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Using the Multicom Domus DataSet

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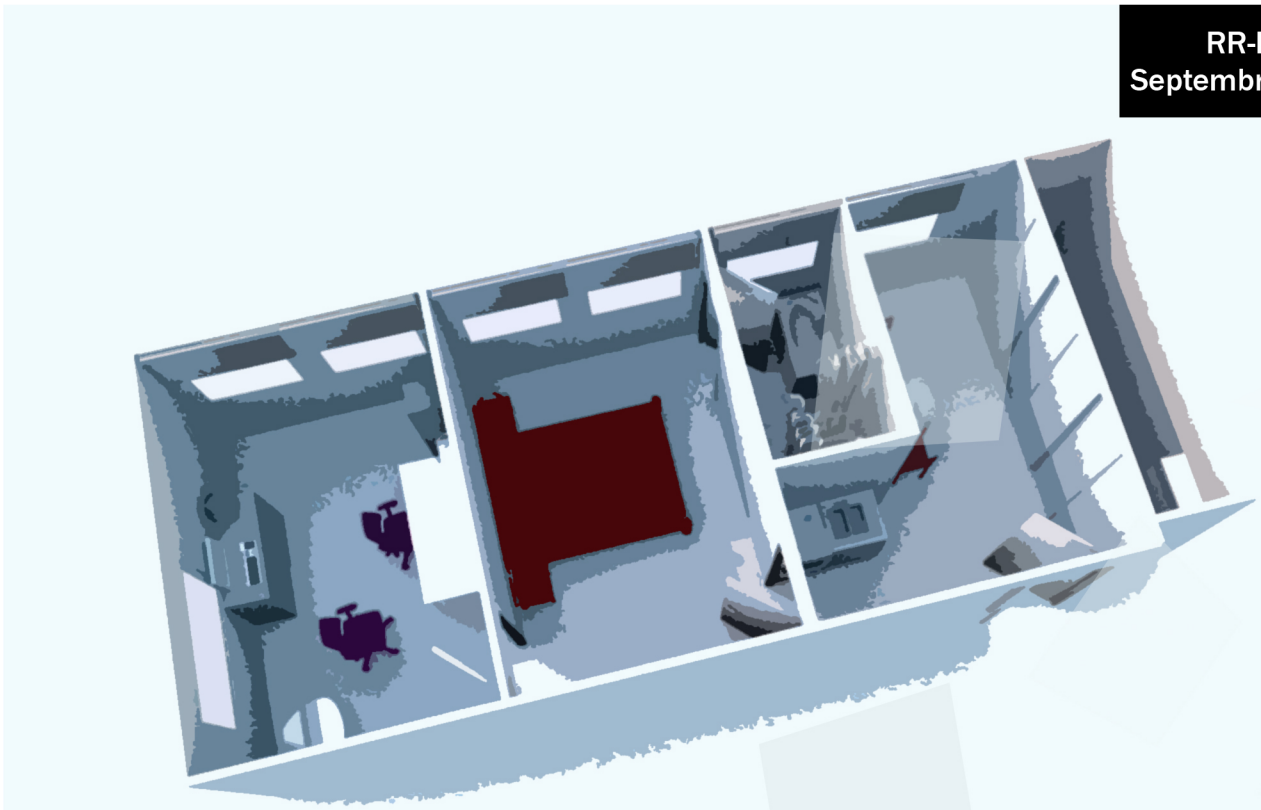

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ABSTRACT*:*
As part of an ongoing thesis, Multicom has developed an environment to capture traces of activity of a subject undergoing predefined scenarios or not, within DOMUS, the home's intelligent platform. The events forming the traces notify any change of condition or value of sensors (motion detectors, light, water flow, power consumption ...) and various actuators (lighting, ordered taken, shutter). These events are linked to user actions or the environment.
The data produced during these experiments are made available to anyone interested in such a dataset. This document aims to explain their format and means.

KEYWORDS*: dataset, intelligent buildings, ambiance perception, inhabitant's perception*

1. INTRODUCTION

1.1. Research platform

The DOMUS smart flat is part of the Multicom's research platform. This 40 square meter flat is composed as followed:

- A kitchen and dining room, with a sink, an electric 2 ring stove, a fridge, crockery, a table and 2 chairs.
- A room with a double bed, a flat TV, two night tables each one of them hiding an RFID reader
- An office with a table and a chair, a sofa, a coffee table and a small low cupboard. An RFID reader is mounted under the table.
- A bathroom with a sink and a shower

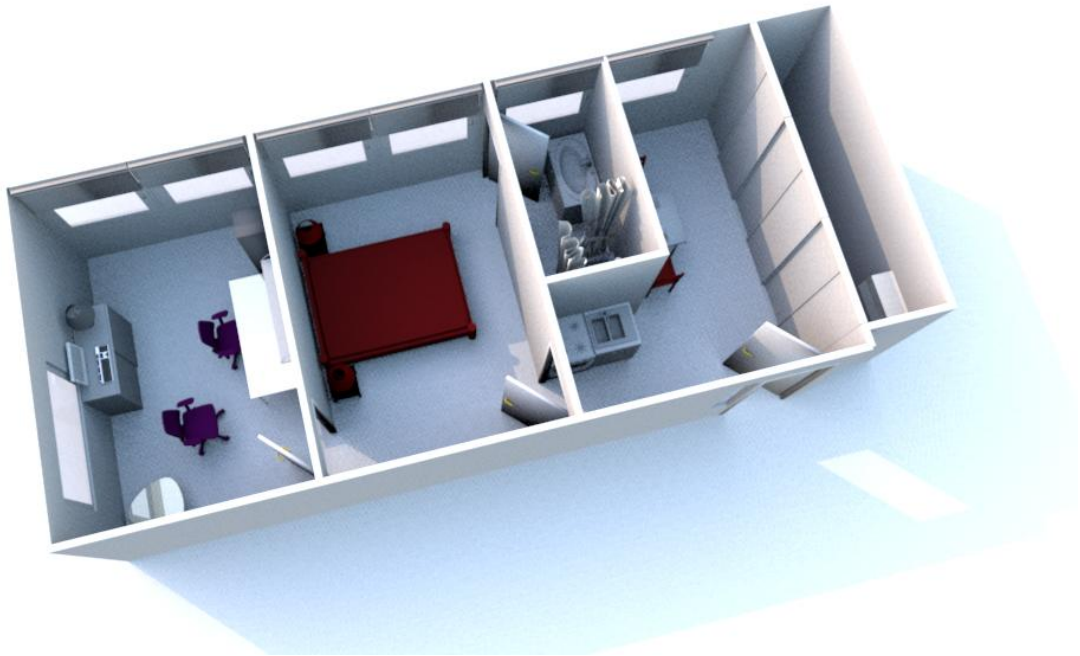


Figure 1 - 3D representation of the DOMUS intelligent flat

1.2. Sensors

Data contained in the dataset is about the following sensors:

- Electricity counter (cumulated consumption, instantaneous consumption, instantaneous voltage and current)
- Water counters, one for hot water and one for cold water (cumulated consumption, instantaneous flow)
- In the office
    - 4 ceiling spots (dimmed per 2, windows side and inner side)
    - One presence detector
    - 3 power plugs
    - 1 dimmed plug
    - 1 temperature sensor
    - 2 external shutters
    - 2 internal blinds
    - 1 luminosity sensor
- In the bedroom
    - One air quality sensor (temperature, relative humidity, $C0_2$ level)
    - 4 ceiling spots (dimmed per 2, windows side and inner side)
    - Controllable curtains

  - 2 external shutters
  - 4 power plugs (2 independent and two controlled in pairs)
  - 2 dimmed plugs (in pair)
- In the bathroom
  - One dimmed light
  - One external shutter
- In the kitchen
  - Two dimmed lights
  - 4 power plug
  - 1 external shutter
  - 1 internal blind
  - 1 luminosity sensor
  - 1 presence detector

1.3. Sensor Model

Each “Object” has one or more application. Each application has a serial number (as a long integer, represented in hexadecimal for convenience), and one or more resources (= representative variable). Resources can act as input or output for the application. For this dataset, only output resources are mentioned.

For example, a dimmed light has one application and this application exposes the “status” resources, corresponding to the effective level of the light (where 0 means off).

2. USING THE RAW DATA

Data are captured in a csv format given the following conventions:

- Each experiment has its own folder
- Each resource is recorded in its own file, named in the following format :

```
[serial number]01-[resource name].csv
```

- File format is csv, the first column is the POSIX time in milliseconds of the recorded event, and the second column is the recorded value.

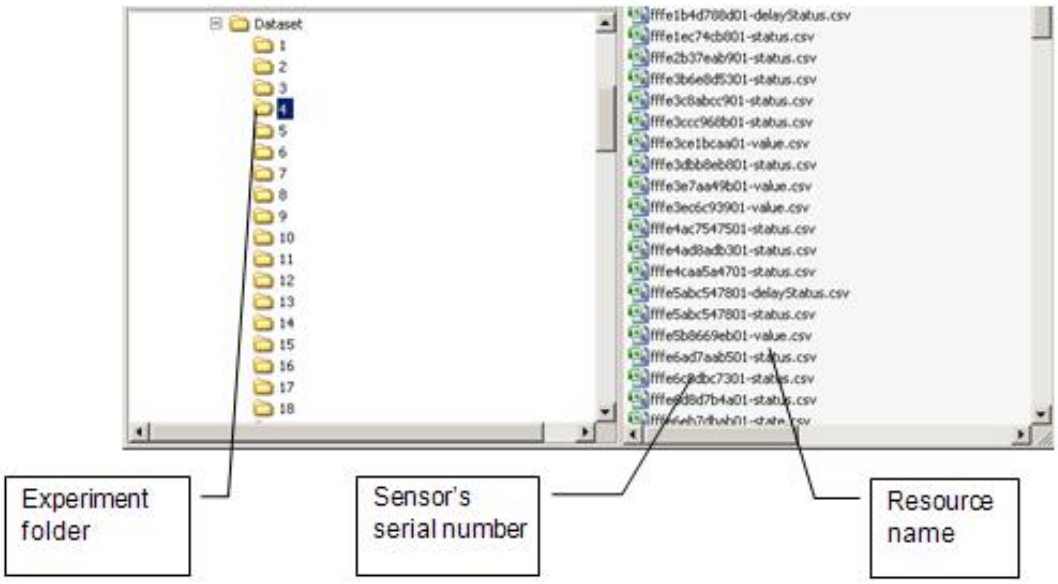


Figure 2 - structure of experiments

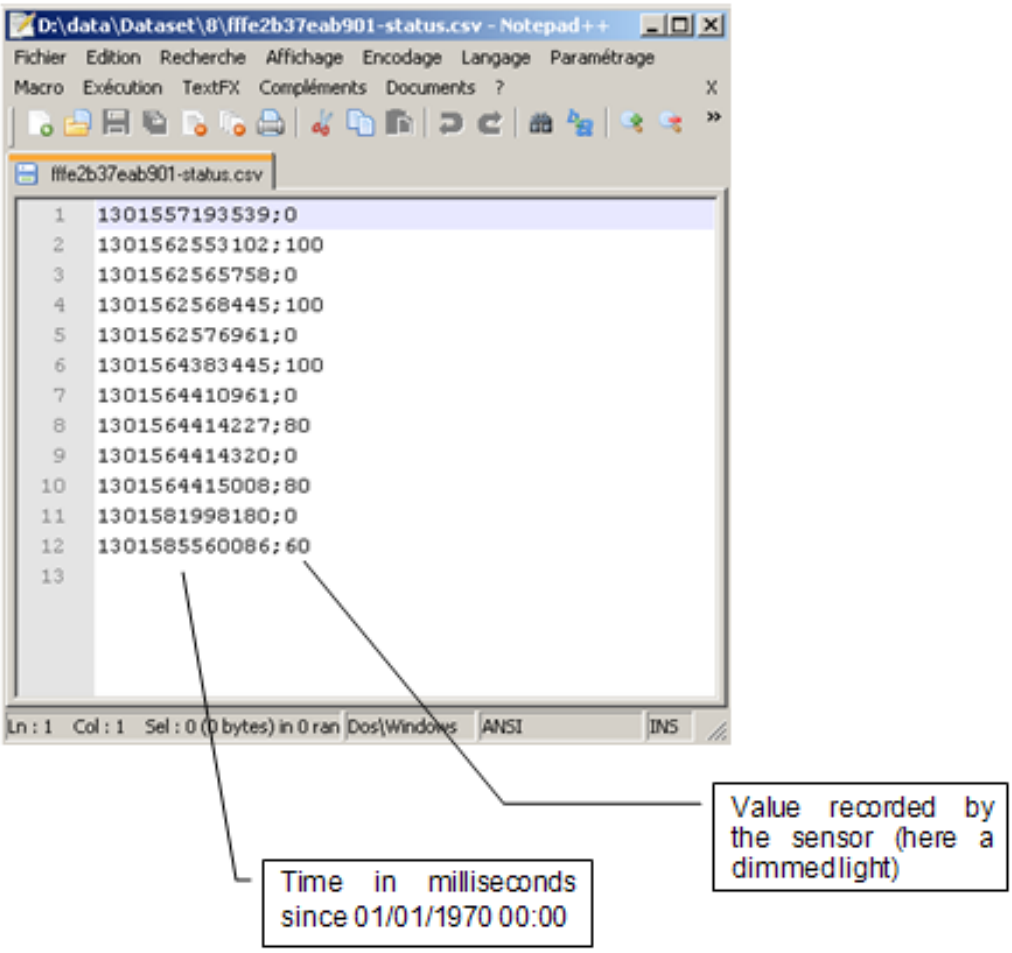


Figure 3 - contents of a sensor file

3. USING THE API

An API has been made in order to easily parse the sensors. Source code and examples are available at https://domus-dataset-api.googlecode.com/svn/trunk/ (subversion), written in Java. Binaries are included, and can be compiled from sources using Maven 2 (http://maven.apache.org/).
(Limited) support can be provided using the project home page facilities.

4. APPLICATION PROFILES

Each collected value is attached to an object, using a meta-application. Therefore, it is important to have knowledge about the involved applications, which can use variable dependences.

4.1. Lighting

4.1.1. Binary

Resource name	status				
Resource type	Integer	**min**	0	**max**	1
			“off”		“on”

4.1.2. Dimmed

Resource name	status				
Resource type	Integer	min	0	max	100
			“off”		“on”

4.1.3. Luminosity

Resource name	value				
Resource type	Integer	min	0	max	32767

4.1.4. RGB Lighting

Resource name	value				
Resource type	Integer	min	0	max	1
			“off”		“on”
Resource name	valueR	(level of red in the current color)			
Resource type	Integer	min	0	max	255
Resource name	valueG	(level of green in the current color)			
Resource type	Integer	min	0	max	255
Resource name	valueB	(level of blue in the current color)			
Resource type	Integer	min	0	max	255

4.2. Blinds

4.2.1. Shutters

Resource name	status				
Resource type	Integer		-1		1
			“down”		“up”

4.2.2. Sun blinds

Resource name	status					
Resource type	Integer		-1	1	-2	2
			“down”	“up”	“lamellas closed”	“lamellas opened”

4.3. HVAC

4.3.1. Ventilation

Resource name	status				
Resource type	Integer	min	0	max	1
			“low speed”		“high speed”

4.3.2. Temperature

Resource name	temperature				
Resource type	Float	min	-273	max	670760

4.3.3. Relative Humidity

Resource name	value	(percentage of relative humidity)			
Resource type	Integer	min	0	max	100

4.3.4. CO2

Resource name	value				
Resource type	Integer	min	0	max	4294967295

4.4. Counting

Resource name	value				
Resource type	Double	min	0	max	4294967295

4.5. Opening

Resource name	status				
Resource type	Integer	min	0	max	1
			“Closed”		“Open”

4.6. Presence

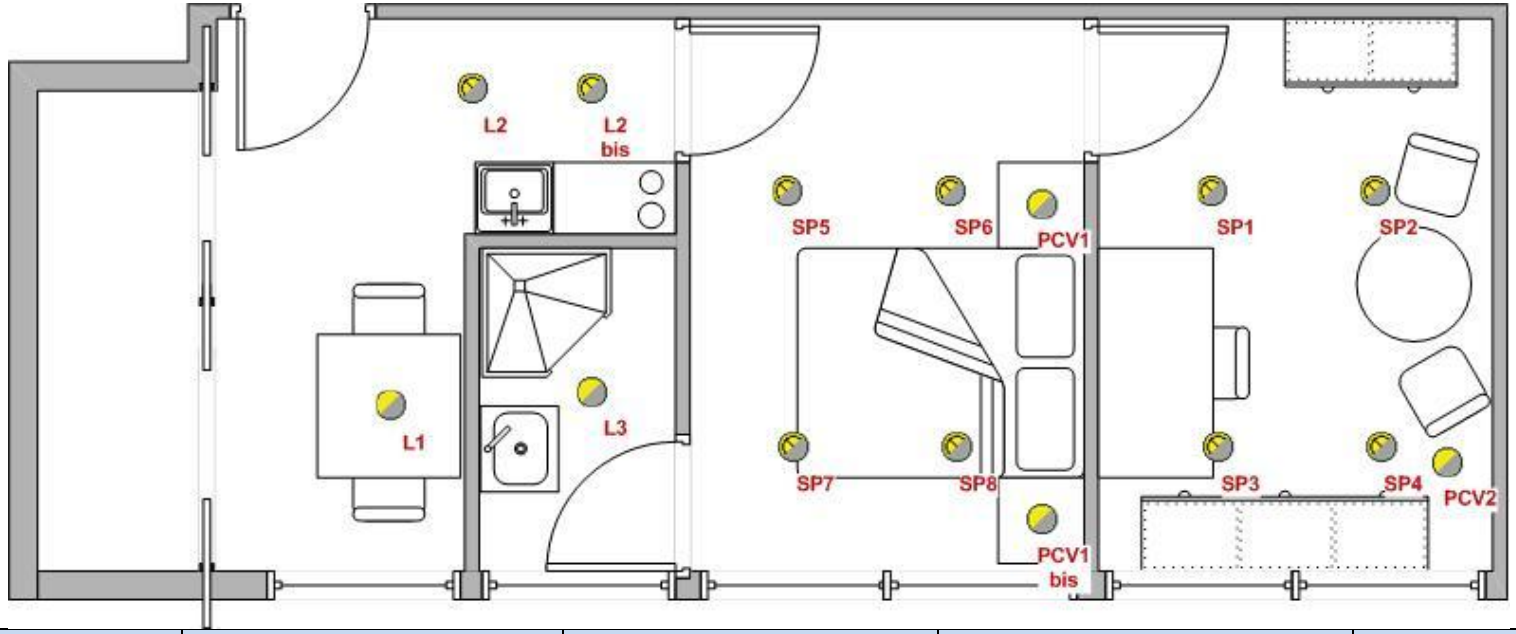
Resource name	status				
Resource type	Integer	min	0	max	1
			“Unoccupied”		“Occupied”

4.7. Misc

Resource name	value	
Resource type	String	

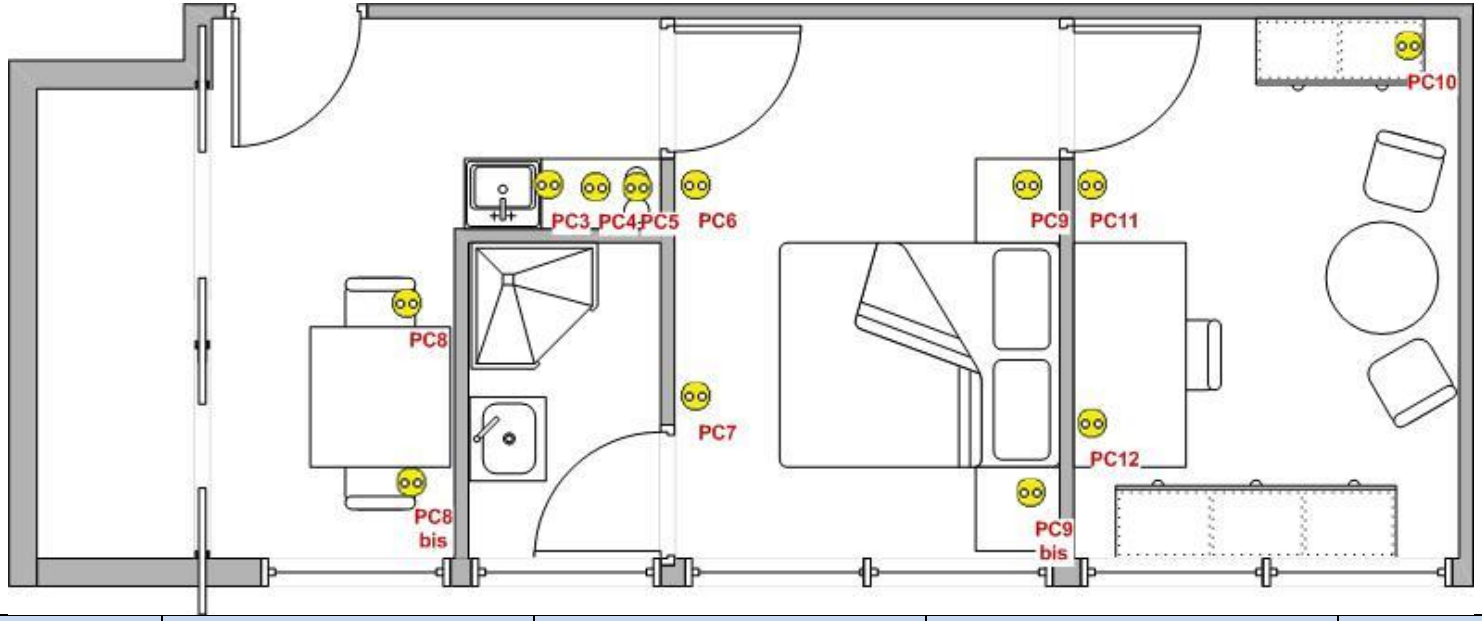
5. SENSORS

5.1. Lighting (Conventionnal)



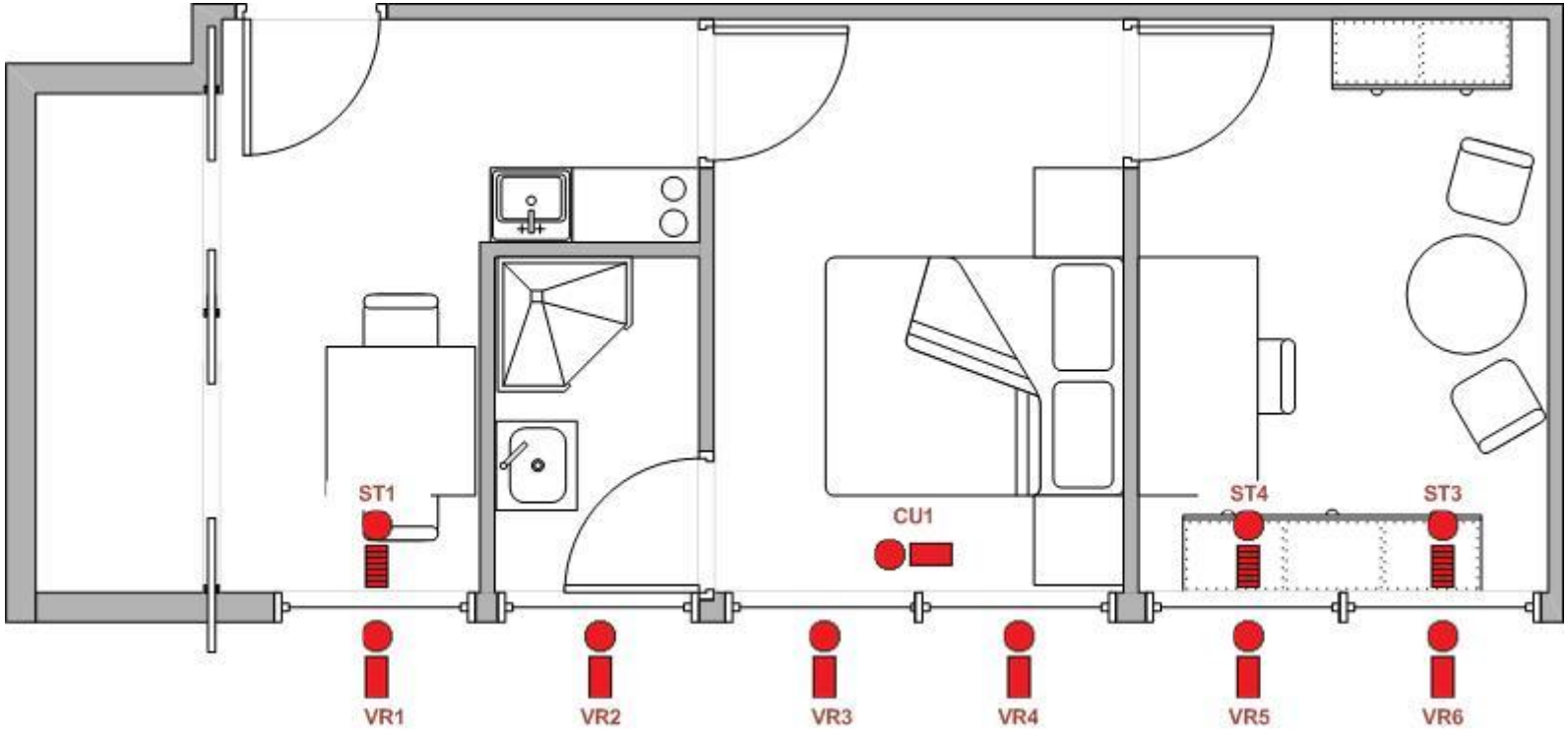
Name	Type	Power	Serial Number	Application profile
L1	Dimmed - Ceiling lamp	100 W	FFFE2B37EAB9	Dimmed
L2 – L2 bis	Dimmed - Spot	2* 50 W	FFFECBB299A8	Dimmed
L3	Dimmed - Ceiling lamp	25 W	FFFEB88797BC	Dimmed
SP5 – SP6	Dimmed - Spots	2 * 50 W	FFFEA4ACFDCC	Dimmed
SP7 – SP8	Dimmed - Spots	2 * 50 W	FFFEF9EF7D48	Dimmed
PCV1 – PCV1 bis	Dimmed - Bedside lamp	2 * 100 W	FFFEB6A85DBB	Dimmed
SP1 – SP2	Dimmed - Spots	2 * 50 W	FFFEDC6CAA6A	Dimmed
SP3 – SP4	Dimmed - Spots	2 * 50 W	FFFE8CC9BAD0	Dimmed
PCV2	Dimmed - Table lamp	100 W	FFFEFB6453C9	Dimmed

5.2. Power plugs



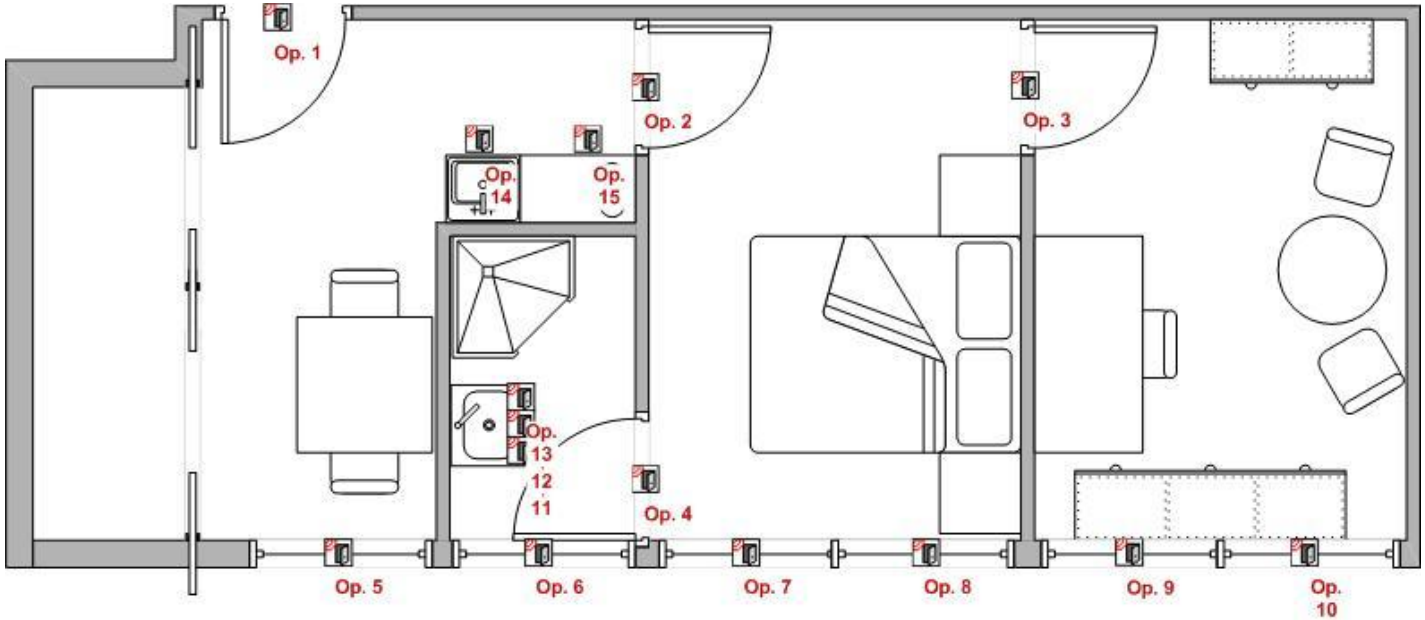
Name	Type	(Eventually) connected to	Serial number	Application profile
PC3	Power plug		FFFE67DAA0C3	Binary
PC4	Power plug		FFFEAA3DE849	Binary
PC5	Power plug		FFFE8EA1E6DD	Binary
PC6	Power plug	Heater	FFFED3E7ECEB	Binary
PC7	Power plug		FFFEDA97BB69	Binary
PC8 – PC8 bis	Power plug	Coffee machine, toaster	FFFEB853BA76	Binary
PC9	Power plug		FFFEAB498E8A	Binary
PC10	Power plug	Post lamp	FFFEAA6A458E	Binary
PC11	Power plug	Desktop lamp	FFFEBB9B539B	Binary
PC12	Power plug	Desktop lamp	FFFE98D7DAA8	Binary

5.3. Shutters



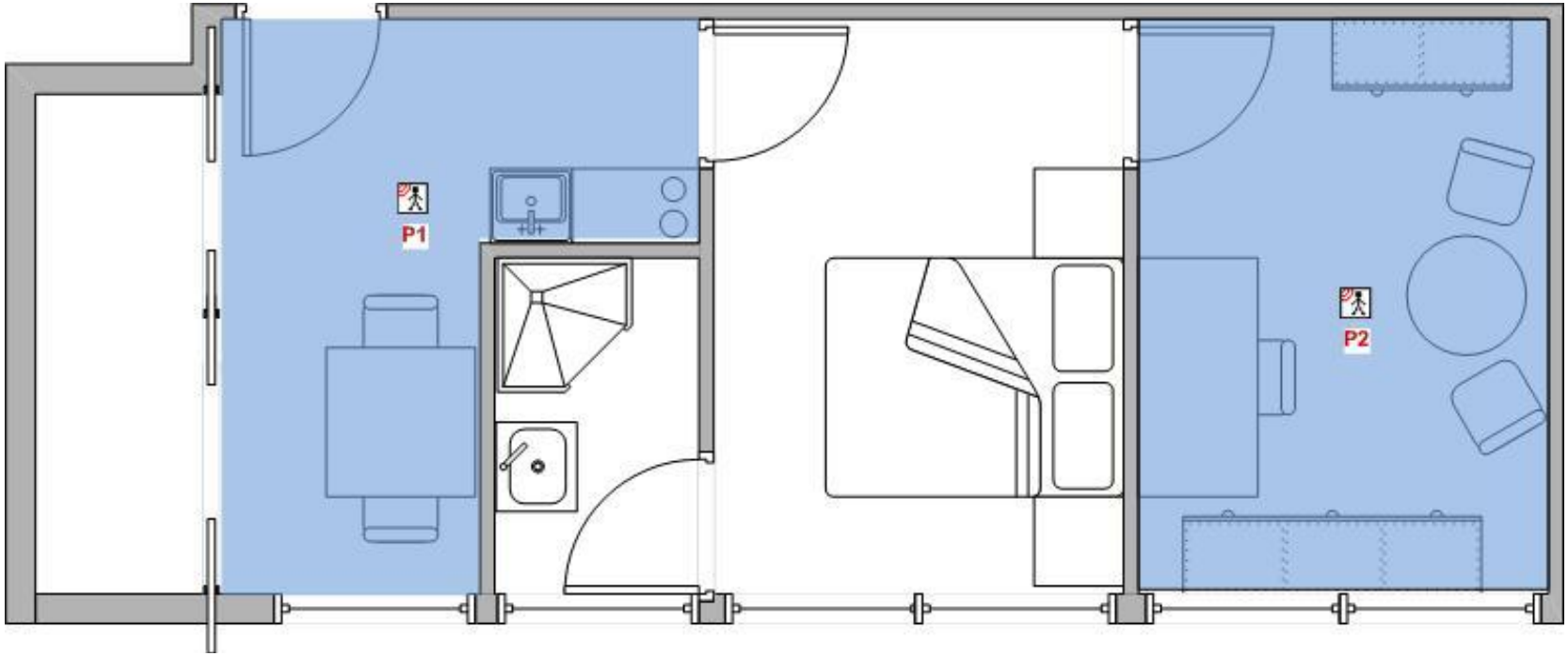
Name	Type	Serial number	Application profile
VR1	Shutters	FFFE63C3A7B2	Shutter
VR2	Shutters	FFFE61DC66BA	Shutter
VR3	Shutters	FFFEC7396CB7	Shutter
VR4	Shutters	FFFEC659B23D	Shutter
VR5	Shutters	FFFEABB51ACA	Shutter
VR6	Shutters	FFFED50B88C7	Shutter
ST1	Blinds	FFFEA8BCF469	Sun blinds
ST2	Blinds	FFFEAEDCCB67	Sun blinds
ST3	Blinds	FFFE8BB9CA7C	Sun blinds
CU1	Curtains	FFFE3B6E8D53	Shutter

5.4. Opening



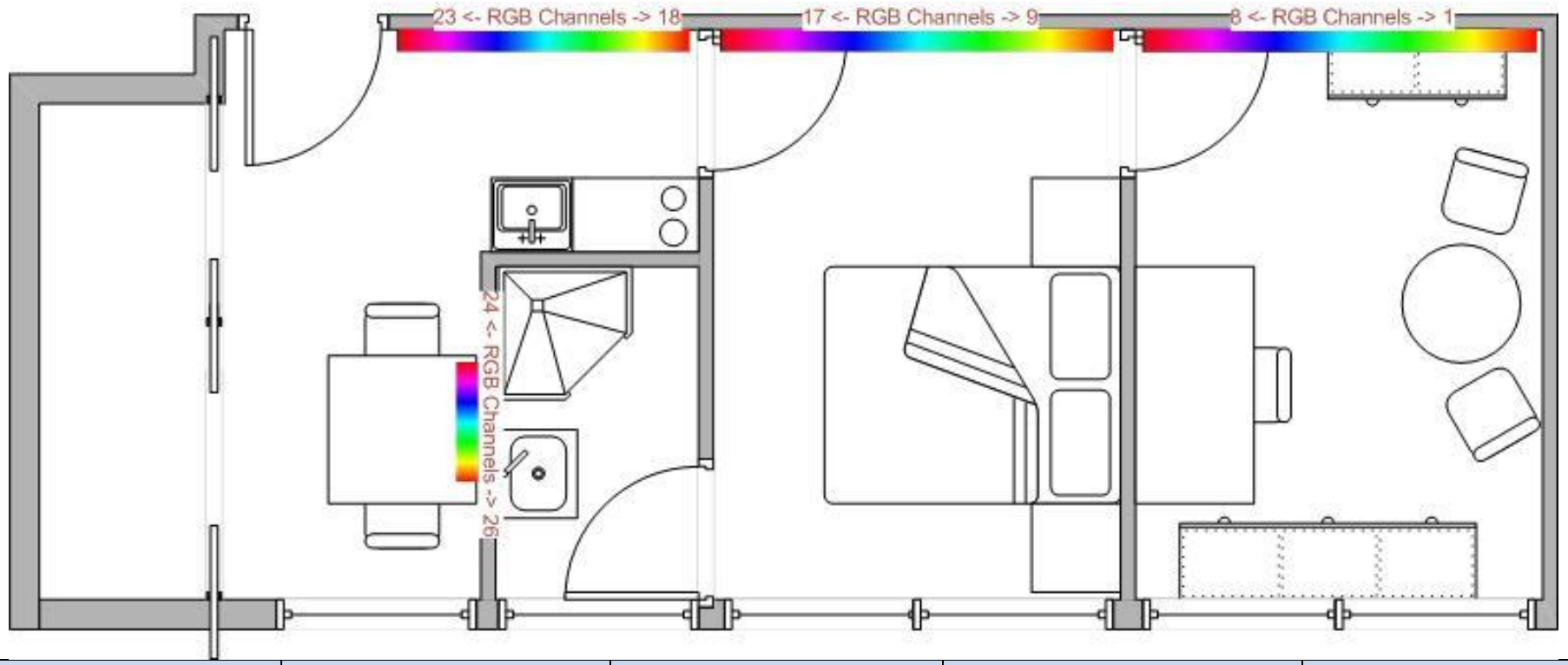
Name	Type	Detects	Serial number	Application profile
Op. 1	Opening detector	Entry door	FFFE793BF9A3	Opening
Op. 2	Opening detector	Kitchen / Bedroom door	FFFE8D5B3199	Opening
Op. 3	Opening detector	Bedroom / Office door	FFFECAAA7D8F	Opening
Op. 4	Opening detector	Bedroom / Bathroom door	FFFE79B6B39C	Opening
Op. 5	Opening detector	Kitchen window	FFFE1EC74CB8	Opening
Op. 6	Opening detector	Bathroom window	FFFE9C5EBCD8	Opening
Op. 7	Opening detector	Bedroom window 1	FFFECABA26B6	Opening
Op. 8	Opening detector	Bedroom window 2	FFFEB595A7B1	Opening
Op. 9	Opening detector	Office window 1	FFFE8658CAAA	Opening
Op. 10	Opening detector	Office window 2	FFFE7AAB3AA5	Opening
Op. 11	Opening detector	Left bathroom closet door	FFFE17BAB4BA	Opening
Op. 12	Opening detector	Middle bathroom closet door	FFFEAA5ACE9D	Opening
Op. 13	Opening detector	Right bathroom closet door	FFFEB8A8DA6A	Opening
Op. 14	Opening detector	Kitchen closet door (under sink)	FFFE9B5B62C8	Opening
Op. 15	Opening detector	Fridge door	FFFE919B82B3	Opening

5.5. Presence



Name	Type	Serial number	Application profile
P1	IR Presence detector	FFFECC84D66B	Presence
P2	IR Presence detector	FFFE9992F78D	Presence
P1 (Luminosity)	Luminosity sensor	FFFE48CA9395	Luminosity
P2 (Luminosity)	Luminosity sensor	FFFE659CDFB3	Luminosity

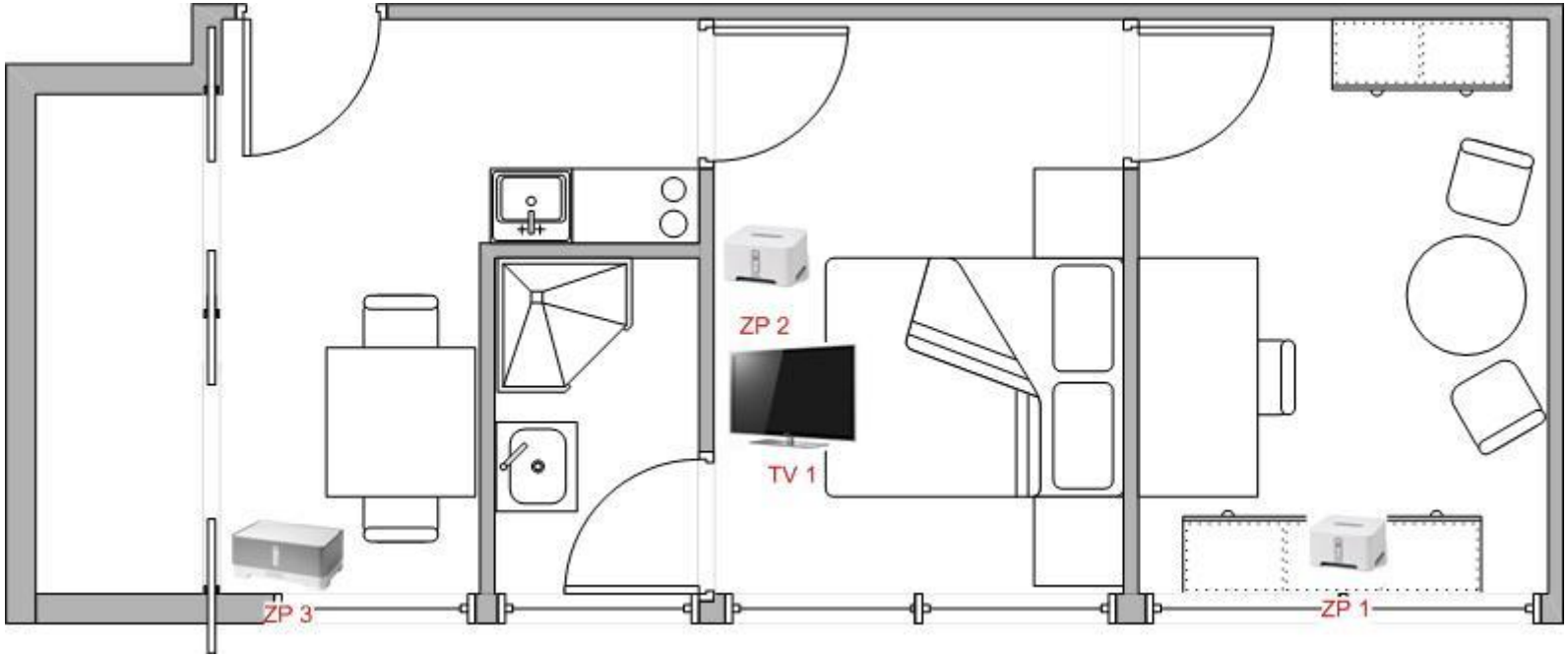
5.6. RGB Lighting



Name	Type	Location	Serial number	Application profile
RGB 1	RGB Channel	Office	FFFE9BCA9F35	RGB Lighting
RGB 2	RGB Channel	Office	FFFEC74B3569	RGB Lighting
RGB 3	RGB Channel	Office	FFFEACD9A33A	RGB Lighting
RGB 4	RGB Channel	Office	FFFE89BC9AC6	RGB Lighting
RGB 5	RGB Channel	Office	FFFEAB7B7789	RGB Lighting
RGB 6	RGB Channel	Office	FFFE6B19CAC9	RGB Lighting
RGB 7	RGB Channel	Office	FFFEAEBA8E63	RGB Lighting
RGB 8	RGB Channel	Office	FFFE3A67D3AE	RGB Lighting
RGB 9	RGB Channel	Bedroom	FFFE99ADB766	RGB Lighting
RGB 10	RGB Channel	Bedroom	FFFE1BDBACA9	RGB Lighting
RGB 11	RGB Channel	Bedroom	FFFE99B7AAA5	RGB Lighting

RGB 12	RGB Channel	Bedroom	FFFE3E9AA48C	RGB Lighting
RGB 13	RGB Channel	Bedroom	FFFE71ABCAA8	RGB Lighting
RGB 14	RGB Channel	Bedroom	FFFEB6A3F733	RGB Lighting
RGB 15	RGB Channel	Bedroom	FFFE81A935AE	RGB Lighting
RGB 16	RGB Channel	Bedroom	FFFE36AAEB3B	RGB Lighting
RGB 17	RGB Channel	Bedroom	FFFE8ABBAF66	RGB Lighting
RGB 18	RGB Channel	Kitchen (wall)	FFFE4A5973B6	RGB Lighting
RGB 19	RGB Channel	Kitchen (wall)	FFFE630D5969	RGB Lighting
RGB 20	RGB Channel	Kitchen (wall)	FFFECA72567D	RGB Lighting
RGB 21	RGB Channel	Kitchen (wall)	FFFE88CD5944	RGB Lighting
RGB 22	RGB Channel	Kitchen (wall)	FFFEBB5D967F	RGB Lighting
RGB 23	RGB Channel	Kitchen (wall)	FFFEEED7339C	RGB Lighting
RGB 24	RGB Channel	Kitchen (table)	FFFEADCAC66B	RGB Lighting
RGB 25	RGB Channel	Kitchen (table)	FFFEDA4B7B9D	RGB Lighting
RGB 26	RGB Channel	Kitchen (table)	FFFEACDCBABA	RGB Lighting

5.7. Multimedia



Name	Type	Location	Serial number (sound)	Serial number (filename)
ZP 1	Audio Renderer device	Office	FFFE1432ADAA	FFFE59188D82
ZP 2	Audio Renderer device	Bedroom	FFFEC2A9ABBA	FFFE98E7BCDD
ZP 3	Audio Renderer device	Kitchen	FFFE9B398B4B	FFFE8AAA49B5
TV 1	Audio/Video Renderer device	Bedroom	FFFE7A8B0DA9	

Remark: sound as the same application profile as a dimmed light, were the level corresponds to the volume. This volume control is manufacturer dependant, linked to the capabilities of the device. 0 means mute.
The filename resource is linked to the “misc” application profile, containing usually the file path of the current media played.

5.8. Miscellaneous sensors

5.8.1. Air quality

Name	Serial number	Location	Application profile	Unit
Temperature	FFFE9DA3A50A	Office	Temperature	°C
Temperature	FFFEB8A8CCBB	Bedroom	Temperature	°C
CO_2 concentration	FFFE97678AAD	Bedroom	CO_2	ppm
Relative humidity	FFFE3CE1BCAA	Bedroom	%	%

5.8.2. Electricity consumption and quality

Name	Serial number	Application profile	Unit
Global consumption since beginning	FFFED998E65A	Counting	kW/h
Current	FFFEDBAABA48	Counting	Amp.
Instant power on phase 1	FFFEDBB898DE	Counting	W/h
Total instant power	FFFE755B9A41	Counting	W/h
Voltage	FFFE7AA3A7CE	Counting	Volts

5.8.3. Water consumption

Remark: a lot of uncertainty concerns these counters, since the firmware and documentation are in a language that couldn't be understood by the installers, and far too technical to be translated by an online web service.

Name	Serial number	Application profile	Unit
Hot water global consumption since beginning	FFFE395A4D9C	Counting	L
Hot water flow	FFFE8A746A6D	Counting	L/h
Cold water global consumption since beginning	FFFE3E7AA49B	Counting	L
Cold water flow	FFFEDAABBCB5	Counting	L/h

5.8.4. Weather...

Remark: weather data are provided using an “unstable” web service. Other data from nearby (Grenoble, FR) connected weather station can be used since most of them archive their measures.

Name	Serial Number	Application profile	Unit
External temperature	FFFEA94554AA	Misc	°C
Atmospheric pressure	FFFEAA37796B	Misc	mbar
External relative humidity	FFFE3EC6C939	Misc	%
Wind speed	FFFE9A4A5BAB	Misc	m/s
Wind direction	FFFEC7BCDDE9	Misc	
UV Index	FFFE8B34ABAC	Misc	

5.8.5. User’s perceptions

Name	Serial Number	Application profile	(Likert) Scale legend
Global comfort	FFFE9B2CA3BC	Misc	Very unpleasant (0) to very pleasant (10)
Thermal comfort	FFFE53638989	Misc	Very unpleasant (0) to very pleasant (10)
Lighting comfort	FFFEA8DB4B5C	Misc	Very unpleasant (0) to very pleasant (10)
Air quality	FFFE645AA539	Misc	Very unpleasant (0) to very pleasant (10)
Acoustic comfort	FFFE47C76887	Misc	Very unpleasant (0) to very pleasant (10)

5.8.6. User’s feelings

Name	Serial Number	Application profile	(Likert) Scale legend
Temperature	FFFEAA6CD509	Misc	Very cold (0) to very hot (10)
Humidity	FFFE9249ADAB	Misc	Very humid (0) to very dry (10)
Luminosity	FFFE9A88BBDE	Misc	Very dark (0) to very bright (10)
Ventilation / air speed	FFFEBC2B3C4B	Misc	Very slow (0) to very high (10)
Smell	FFFE8D49BB6C	Misc	Very unpleasant (0) to very pleasant (10)
Noise level	FFFE7FADA15E	Misc	Very low (0) to very high (10)
Agreeableness of background noise	FFFE5B8669EB	Misc	Very unpleasant (0) to very pleasant (10)

6. EXPERIMENTS

6.1. Experiments 1 to 20

The goal of these experiments was to study inhabitants' perception of an "intelligent" ambiance. 20 people were asked to spend about 1 hour and a half in the intelligent flat. The experiment was divided in 3 slots of 20 to 30 minutes, each one of them in a specific room with a specific activity as follows:

- First slot : people were asked to be in the office and to play training games (about concentration and memory)
- Second slot: people were asked to be in the bedroom, place themselves in a comfortable position and watch a documentary on TV. Documentary was preselected by the experimenter
- Third slot: people were asked to cook in the kitchen. Menu was preselected by the experimenter.

Inhabitants were asked to fill a form every five minutes in order to understand their perception of comfort with a sensorial semantic (paragraph 5.8.5) and a technical semantic (paragraph 5.8.6). Each of these variables were presented in the form of a Likert scale to the inhabitant.

N	Gender	Age	Clo[1]	Remarks
1	M	> 60	0,5	
2	F	30-40	0,6	
3	M	40-50	0,6	
4	M	30-40	0,6	
5	M	> 60	0,7	Refused to cook, last slot aborted
6	F	20-30	0,4	
7	F	30-40	0,5	
8	F	< 20	0,5	
9	F	40-50	0,6	Experiment had to be aborted; subject didn't understand the protocol and repetitive indications couldn't bring her "back" in conditions to continue. Data should be analyzed with extreme care.
10	F	30-40	0,5	
11	F	30-40	0,7	
12	F	< 20	0,5	
13	M	< 20	0,5	
14	M	20-30	0,4	
15	M	> 60	0,5	
16	F	< 20	0,5	
17	F	20-30	0,5	
18	F	50-60	0,6	
19	M	50-60	0,4	
20	F	< 20	0,4	

[1] « Clo » : Clothing insulation

6.2. Experiments 21 to 24

The purpose of these experiments is rather similar to the previous ones. The difference is that subjects were familiar with the intelligent flat as they are part of (or familiar with) the research group. For these experiments, they agreed to spend a full night in the intelligent flat.

Users had no instructions, and were asked to spend their time as they would do in a hotel. Most of them had their dinner and breakfast during the experiment.

No direct observation could be made. Feedback from the users indicated lack of usability (bad antenna for the TV, slow computer, and long delay to wait before hot water availability...).

The experiment n° 24 has to be stopped a little before 2:00 AM, since an alarm problem at the building level forced the user to quit the building.

N	Gender	Age	Remarks
21	M	> 60	
22	M	30-40	
23	F	20-30	
24	F	20-30	Aborted at 2 :00 AM due to unexpected intrusion alarm activation for the whole building

7. CONCLUSION

This document has synthesized guidelines to use our dataset produced for intelligent buildings research. Further information about this dataset can be obtained by contacting the authors.

Other dataset are publicly available and can be found at the following URLs:

- https://sites.google.com/site/tim0306/datasets
- http://boxlab.wikispaces.com/List+of+Home+Datasets
- http://ailab.wsu.edu/casas/datasets.html
- http://domus.usherbrooke.ca/jeux-de-donnees/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