



CREW WinnComm tutorial

3: Benchmarking and Common Data Format

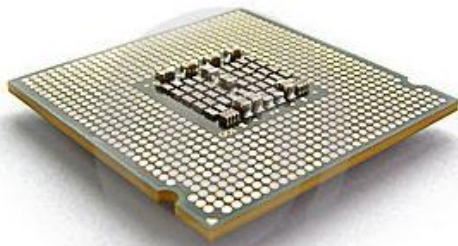
Stefan Bouckaert, Ingrid Moerman (IBBT)



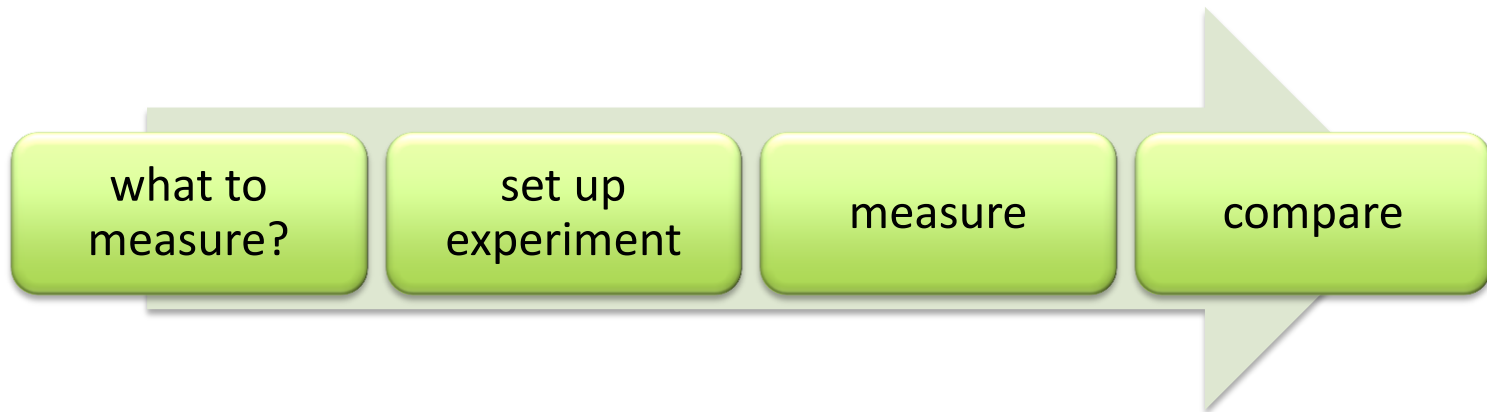
WinnComm 2012, Brussels

The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 258301 (CREW project).

Experimental performance evaluation is widely used



- How to quantify the performance of my solution ?
- How does solution **A** compare to solution **B** ?

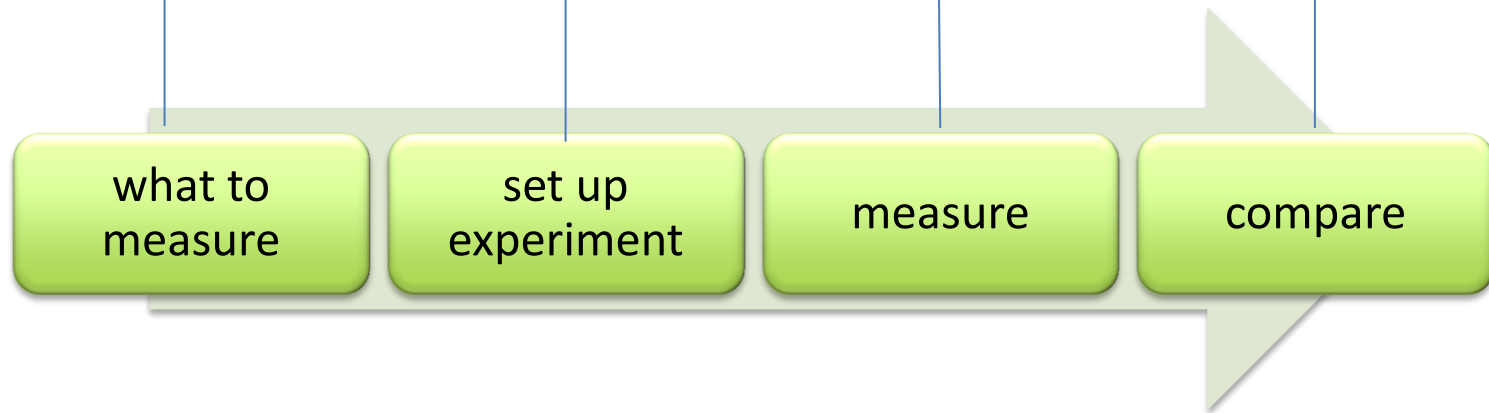


no uniform metrics
ad-hoc defined metrics

no clear description
hard to reproduce

no clear methodology

apples and oranges?



Definition

The act of measuring and evaluating computational performance, networking protocols, devices and networks, under **reference conditions**, relative to **a reference evaluation**.

Goal

Enable fair comparison between different solutions, or between subsequent developments of a System Under Test (SUT).

- old concept, but new/evolving research domains
→ new interpretation of 'benchmarking'
- examples from FIRE projects
 - BonFIRE
 - CREW
 - OneLab2 → OpenLab
 - ...

}

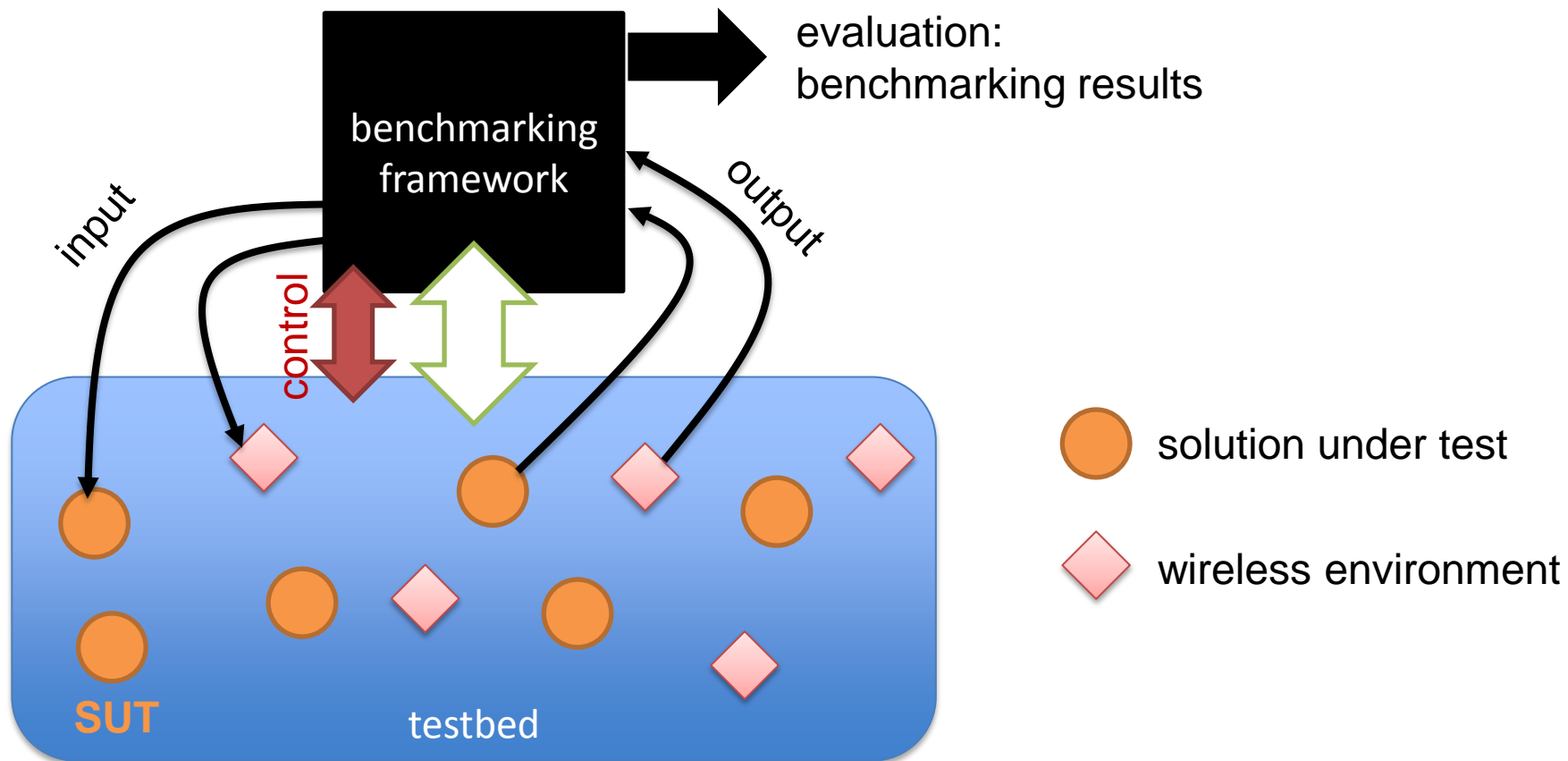
wired networks
wireless
cognitive radio (networks)
cloud
...
- **white paper on benchmarking:**
www.crew-project.eu/documents



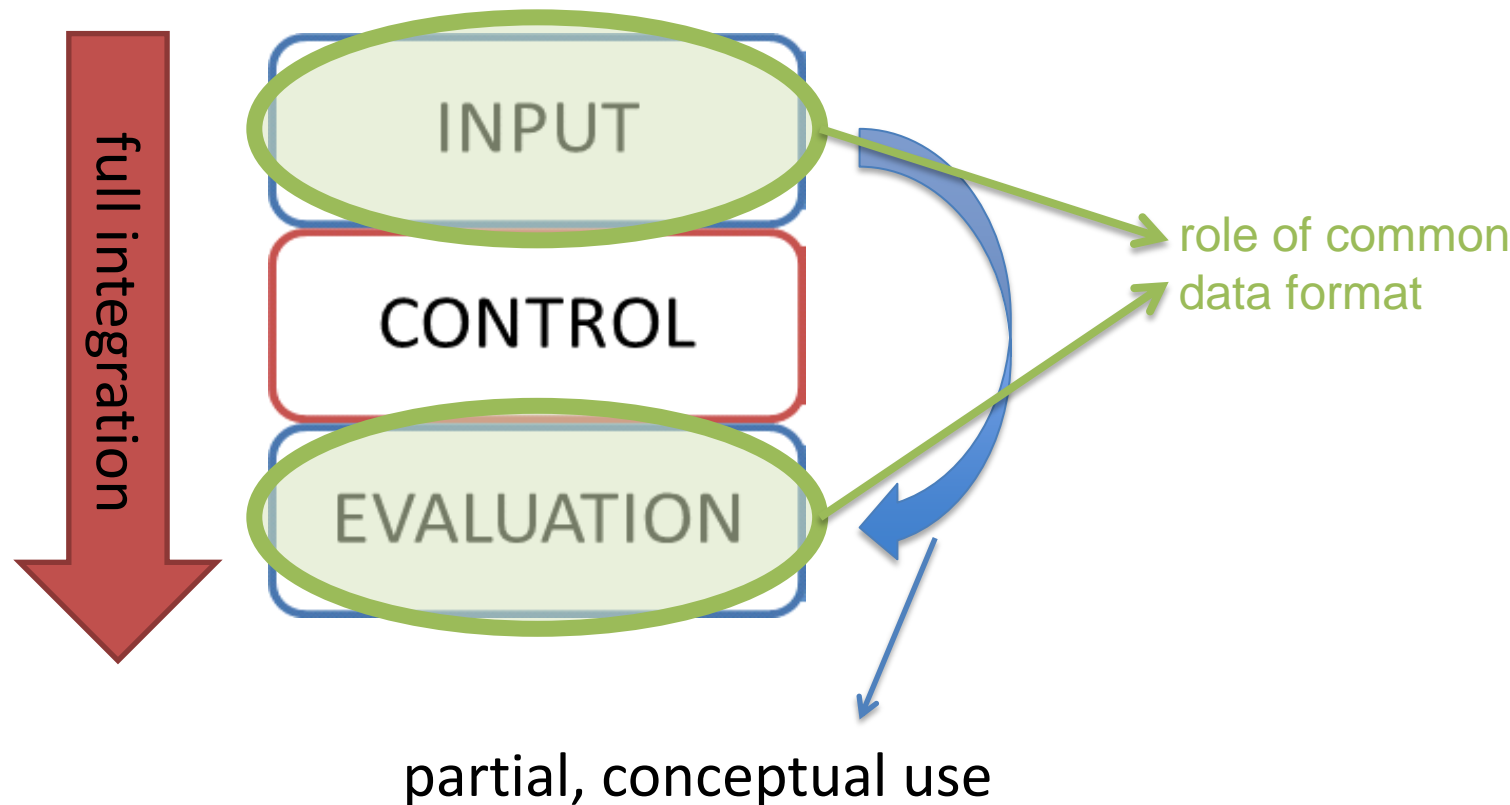
- **Primary scope:** cognitive radio

- **Challenge:**

diversity of testbeds vs. “generic” benchmarking?



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diversity of testbeds vs. “generic” benchmarking?



- At input side: describing experiments
- At result side: convert results to common data format

- Based on IEEE 1900.6 standard
 - Extended with data structures
 - meta-information,
 - experiment specification
 - parameters that are not directly related to sensing (e.g., throughput, BER, FER, etc.)
 - file format: JSON

- More info: www.crew-project.eu/portal

Case: comparing sensing solutions

■ Scenario, described in a common data format

1. specification of the Wi-Fi signal
(i.c.: replay recorded signal)
2. topology, (i.c.: sensor
connected over coax to signal gen.)
3. background interference
(i.c.: none)



■ Output

- results collected “manually” in a proprietary format
- results are converted to a common data format
- from the uniformed results, comparable metrics and scores are derived

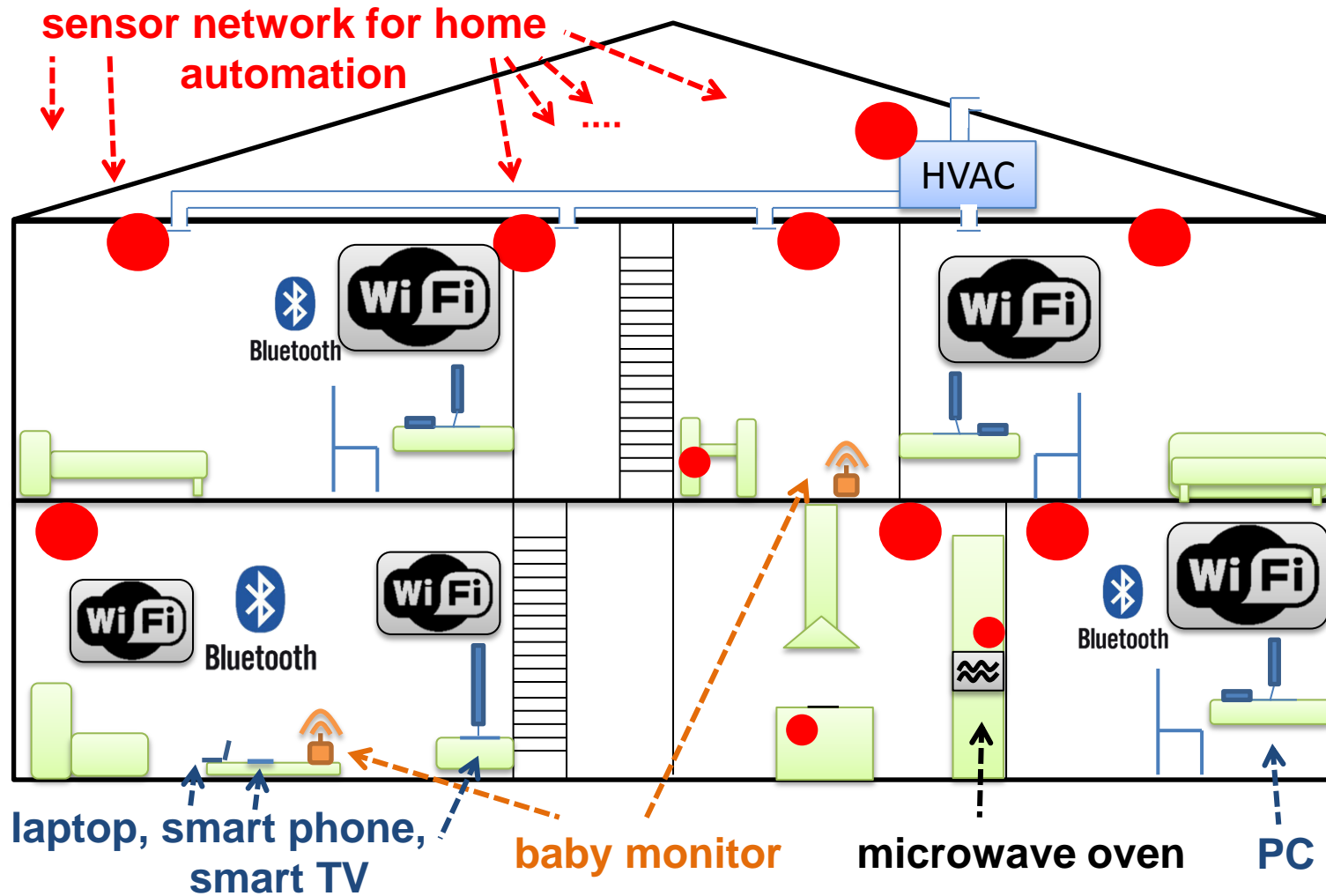


technology centre
<http://ilabt.ibbt.be>

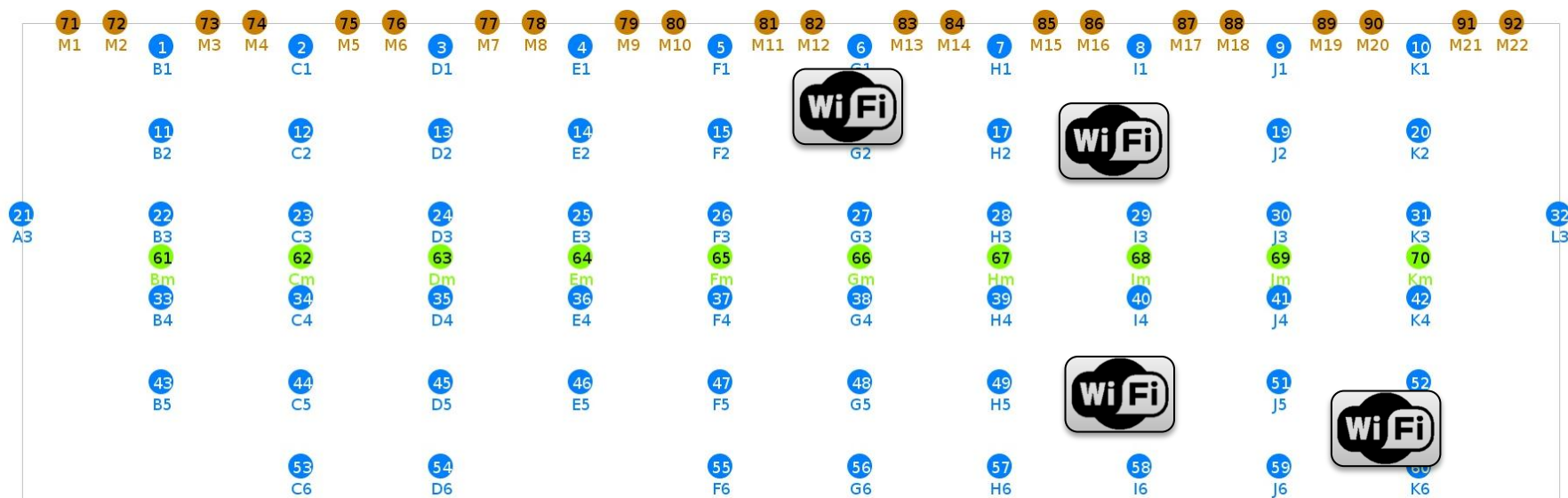
usecase + screencast: benchmarking of a cognitive sensor network protocol inside the IBBT w-iLab.t testbed

A specific benchmark for a specific purpose:

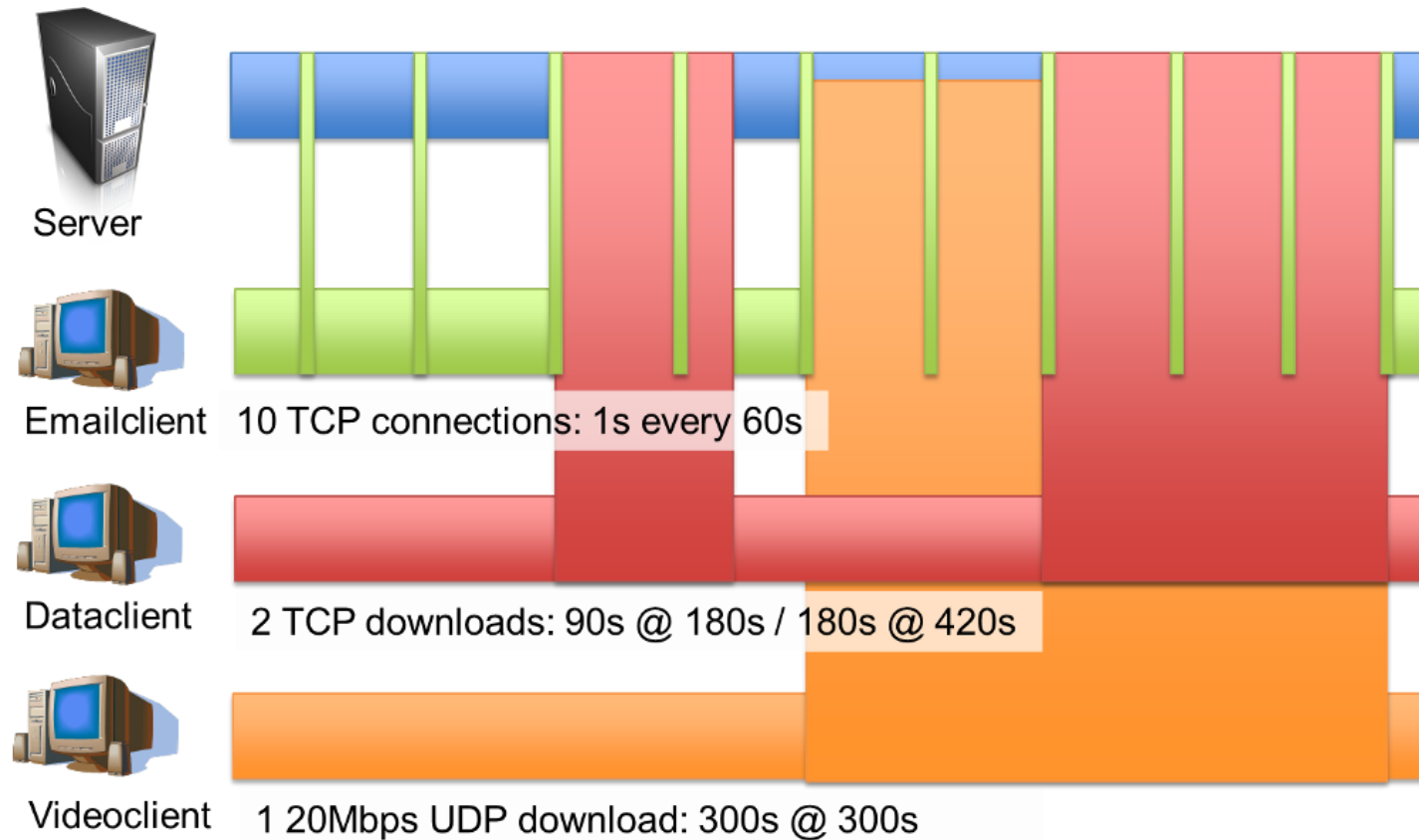
i.e. benchmarking the reliability of a sensor network protocol in a specific topology, given a certain level/pattern of background interference



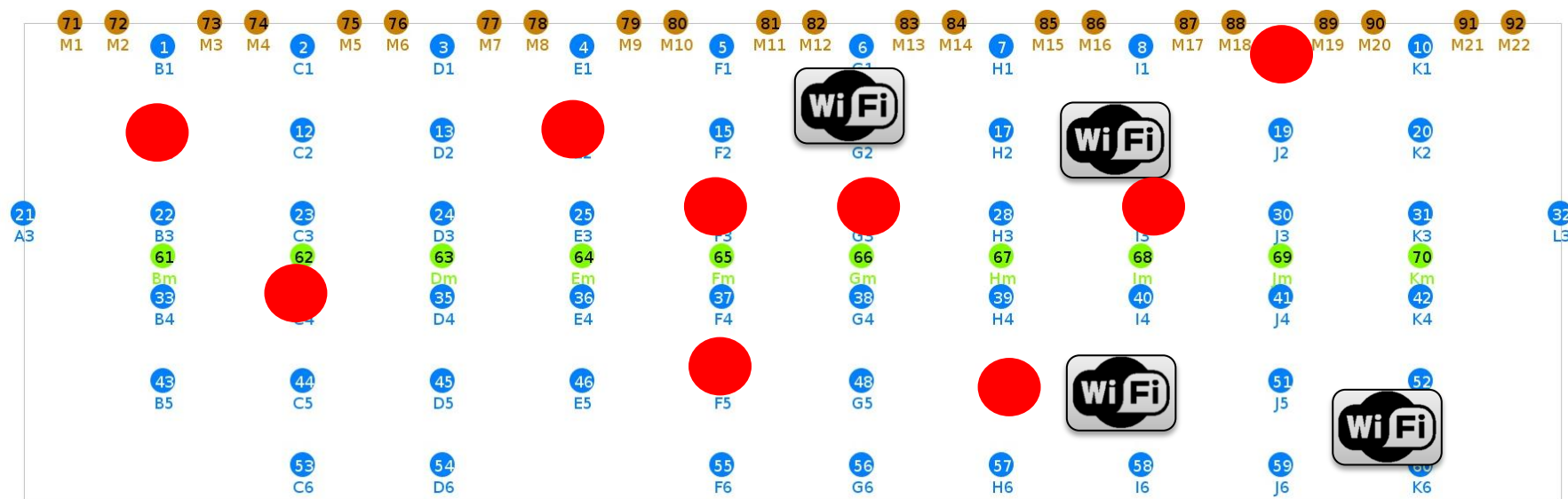
■ Reproducible background scenario



Reproducible background scenario



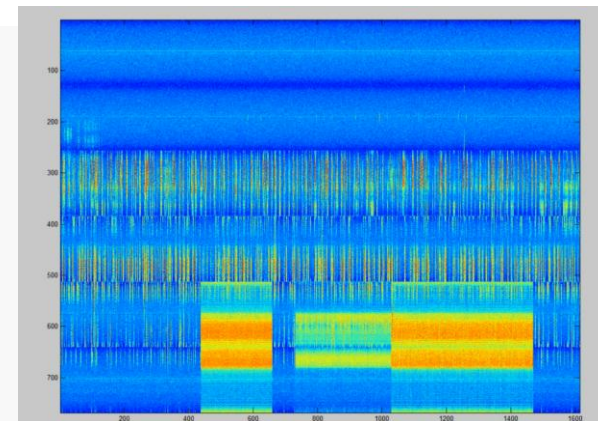
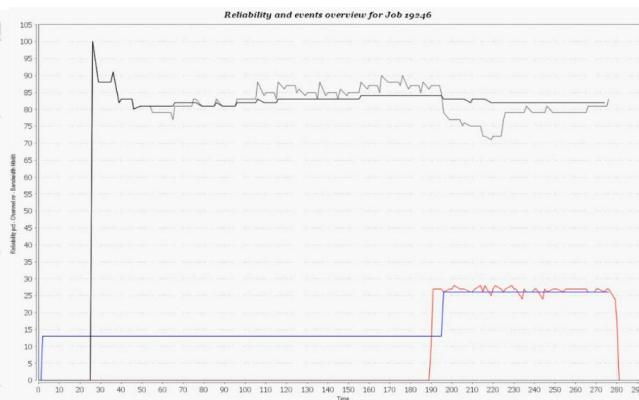
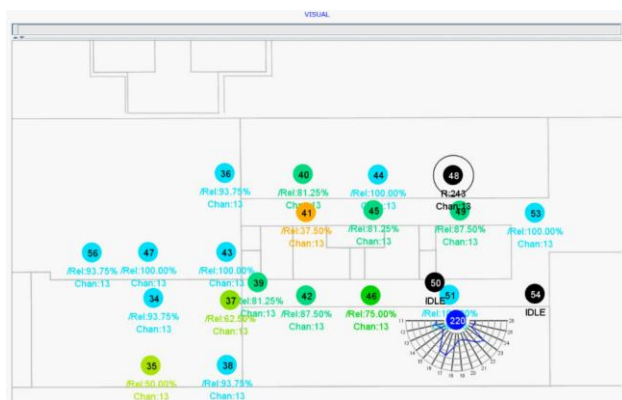
Given this particular background scenario, add the sensor protocol under test.



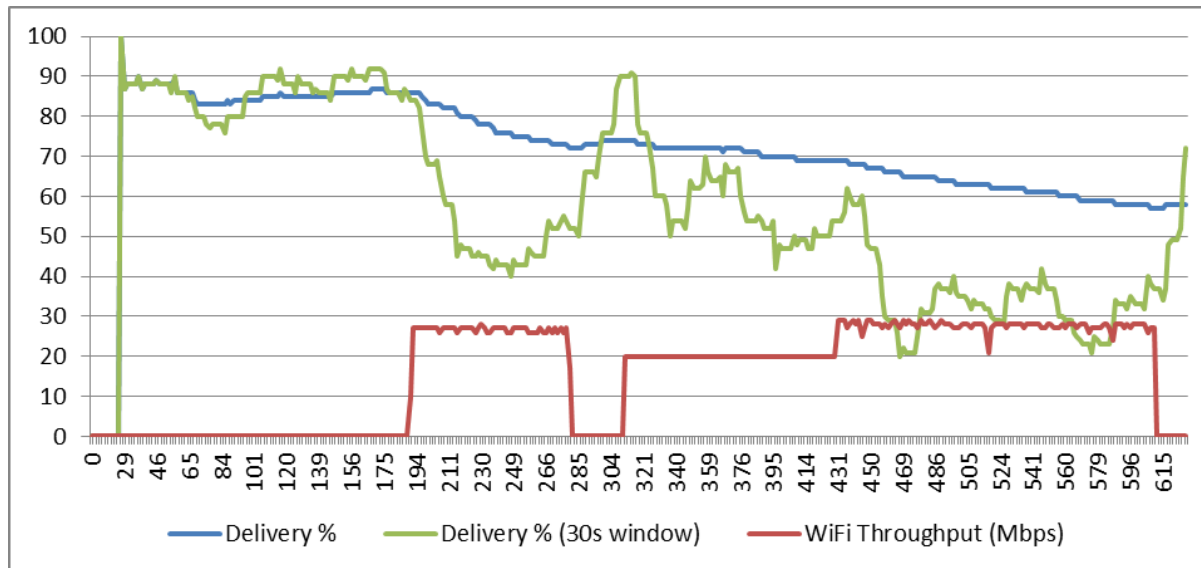
 Sensor node, part of the solution under test

■ SCREENCAST: The benchmark is executed

- real-time analysis
- real-time visualization
- real-time processing of results



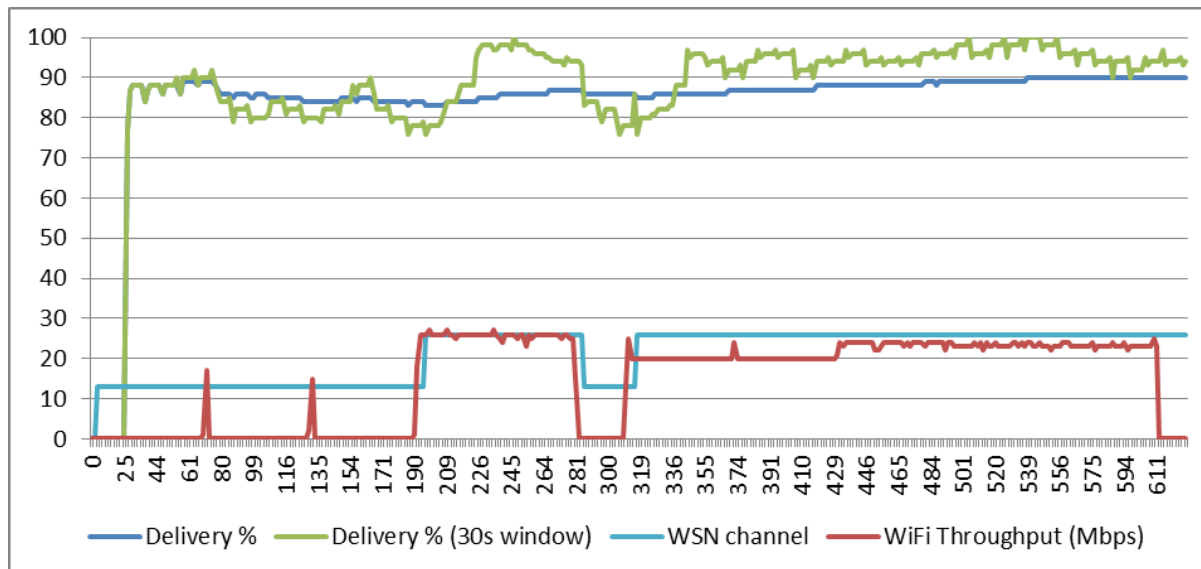
Fair comparison between solutions



Example: coexistence of Wi-Fi and Zigbee sensor nodes

■ **No channel switching:**

- *WiFi activity leads to significant degradation of WSN performance*



■ **With channel switching:**





- *Much better level of coexistence between WSN and WiFi network*

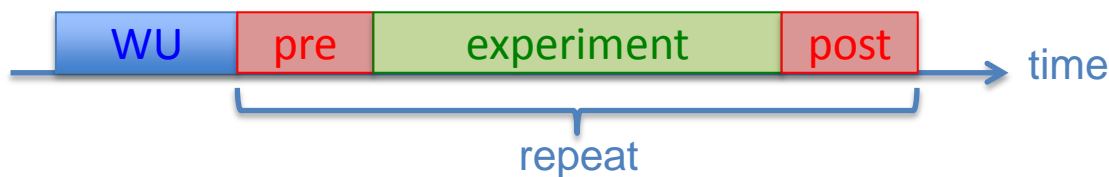
Assess wireless channel during experiment

■ Heterogeneous distributed sensing

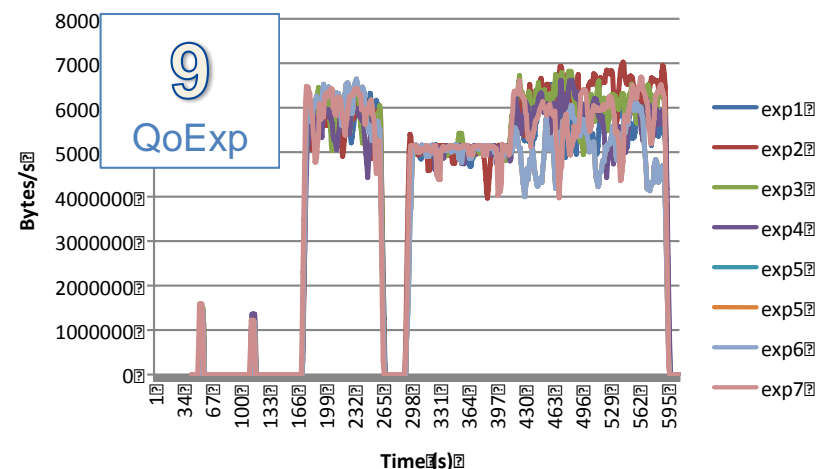
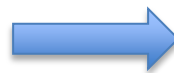
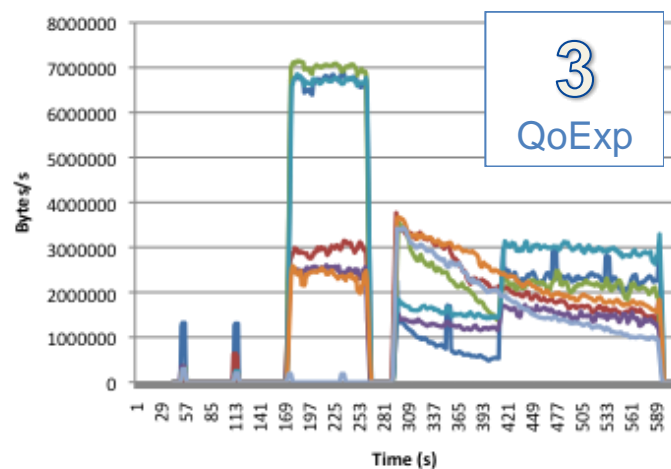
- Collect PSD measurements from geographically distributed sensing devices
- Analyze spectrum

■ Experiment cycle

- 4 phases
 -  warming up
 -  pre pre-assessment of wireless environment (create PSD map)
 -  in situ assessment of wireless environment (create PSD map)
 -  post post-assessment of wireless environment (create PSD map)
- Assess presence of external interference through
 - analysis of pre/post/in situ PSD maps
- If needed, repeat experiment cycle
 - correlation between subsequent in PSD maps
- Give global score for validity of experiment



Assess quality of wireless experimentation environment



■ Outside of IBBT testbed

- Use of concepts, methodology
- CREW can provide traces for background traffic
 - primary user behavior
 - repeatable signal traces (e.g. Wi-Fi, Bluetooth)
- Common data format
 - public database under construction

■ IBBT testbed

- characterization of the testbed environment
- use testbed to set up repeatable environment
 - library is being built with “typical” background interference
 - new environments can be user-defined and saved/shared
- benchmarking framework is planned to be released as a standalone tool

- **Benchmarking in CREW:** old concept applied to wireless networking testbeds
- **Basic use:** methodologies, traces
- **Full implementation example@IBBT:**
benchmark the solution under test
AND the wireless environment/testbed
- **Common data format:** extensible, based on IEEE1900.6



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