Networking and Theory

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“Theory”: a supposition or a system of ideas intended to explain something, especially one based on general principles independent of the thing to be explained;
A gap between experience and theory in networking?

- IETF is a unique SDO with many contributions from universities
  - We even have an IRTF!
- But there seems a gap in networking area (as a whole)
  - Innovations and designs rely heavily on experience
  - I don’t find a well-defined body of knowledge, or a systematic set of approaches, which can guide us to
    - Make design choices
    - Understand tradeoffs behind decisions

• Doubts quoted: “What is networking?“
  • “Is it just a plethora of protocols acronyms, mostly consisting of three or four letters.”
  • “Or, are we a heap of header formats, for Ethernet frames, IP packets, TCP segments and UDP messages, and application-layer messages?”
  • “So, perhaps we are a big bunch of boxes that perform various functions on packets, flows, or TCP connections?”

• Appeals
  • Our field is all about change, ... But, while we continue to embrace change, I hope that we can make the questions we ask more precise, and the way we answer them more rigorous, so we can put networking ...on a stronger foundation.
  • I fear we err too far on the side of valuing new problems over deeper answers to existing questions. We need to fight this urge, to encourage more thorough, complete, and deeper research that truly helps the field “grow up,” without losing its child-like sense of wonder.
Why IETF?

- **Why adding some “theory” ingredients helps IETF**
  - Explain the existing designs
  - Predict the outcomes from new designs for new problems
  - ...
  - Make it easy for the new generation/new comers
    - to inherit
    - to make their contributions

- **Why IETF can help**
  - We have both rich successful experiences and expertise in theory --we have so many academic participants.
Why now?

• We may require more theoretical analysis than before, facing new requirements
  • “Deterministic” or "bounded delay" services beyond "best effort"
  • New methods beside “per-hop & per-flow” reservation?

Application of Network Calculus to the TSN Problem Space

Jean-Yves Le Boudec$^{1,2,3}$
EPFL
IEEE 802.1 Interim Meeting
22-27 January 2018
(1) Mathematical Foundations of Computer Networking, Srinivasan Keshav, Waterloo University

(2) The Sciences of the Artificial, Herbert A. Simon, 1996

“there already exist today a number of components of a theory of design and a substantial body of knowledge, theoretical and empirical, relating to each.”

It includes at least the following topics:

THE EVALUATION OF DESIGNS
1. Theory of evaluation: utility theory, statistical decision theory
2. Computational methods:
   a. Algorithms for choosing optimal alternatives such as linear programming computations, control theory, dynamic programming
   b. Algorithms and heuristics for choosing satisfactory alternatives
3. THE FORMAL LOGIC OF DESIGN: imperative and declarative logics

THE SEARCH FOR ALTERNATIVES
4. Heuristic search: factorization and means-ends analysis
5. Allocation of resources for search

7. REPRESENTATION OF DESIGN PROBLEMS
Actions?

• Folks, who find this interesting, please contact us to share your views, and let’s see what will happen...

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Thank You