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COMPUTER NETWORK PROTOCOL & APPLICATION ANALYSIS

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ABSTRACT

Over the past decades, the Internet has grown from a small experimental network that served as a playground for researchers to a global infrastructure that connects hundreds of millions of people. Today, the Internet stands as the largest and the most complex computer system that has ever been created. Reliable and efficient communication in computer networks requires specialized communication protocols. Earlier research has emphasized system performance at lower levels, within the communication network itself, while this work considers the efficiency of protocols for communication between processes in the host computers attached to a computer network. Throughput and delay are chosen as the primary performance measures. Network transmission characteristics, protocol parameters, and process behavior all interact in determining the efficiency of communication between remote processes. Models are developed to determine the impact of protocol parameters such as retransmission interval, window size, buffer allocation, packet size, and acknowledgment strategy on protocol performance. Several graphs showing quantitative performance results for representative situations are included. Complexity is now the dominant constraint for the design, engineering, and management of computer networks and protocols. The first consequence of high complexity is that even though the Internet and various underlying protocols are engineered artifacts, it becomes increasingly more difficult to understand how the Internet works and how various protocols interact with each other in the Internet. Complexity also directly contributes to the high fragility of the Internet. Internet may have large-scale cascading effects, causing wide-spread failures and performance degradations of applications and critical network services. The chains of casual relationships for these failures are poorly understood today. The problem is exacerbated by the fact that there is an increasing need to rapidly develop and deploy new capabilities. The challenge is to support these new capabilities without increasing the complexity of the overall system, and to understand how new solutions will perform , interact with other components of the network and to reduce network complexity.

1. INTERNET MEASUREMENT DRIVEN PROTOCOL DESIGN

Over the past several years researchers in collaboration with industrial partners have conducted some of the largest network measurement studies. A distinguishing aspect of Internet measurement research projects is that our studies are purposely designed to aid the development and evaluation of new protocols, a methodology we call Measurement-Driven Protocol Design.

Consider the multi-homing routing protocol design study led by Srinivasan Seshan and Bruce Maggs, in collaboration with IBM and Akamai. First, they identified key links belonging to various carrier ISPs that could directly limit the Internet performance of the end-networks. They studied how the end-networks can employ a clever route selection technique, called multi homing route control to avoid performance bottlenecks and obtain much better Internet performance. Also, they investigated whether improvements in network link capacities over time will eliminate Internet performance problems altogether. They observed that the Internet's topological structure and routing might, worsen the situation in the future. Finally, they outlined simple changes to the topology of the Internet that can ensure robustness and efficiency in the functioning of the future network.

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Other projects include the bandwidth measurement tool project the routing design project led by Hui Zhang, the DNS study by Srinivansan Seshan and Bruce Maggs, the feasibility study of large-scale End System Multicast video streaming led by Hui Zhang and Bruce Maggs, the Global Network Position project led by Hui Zhang and Eugene , and the resilient overlay routing project led by David Andersen. These projects have significantly improved our understanding of the Internet and the research methodology for designing scalable and robust protocols for the complex Internet environment.

In our research, we also emphasize the building of measurement tools and data repositories to facilitate the research for ourselves and other researchers. As an example, some researchers have leading an effort to build a large-scale measurement collection and analysis framework, called the Internet Data repository. The Data repository acts as a collection point for data streaming from probe machines located around the world, provides researchers with a unified interface to analyze and compare all of this data, and also supports mechanisms to permit these researchers to contribute their own data and analysis tools.

The proposed research work intends to encompass comprehensive studies on overviews on of Ad Hoc and P2P networking. Thorough comparative studies shall be accomplished on the following areas

- P2P and Ad Hoc Networking and node/peer discovery in Ad Hoc and P2P networks.
- The IETF Ad Hoc network routing protocols.
- Content discovery and propagation in P2P networks and routing in Ad Hoc networks.

2. PROTOCOL-

Routing protocols can also be classified as link state protocols or distance-vector protocols. Routers using a link state routing protocol maintain a full or partial copy of the network topology and costs for all known links. Routers using a distance-vector protocol keep only information about next hops to adjacent neighbors and costs for paths to all known destinations. Generally speaking, “link state routing protocols are more reliable, easier to debug and less bandwidth-intensive than distance-vector” protocols. Link state protocols are also more complex and more compute- and memory-intensive. There are some previous protocols, such as the Source Tree Adaptive Routing (STAR) protocol and the Partial Tree-Sharing Protocol (PTSP), which are not the focus of active investigation now and their ideas are similar to more recently proposed protocols, such as the Topology Broadcast Based on Reverse-Path Forwarding protocol.

Routing is a function in the network layer which determines the path from a source to a destination for the traffic flow. A routing protocol is needed because it may be necessary to traverse several nodes (multi-hops) before a packet reaches the destination. The routing protocol’s main functions are the selection of routes for various source destination pairs and the delivery of messages to their correct destination. In wireless networks, due to host mobility, network topology may change from time to time. It is critical for the routing protocol to deliver packets efficiently between source and destination.

3. NEXT GENERATION NETWORK AND PROTOCOL ARCHITECTURE

Due to the phenomenal success of the Internet, most networking researchers today are working on solutions that incrementally improve the Internet with the implicit assumption that radical new solutions are not needed or have no chance of ever being deployed. IP, the technical foundation of Internet, is widely regarded, by both the general and technical communities, to be the convergence technology layer for all communication infrastructures and services.

Network control is the first area we have identified that needs radical improvement. Originally designed to support only best-effort delivery, today’s network control system must also support network-level objectives such as traffic engineering, survivability, security, and policy enforcement, in diverse environments ranging from data center, enterprise, to service provider networks. Retrofitting these network objectives on today’s box-centric control architecture has led to bewildering complexity, with diverse state and logic distributed across numerous network elements and management systems. This complexity is responsible for the increasing fragility of IP networks and the tremendous difficulties facing people trying to understand and manage their networks. Continuing on the path of incremental evolution would lead to additional point solutions that exacerbate the problem. Instead, we advocate re-architecting the

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control and management functions of data networks from the ground up. The 4D project, led by Hui Zhang and in collaboration with AT&T and Princeton, aims to dramatically simplify network control and management by introducing network-wide abstractions primitives.
Security is another of our focus area. The Internet as it stands today is plagued by a wide variety of malicious attacks such as email viruses, worms, DoS attacks, and DDoS attacks. Much research has been done to improve the accuracy and response time in detecting attacks. However, it is obvious this is an arms race where new attacks will be invented trying to outwit existing signature-based detection and analysis techniques. In the Dragnet project, led by Hui Zhang and Mike Reiter, we try to identify primitives that, if built into the network architecture, can break the arms race and provide the tools needed to obtain security against attacks initiated remotely across the network. In particular, we are investigating the feasibility and advantages of having auditing and forensic capabilities as the fundamental building block for a network security architecture.

We also investigate other fundamental elements that need to be added to the network architecture. For example, some researchers have shown in their previous work that giving end-points a choice of paths through the network helps them achieve much higher end-to-end availability and performance. Andersen has explored a set of simple primitives to make path selection a fundamental component of the future network architecture.

4. SELF-MANAGING UNWIRED NETWORKS

Until recently, most dense deployments of wireless networks were in campus-like environments, where experts carefully plan cell layout, sometimes using special tools. The rapid deployment of cheap 802.11 hardware and other personal wireless technology like 2.4Ghz cordless phones, Bluetooth R devices, etc., however, is quickly changing the nature of deployed wireless networks. Increasingly, the wireless networks found in residential neighborhoods, shopping malls, and apartment buildings, are dense. The resulting high complexity makes it increasingly more difficult to even professionals, let alone non-experts, to plan and manage these networks. As a consequence, these networks often suffer from serious contention, poor performance, and security problems.

The research is organized into a set of stages that use increasingly more advanced technology. Our research today focuses on auto configuring parameters that are accessible in today's wireless systems. As emerging technologies such as directional antennas and cognitive radios become available, they will be used to improve the performance, security and manageability of the wireless networks.

A key challenge in studying wireless networks is the inability to perform repeatable and realistic experiments. Techniques that have proven successful for wired networks e.g., test beds such as Planet Lab are inadequate for analyzing wireless networks. The reason is that while the physical layer can often be ignored in wired networks, in wireless networks the physical layer fundamentally affects operation at all layers of the protocol stack. Researchers have used many different techniques to evaluate wireless protocols, but none are very attractive. Running experiments using real hardware and software is highly realistic, but this approach faces serious repeatability and controllability challenges. Simulation avoids these problems, but it faces formidable challenges in terms or realism since the simulator has to recreate all layers of the system. Peter Steen kiste has developed a new FPGA based emulator approach that combines the benefits and real world experimentation opening the door to a new, rigorous ways of evaluating wireless network protocols.

5. DESIGN OF PROTOCOL

The IP service model has stayed largely unchanged ever since it was invented 30 years ago. There have only been two significant efforts to make changes to the service model: QoS and Multicast (IP Multicast). Carnegie Mellon researchers have made fundamental contributions to the design of both QoS and multicast protocols.

In the area of QoS, most existing QoS resource management architectures require a stateful network, i.e. routers need to maintain per flow state. There have been concerns, both at philosophical and technical levels, that it might be too expensive to engineer a stateful network that is highly robust and scalable with respect to number of flows, number of nodes, and link speed. In contrast, the current Internet is based on a stateless architecture. While such a stateless network is usually more robust and scalable than stateful networks, it cannot provide the rich QoS

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functionalities demanded by applications, administrators, and service providers. Ion Stoica, Hui Zhang, and Scott Shenker proposed an architecture that does not require core routers to maintain per flow state yet can provide QoS services similar to those provided by stateful networks. This is the first architecture that combines the advantages of stateful and stateless networks.

In the area of multicast, prior to Yanghua Chu, Sanjay Rao, and Hui Zhang's work on End System Multicast, it had been taken for granted that multicast functionalities should be implemented at the IP level. In addition, IP Multicast was accepted by IETF, the standard organization for the Internet, as the standard for both IPv4 and IPv6. Significant investments were made by industry to implement IP multicast in routers and host operating systems .

Secure Routing Protocol, SRP, is another protocol extension that can be applied to any of the most commonly used protocols today. The basic idea of SRP is to set up a security association (SA) between the source and the destination node. An SA is a secret-key scheme used to preserve integrity in the routing information. The SA is usually set up by negotiating a shared key based on the other party's public key, and after that the key can be used to encrypt and decrypt the messages. The routing path is always sent along with the packets, unencrypted though since none of the intermediate nodes have knowledge of the shared key. The above features are achieved with low computational cost and bit overhead. In addition, the protocol is practically immune to IP spoofing and implements partial caching without compromising security in the network. More than one RREQ packet reaches the destination through different routes. The destination calculates a MAC covering the RREP contents and then returns the packet to the source over the reverse route accumulated in the respective RREQ packet. The destination responds to one or more route request packets to provide the source with an as diverse topology picture as possible.

6. CHANGING IP ADDRESSES

It is easier to change private IP addresses, the ones used internally on your local network. If using static addressing, you can directly set a new IP address on the device. If using dynamic addresses supplied via a network router, you have a few options:

- release and renew the DHCP address on the client
- set up the router to use a different IP address range
- change one or more devices on the network from dynamic to static addressing. You can mix static and dynamic clients on the same network as long as you avoid using static IP addresses within the numeric range where the DHCP server is likely to issue its addresses.

7. CONCLUSIONS

Some people change a public IP address to avoid online bans. Web site message boards and other services sometimes block individuals by their IP address. Note that some sites block people by their user names, and changing the IP address will have no effect in this case. ISP may assign you an invalid address due to some technical glitch in their equipment. This is another reason to change your public IP address.
Changing a private IP address does not at all help with Internet address issues. However, changing these makes sense in a few situations:

- if you have accidentally configured an invalid address such as a static IP address in the wrong numeric range
- if you are using a malfunctioning router that is providing bad addresses, such as one already being used by another computer on your network
- if you are installing a new router and re-configuring your home network to use its default IP address range

The choice of IP address does not affect your network performance or network security in any meaningful way.

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