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On the existence of experimentally- driven research methodology

A FIREworks white paper



Introduction

- Attempt to scope the area of *experimentally driven research*
 - Propose a *methodology*
 - Related terminology
 - Understand how this methodology can be applied
- A first step in a controversial debate



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FIRE foundational objectives

- Multi-disciplinary research environment
 - Experimentally driven research
 - Large scale European experimental facility
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- The rationale was to create a dynamic between elaboration, realization, and validation by means of iterative cycles of experimentation



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Systematic experimentation

- No theoretical *experimental model* exists
- A systematic *experimental methodology* can be defined in steps such as
 - specification of the performance objectives, constraints, and description of expected results
 - definition of relevant performance criteria and metrics
 - description of the modus operandi, e.g. configuration, initialization, running conditions and (iterative) procedures to be executed
 - reporting on observations and the resulting analysis and the feedback on each iteration before reaching (partial) conclusion



- Formal description of experiments
 - Take into account that different execution environments may offer different degrees of ***controllability*** and ***monitorability*** for the relevant experiment parameters
- Understand and characterise the output of experimentation in order to ensure ***verifiability, reliability, repeatability,*** and ***reproducibility*** of the experimental results



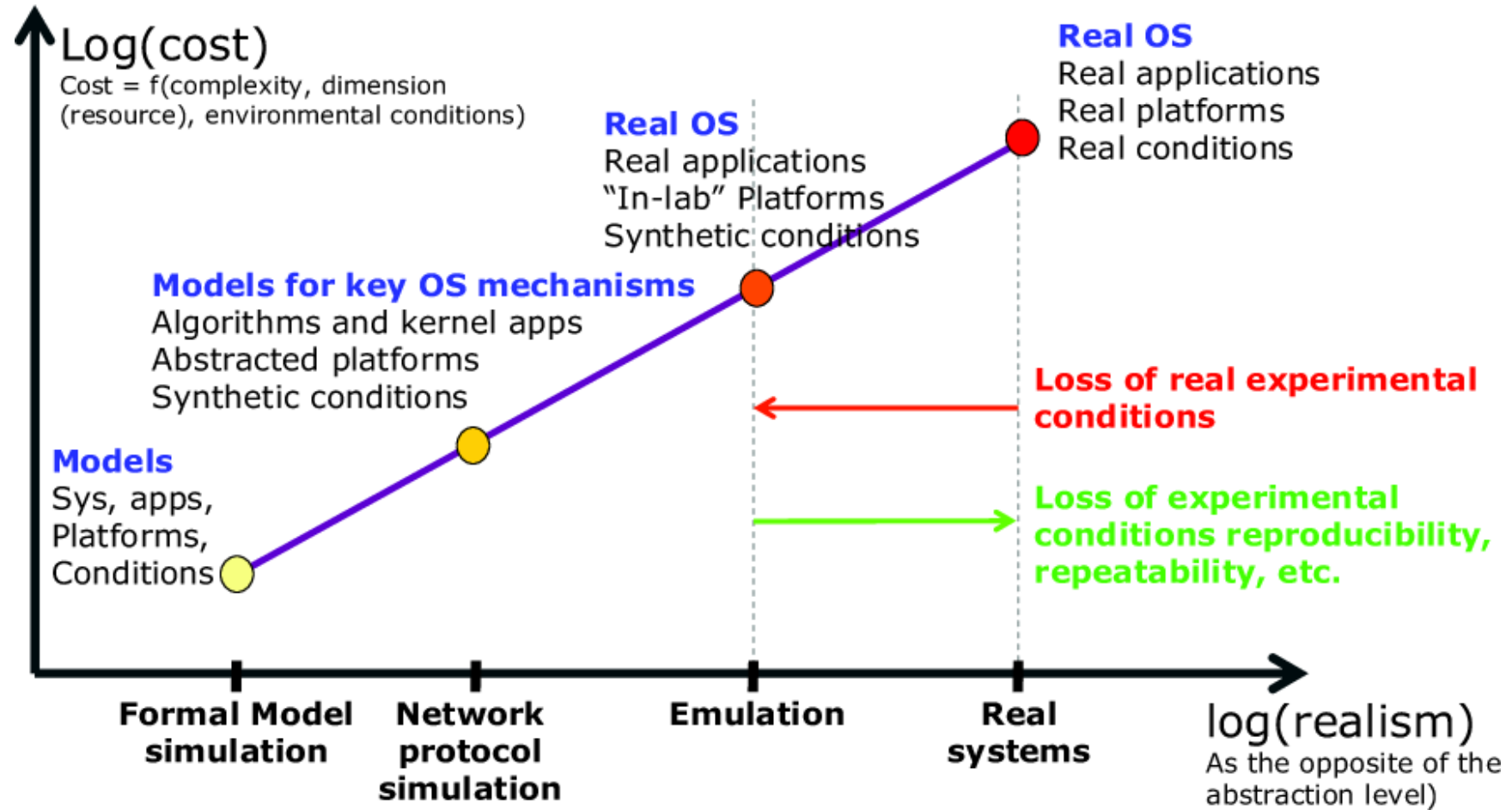
Cost vs. Realism

- Experimentation as a research methodology to achieve concrete results: where, how, when¹
 - By Dimitri Papadimitriou at FIA Stockholm, November 23-24, 2009
- Cost increases but realism as well
 - Formal model → Simulation → Emulation → Real systems



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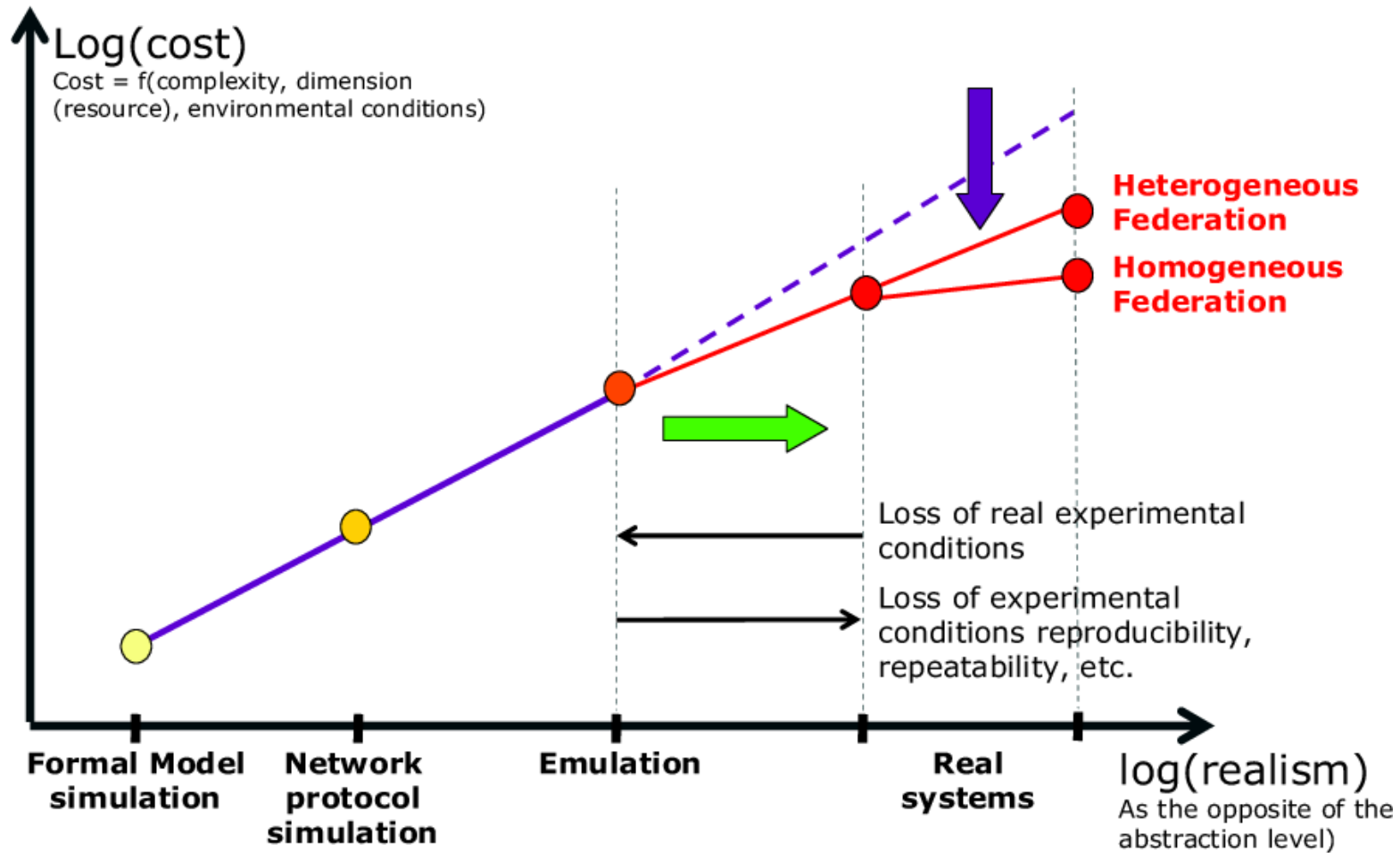
Cost vs. Realism





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Control cost through federation





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Testing vs. Experimentation

- Testing is well defined, e.g. by ETSI
 - Conformance testing, Interoperability testing
- Experimentation (in our discipline) is not well defined
 - The orderly or methodical observation of the variation of facts resulting from artificial stimuli in a reproducible environment that confirms a hypothesis (verification) or rejects it (falsification)
 - Modify stimuli ... observe impact
 - A hypothesis is valid if we can show that an experiment can be reproduced

Testing is well defined, e.g. by ETSI



Can we draw a line?

- Distinguish between testing and experimentation according to the knowledge about the right stimuli and observation points of a system?
 - **testing** has a known list of stimuli and observation points which can be used to determine if a system is working correctly
 - **experimentation** is the search for the right stimuli and observation points that are useful for a reasonable assessment of a system
- Distinguish according to the level of maturity of the knowledge about the behaviour of a system?
 - draw a line between **research** and **development**, applying experimentation in the research phase and testing the technology development phase of the activities



Benchmarking

- As a remark it is important to distinguish **experimentation** and **benchmarking**, the latter being defined as
 - a test procedure executed under controlled (often optimal) conditions to measure functional and/or performance metrics and compare the results to an existing specification e.g. well-accepted industry standard.



More definitions

- Testbed, Testbed federation, Trial, Pilot
- Large scale?
 - In LSI/VLSI circuit design it was large-scale 100-5000 circuit elements → very-large-scale (5k-50k), → super-large-scale (50k-100k) → ultra-large-scale (>100k) ...
- Use the **cost** factor as a measure, whereas cost is a function of complexity, dimension and environmental conditions
 - **Large-scale** denotes an environment that exceeds the **cost** of a laboratory environment at any given point in time by one or more levels of magnitude.



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Enter the debate

- We invite you to download the paper and challenge the *methodology* and related *terminology*
- Provide your to info@ict-fireworks.eu or directly to me gavras@eurescom.eu
- TridentCom 2010, 18-20 May 2010 - Berlin, Germany
<http://www.tridentcom.org>

TridentCom 2010

18-20 May 2010 - Berlin, Germany

The 6th International ICST Conference on Testbeds and Research Infrastructures for the Development of Networks & Communities



Technical sponsorship



18-20 May 2010 - Berlin, Germany

Please note that TridentCom 2010 participation is limited due to the limited number of seats of the conference facilities. Thus register as soon as possible to assure your attendance.

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TridentCom 2010 - Call for participation

Early Bird registration deadline is Sunday, 18 April, 2010!!

TridentCom 2010, this year's biggest international testbed conference, is devoted to "Testbeds and Experimental Facilities for the Future Internet". It will take place in the vibrant city of Berlin, Germany, from 18 to 20 May 2010. TridentCom 2010 will provide a forum to explore existing and planned testbed concepts, infrastructures, and tools to address the research and business challenges of ICT convergence.

The three-day event features 5 keynotes about the German G-Lab, the European FIRE initiative, the US GENI programme and the Japanese New Generation Network project framework, 4 tutorials, 41 papers from 20 countries presented in 11 technical sessions.

Session topics include:

- Federated and large scale testbeds
- Future Internet testbeds
- Future wireless testbeds
- Federated and large scale testbeds
- Monitoring in large scale testbeds

In addition, posters from the German G-Lab projects, European FIRE projects and other running projects will give practical insights about ongoing Future Internet research. A panel comprising major industry and academic players will discuss distinguished issues of Future Internet experimentation.

Don't miss this unique opportunity to get insights on Future Internet testbeds by the world's leading ICT testbed experts. Further information about the detailed conference program as well as the online registration is now available on the TridentCom website at <http://www.tridentcom.org>