

# SYSTEM-OF-SYSTEMS THAT ACT LOCALLY FOR OPTIMIZING GLOBALLY

EU FP7 - SMALL/MEDIUM-SCALE FOCUSED RESEARCH PROJECT (STREP)  
FP7-ICT-2013.3.4: ADVANCED COMPUTING, EMBEDDED AND CONTROL SYSTEMS  
D) FROM ANALYZING TO CONTROLLING BEHAVIOUR OF SYSTEM OF SYSTEMS (SOS)

## **Local4Global Consortium Meeting**

Implementation

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23.09.2015

Chania, Crete, Greece

LOCAL<sup>4</sup> GLOBAL

# Local<sup>4</sup> Global

## Contact Information

For information regarding this Project: Check the Project Web-Site: <http://local4global-fp7.eu>

Participants	
1	CERTH - Centre for Research and Technology
2	ETHZ – Eidgenössische Technische Hochschule Zürich
3	RWTH – RWTH Aachen University
4	IK4 – IK4 TEKNIKER
5	TRV – TRANSVER GmbH
6	TUC – Technical University of Crete
7	TUM – Technische Universität München

Project Acronym: Local4Global

Project Number: 611538

Project Start Date: October 2013

Duration: 3 Years

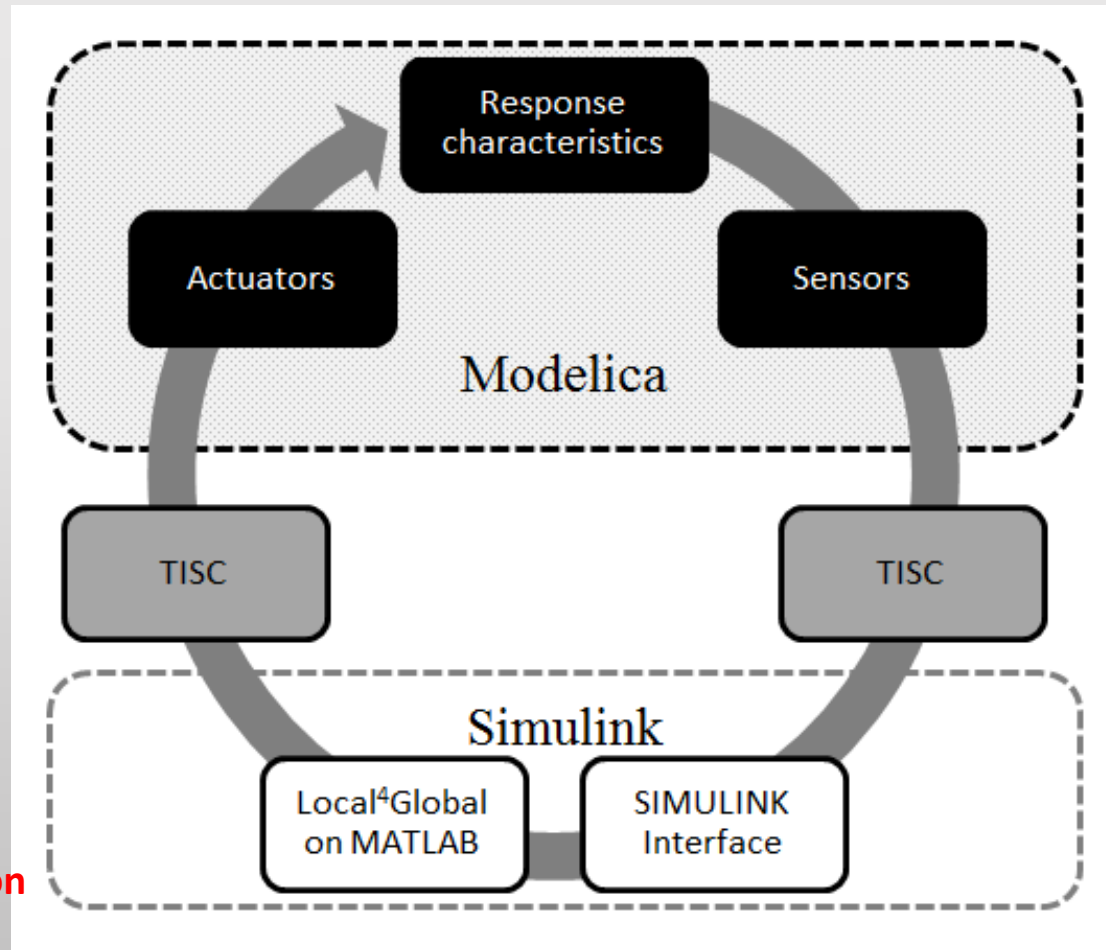
Funded by: EU FP7

Program Name:

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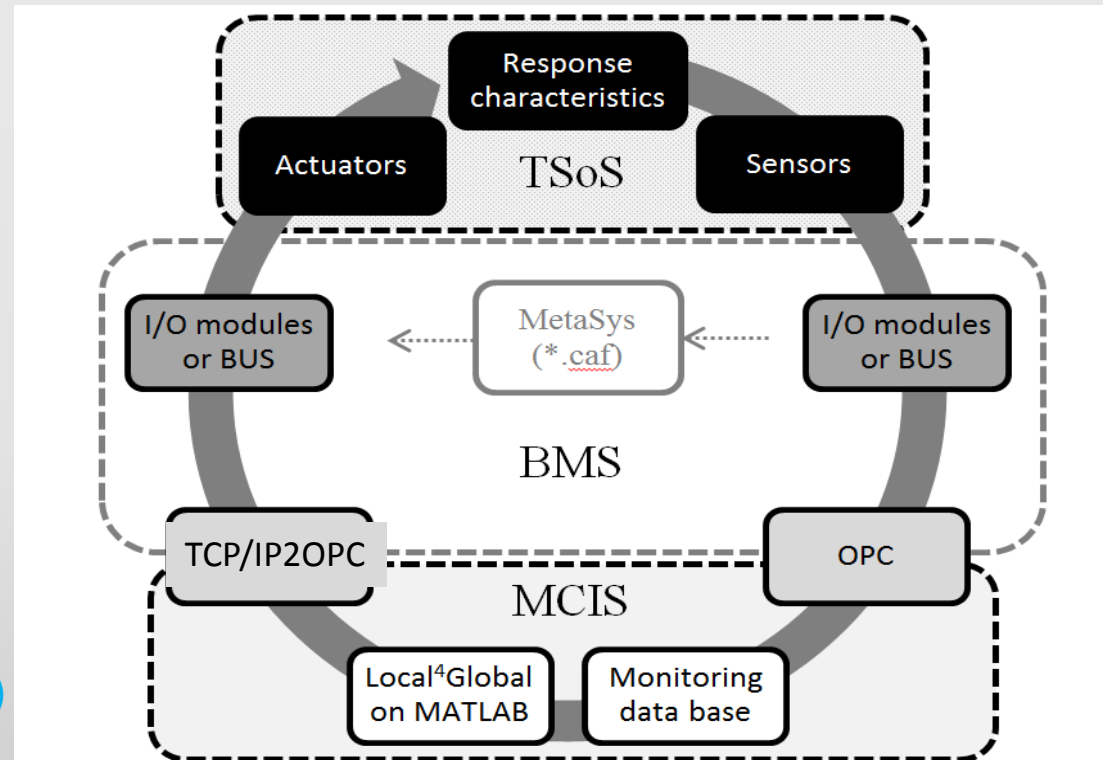
# Simulative Pre-Analysis

1. Physical model in DYMOLA/Modelica  
**DONE**
2. Control model (and interfaces) in MATLAB/Simulink  
**DONE**
3. Co-Simulation coupled by TISC  
**DONE**
4. Adjustments, functional test, fine tuning  
**Final (positive) version**

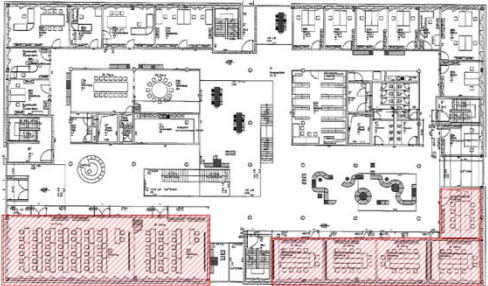



# State of test bed preparation

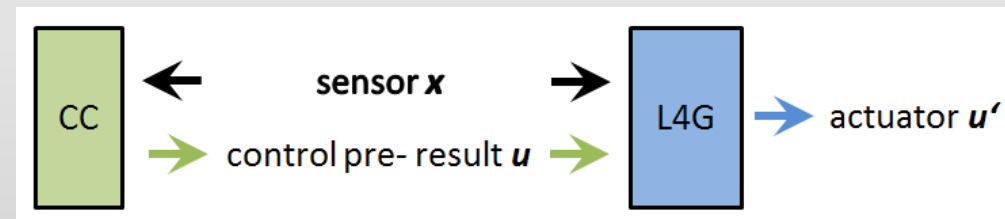
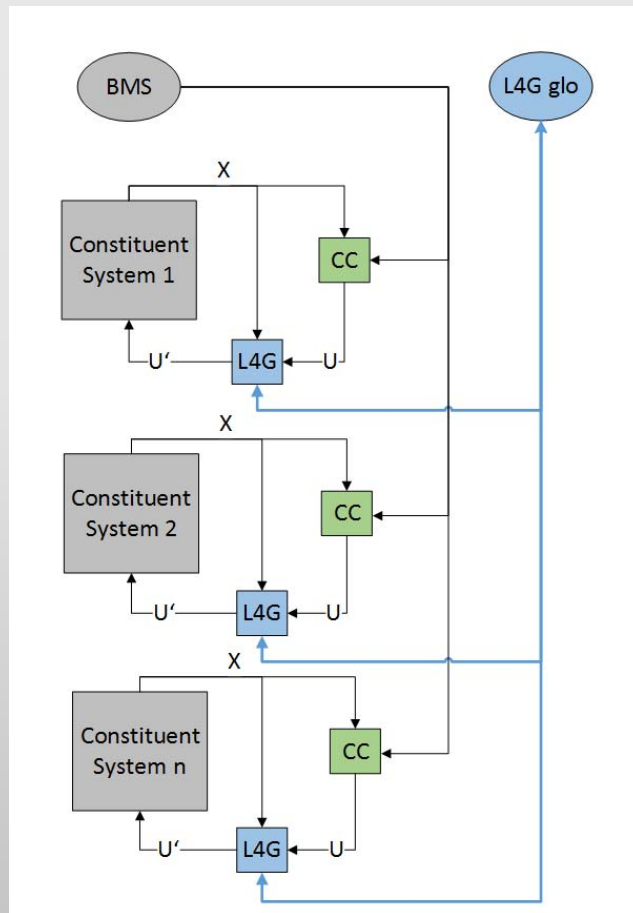
1. Tailoring Local4Global for L4G building TSoS  
**DONE**
2. Monitoring expansion for specific evaluation issues  
**DONE**
3. Algorithm implementation in the real TSOS  
**Which set?**
4. Experiments
  1. Small TSoS (3 conf) (**ready to go**)
  2. Conf. TSoS
  3. Office TSoS
  4. L4G TSoS



# L4G building TSoS overview

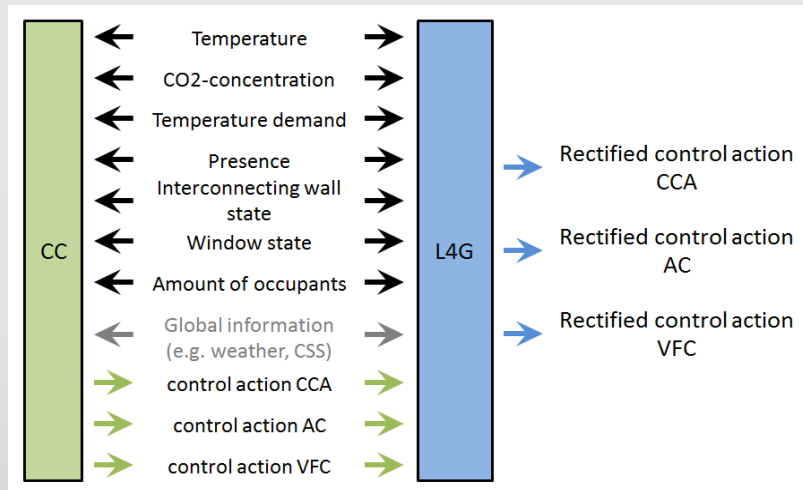
TSoS objectives	thermal comfort; air quality; energy efficiency	
TSoS boundaries	Conference and office spaces	
Constituent systems	<p>„Conference“ (3-7 single spaces)</p> 	<ul style="list-style-type: none"> <li>• concrete core activation (CCA)</li> <li>• air cooler (AC)</li> <li>• volume flow controller (VFC)</li> </ul>
	<p>„Office“ (6 single spaces; 2 groups)</p> 	<ul style="list-style-type: none"> <li>• <del>concrete core activation (CCA)</del></li> <li>• façade ventilation unit (FVU)</li> </ul>
Related external Systems	<ul style="list-style-type: none"> <li>• weather</li> <li>• superior building management system (BMS)</li> <li>• (central) supply systems (CSS)</li> </ul>	

# Implementation Strategy - Generic

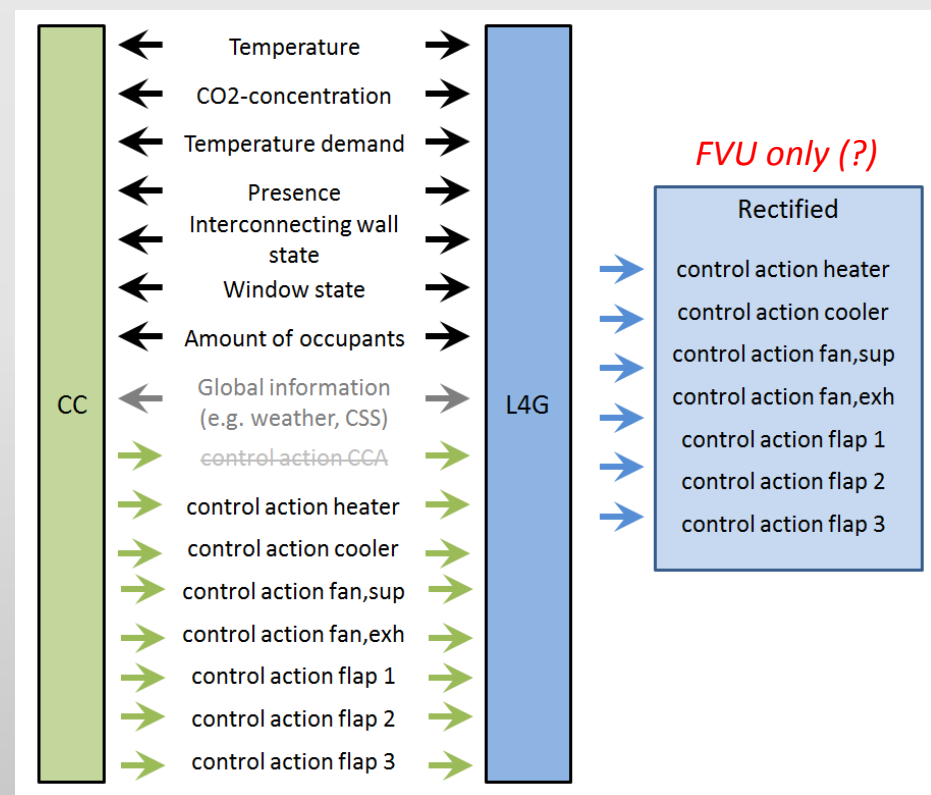


# Implementation Strategy - Detail

## Conference system



## Office system



# Experimental Planning – D5.2.2

Phase	A1	A2	A3	A4	B1	B2	B3	C1	C2	C3	D
Level	System	System	SoS	SoS	System	SoS	SoS	SoS	SoS	SoS	SoS
Objective	functional testing	functional testing	functional testing	validation	functional testing	functional testing	validation	functional testing	validation	operation	artificial circumstances
Scope	single small conference system	single large conference system	group of small conference systems	group of small conference systems	single office system	group of office systems	group of office systems	L4G building TSoS	L4G building TSoS	L4G building TSoS	L4G building TSoS
Off. 10.09	Ref.	Ref.	Ref.	Ref.	Ref.	L4G	L4G	L4G	L4G	L4G	L4G
Off. 10.10	Ref.	Ref.	Ref.	Ref.	L4G	L4G	L4G	L4G	L4G	L4G	L4G
Off. 10.11	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Off. 10.12	Ref.	Ref.	Ref.	Ref.	Ref.	L4G	L4G	L4G	L4G	L4G	L4G
Off. 10.25	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	L4G	L4G	L4G	L4G
Off. 10.26	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Off. 10.27	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	L4G	L4G	L4G	L4G
Off. 10.28	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	L4G	L4G	L4G	L4G
Conf. 00.17	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	L4G	L4G	L4G	L4G
Conf. 00.18	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Conf. 00.19	Ref.	Ref.	L4G	L4G	Ref.	Ref.	Ref.	L4G	L4G	L4G	L4G
Conf. 00.20	L4G	Ref.	L4G	L4G	Ref.	Ref.	Ref.	L4G	L4G	L4G	L4G
Conf. 00.21	Ref.	Ref.	L4G	L4G	Ref.	Ref.	Ref.	L4G	L4G	L4G	L4G
Conf. 00.23	Ref.	L4G	Ref.	Ref.	Ref.	Ref.	Ref.	L4G	L4G	L4G	L4G
Conf. 00.24	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	L4G	L4G	L4G	L4G

## LEGEND

L4G := controlled by Local4Global algorithm

Ref. := controlled by current control strategy

### Functional testing

Implementing control algorithm  
Connecting to data points  
Activating L4G control  
Runtime observation

### Validation

Set-up of simulation  
Editing data  
Simulation run  
Documenting results

### Operation

Set-up of experimental schedule  
Activating operation  
Runtime observation  
Troubleshooting

### Artificial circumstances

Set-up of experimental schedule  
Runtime observation  
Documenting results



# Experimental Planning – Chania

Phase	A1	A2	A3	B1	B2	C1	C2	C3	D	E	F
<b>Objective</b>	functional testing	validation	operation / base results	functional testing	operation / base results	functional testing	validation	operation / base results	operation / base results	art. circ.	<b>EVALUATION</b>
<b>Scope</b>	<u>small</u> conference TSoS	<u>small</u> conference TSoS	<u>small</u> conference TSoS	<u>entire</u> conference TSoS	<u>entire</u> conference TSoS	<u>small</u> office TSoS	<u>small</u> office TSoS	<u>small</u> office TSoS	<b>L4G building</b> TSoS	<b>L4G building</b> TSoS	<b>L4G building</b> TSoS
<b>Off. 10.09</b>	Ref.	Ref.	Ref.	Ref.	Ref.	L4G	L4G	L4G	L4G	L4G	
<b>Off. 10.10</b>	Ref.	Ref.	Ref.	Ref.	Ref.	L4G	L4G	L4G	L4G	L4G	
<i>Off. 10.11</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	
<b>Off. 10.12</b>	Ref.	Ref.	Ref.	Ref.	Ref.	L4G	L4G	L4G	L4G	L4G	
<b>Off. 10.25</b>	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	L4G	L4G	
<i>Off. 10.26</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	
<b>Off. 10.27</b>	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	L4G	L4G	
<b>Off. 10.28</b>	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	L4G	L4G	
<b>Conf. 00.17</b>	Ref.	Ref.	Ref.	L4G	L4G	Ref.	Ref.	Ref.	L4G	L4G	
<i>Conf. 00.18</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	<i>Ref.</i>	
<b>Conf. 00.19</b>	L4G	L4G	L4G	L4G	L4G	Ref.	Ref.	Ref.	L4G	L4G	
<b>Conf. 00.20</b>	L4G	L4G	L4G	L4G	L4G	Ref.	Ref.	Ref.	L4G	L4G	
<b>Conf. 00.21</b>	L4G	L4G	L4G	L4G	L4G	Ref.	Ref.	Ref.	L4G	L4G	
<b>Conf. 00.23</b>	Ref.	Ref.	Ref.	L4G	L4G	Ref.	Ref.	Ref.	L4G	L4G	
<b>Conf. 00.24</b>	Ref.	Ref.	Ref.	L4G	L4G	Ref.	Ref.	Ref.	L4G	L4G	

		Sep 15	Oct 15	Nov 15	Dec 15	Jan 16	Feb 16	Mar 16	Apr 16	May 16	Jun 16	Jul 16	Aug 16	Sep 16
	Requirements	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2
A1	Decision Version	■	■											
A2														
A3				■ results A										
B1	A successfull		■	■	■	■	■	■	■	■	■	■	■	■
B2								■ results B						
C1	Algorithm for Offices	■	■	■	■	■	■	■	■	■	■	■	■	■
C2														
C3								■ results C						
D	A,B,C succesfull							■ first results D	■	■	■	■	■	■
										■ final results D				
E	main results of D											■ additional results E		
F	experiments done												■ reports	

# Next steps

- Agreement on the test case algorithm
  - Approach (decentralized, centralized)
  - Parametrization
- Experiments
  - Agreement on the schedule
  - Implementation in conference rooms
  - Implementation in offices
  - L4G Operations

Thank you for your attention!

*Questions, suggestions and comments are welcome!*