can cycle at a different rate from each other
- ❑ Data is produced at every scan



- IEC61499 can be applied to large applications as the test with 70 controllers demonstrate
- Selection of network and network tools are key into a successful implementation
- Engineering of function blocks and overall system requires good understanding of the operation of the different component; i.e. software, hardware, networks, IO's
- IEC61499 simplifies considerable the development of such and application compared to what would have to be done with IEC61131



ISaGRAF

Thank you

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