Question2: Current layered structure and protocols were designed for wire-line systems. To incorporate wireless systems, do you think a new networking architecture (special for wireless) should be developed, or just fix and enhance the existing protocols but keep the infrastructure unchanged? Provide your reasons.

Answer:

As I've presented in my answer to Bonus Question No.1, I don't think current network protocols are suitable for wireless networks. However that doesn't mean we have to design and implement a brand new network architecture for wireless networks. All we need to do is to fix and enhance the existing topology and protocols. Reasons for my viewpoint are listed as follows.

**Firstly, the main difference between wire-line and wireless networks lies in the physical layer. Therefore, components in wire-line networks (except for medium-sensitive ones related to physical layer and link layer) could be preserved and enhanced in wireless networks rather than being replaced.** The success of today's Internet is attributed to its independent and transparent protocol design in different layers, and such an architecture allows the flexibility to modify or change the techniques in a certain protocol layer without significant impact on the overall system design. Although this strict layered architecture is not efficient for wireless networks, our options are definitely not limited to chasing for a new architecture. It is far more reasonable that we maintain all the advantages of the current mature layered network architecture, and concentrate our efforts on wireless related problems such as improvements that should be made on physical and link layers or solutions that combine all layers to obtain optimized system performance.

**Secondly, there are a lot we can do to further improve and enhance present network structures and protocols in order to make them suitable for wireless communications.** Research and innovation on handling wireless channel and its impacts on wireless systems never stops ever since the first day that wireless networks come into being. Improvements in physical layer, like powerful and configurable codec method (RS code, CC code, LDPC etc), efficient and implement-friendly modulation type (OFDM), creative and power-saving antenna design (MIMO, time-space coding etc), are providing us more and more "smart" physical equipments. Furthermore, even the layered structure itself is evolving to accommodate wireless applications. One of the hotspot in wireless communication field today, Cross Layer Design and Optimization, is a series of techniques that provide better system performance from information exchanges across protocol layers, and thus lead to efficient utilization of scarce radio resources. Techniques like channel-aware scheduling, joint source/channel coding and power allocation, dynamic-weight generalized processor sharing (DWGPS) and so on are being researched or even putting into reality, and performance of traditional layered structure over wireless channel has been improved tremendously.

**Thirdly, time, complexity and risk for designing and implementing wireless network with new architecture and protocols are significantly high**. The layered structure in wire-line networks has been adopted for over 20 years. Its maturity and popularity were not commutable among all possible network structures available today. And since the future wireless network is expected to converge into a heterogeneous, all-IP architecture that includes different wireless access networks like cellular network, WLAN, Bluetooth and so on, the layered architecture has been researched and enhanced not only by CS scientists in the past, but also increasingly by EE scientists nowadays. So toughness could be imagined intuitively when a new architecture is being researched, designed and especially implemented under the impact of layered architecture and protocols. Furthermore, interface between the newly built network structure and the layered structure will also be a huge challenge, because the convergence of wire-line networks and wireless networks would be a definite trend in the future.

**Last but not least, pressures from the market also play a vital role to orient the direction of network research**. Even though finally an advanced architecture for wireless networks is successfully carried out, the time and effort it has consumed during research, simulation, implementation, manufactory and verification will all turn into price of its products and will be directly transferred to consumers. As products based on layered structure will be much cheaper from this point of view, market reaction of the new-structure-based wireless products will naturally be not acceptable. In other words, just as when we make a choice between TCP and UDP when applying for multimedia services, what we need is just a better and more suitable one, but not the best one.