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Article #1

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**Title**: “Applying Formal Method to Networking: *Theory,* *Techniques and Applications*”

**Source**: IEEE Communications Surveys & Tutorials, Volume: 17, Issue: 1, Firstquarter 2015

**Author**: Junaid Qadir

**Summary**: In his article, Qadir seeks to point out the shortfalls that is the history of networking. Qadir cites the success of the internet from the 1960s as being the primary culprit behind the current state of the internet worldwide. The internet’s vast expansion led to many of its engineers applying new techniques and protocols without fully vetting the implementations. Though effective at the time, continued use has brought to light various bugs due to oversights of the over 7,000 protocols -- evidencing why these “informal methods” are “inadequate for specification, analysis, and validation.” Thus, Qadir seeks to push network development into the “formal method” arena; that is, “computer techniques based on mathematical logic,” following examples such as the computer software industry which has developed various levels of abstraction “designed to simplify the task of programming while ensuring correctness.” To do so, Qadir must overcome apprehension to adopt what some see as excess work that does not derive a plentiful benefit. However, Qadir insists “it is imperative in today’s world [and the future’s]” to move toward automated testing as opposed to the manual techniques used today.

Qadir gives overviews for four areas of interest to the topic: the foundation of logic, tools for specifications and modeling, tehcniques for verification, and programming languages and their verification. Qadir highlights these topics to bring-to-mind the oversights the industry may have forgotten in its attempts to stay up-to-date with the growing demand for the internet. In his section on logic, Qadir surveys various form of logic (11 in total) from the Ancients of Aristotle and Plato to more modern figures like Saul Kripke, from syllogisms to algebra, etc. In similar fashion, Qadir surveys various modeling forms that stand upon and utilize the foundation that is logic, highlighting description languages, specification languages, and verification methods for the models’ specifications. Next, Qadir turns to techniques to verify the aforementioned models. Following, Qadir looks to further illuminate these concepts by giving a survey of programming languages and how they apply to the three previous areas. Finally, Qadir gives a survey on the state of networking and certain groups who have attempted to apply such techniques Qadir has mentioned and their successes in their areas, including topics such as: protocol verification, property verification, network configuration, network security, etc.

**Comments**: This article was very enlightening. I have never looked into the history of internet networking, and anything I hear on the topic rarely criticizes so many areas in the networking field. Should Qadir’s claim be true, it’s hard to imagine how much networking “gymnastics” and “duct-tape” hold together the communication and e-financial stability of the world. Everyone has run into an area where a quick-fix is used instead of taking the time to sit down and analyze the situation, especially if it involves money. One must ask themselves whether he or she will take the time to sit down and truly think through certain implications and how it may affect the future. However, from what Qadir has said, one might find it difficult to find such data that helps one make such a decision!