Large-scale Multitouch Interactive Network Visualization

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Abstract

Although there exist methods for drawing, designing, mapping, and visualizing computer network topologies, it is useful to obtain a graphical representation of large-scale network traffic flow in order to allow a human to understand and reason about the actual, real-time condition of the network. In this work, we present a preliminary realization of that goal, a system that tracks, identifies, and visualizes hosts and network streams interactively.

Introduction

There exist a number of tools and methods for designing abstracted computer networks graphically, as well as for scanning computer networks in order to create such a graphical representation of a network topology after the fact. However, topology is only part of the overall picture. At times it may be useful to examine and interact with the flow of network traffic as well.[Mar08]

This poster presents preliminary work on a system that detects and identifies TCP traffic and builds an interactive graphical representation of the flow of traffic across a network. Significantly, the interface is designed to work on a large multi-touch sensitive display in order to allow users to visualize and interact with large production networks.

The remainder of the poster provides some multi-touch background, describes the interface itself, then concludes with an analysis of the utility of the system and directions for future work.

Multi-touch

The term multi-touch refers to an interface that is capable of receiving, tracking, and responding to multiple finger touches simultaneously. They have risen to prominence recently in portable products such as the Apple iPhone and tabletop computing systems like the Microsoft Surface. In contrast, our work mostly deals with much larger, vertically oriented screens placed as projection surfaces on or near walls.

Several techniques exist for implementing multi-touch interfaces. Here, we focus on the two in use in our projects. The first is named the frustrated total internal reflection (FTIR) method, and the second is called the laser light plane (LLP) method. They are both based on producing regions of higher infrared on the projection surface, to be detected by an IR sensitive camera. In both cases the screen is placed between the user and the camera and projector.

In FTIR, the projection surface must be mounted on a transparent, somewhat flexible material such plexiglass. Infrared light is shined into the plexiglass from LEDs mounted around the edges of the screen. The IR light achieves total internal reflection inside the surface, and without any flexing of the material, little to no light escapes toward the camera. However, when the surface is touched, it deforms enough to change the angle of reflection of the IR light, causing it to escape and be detected and tracked by the camera.[Han]

In LLP, a plane of infrared laser light is created just in front of the touch surface. When a user breaks the plane with his finger, the infrared light illuminates the finger, which is detected and tracked by the IR sensitive camera. Less touching pressure is required in this method, but care must be taken to use enough laser light sources to avoid the possibility of occlusion of one touch by another.[nui09]

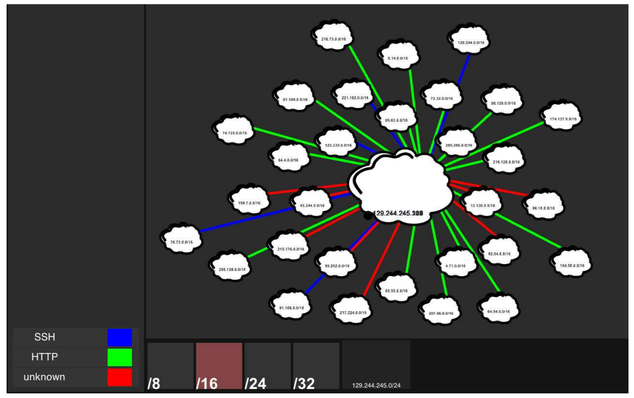
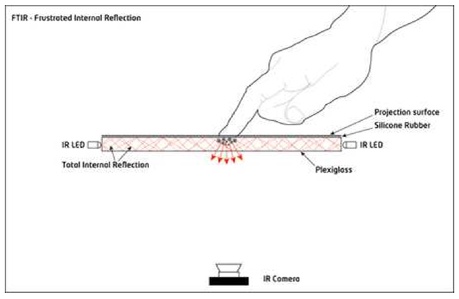


Figure 1: The DVNE Interface.



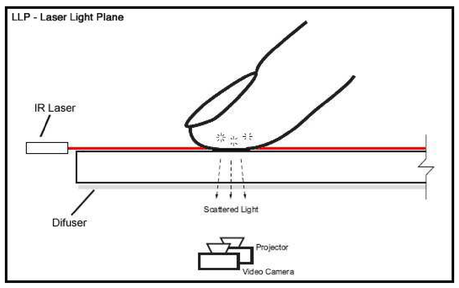


Figure 2: Optical Multi-touch Methods.

The Interface

The interface, dubbed DVNE for Dynamic Visualization of Network Environments, is designed to receive network protocol data from a connected sensor.[LMJH09] The resulting traffic information is used to build a representation of the hosts and streams that comprise the network at any given time. A graphical representation is built, with nodes being sorted by subnet, and the protocols of the streams between them being denoted by color.

The user can resize and move the network representation with familiar standard multi-touch gestures, and touching streams or nodes brings up detailed information about the element in question. The system supports combining particular subnets or just sets of hosts into clouds in order to build a very high-level representation of a network.

Future Work

As computer networks grow in complexity and size, the need for methods for creating abstract representations of those networks so that humans can examine and reason about them becomes more dire. To that end, this work presents the preliminary steps toward building a large-screen multi-touch network traffic visualization, analysis, and management interface.

The system's goal is to promote the ability for network administrators to gain detailed abstract knowledge about a network at a glance. But furthermore, it should be possible for users to administer the network as well. Future plans for the project include visualization of intrusion detection results, and methods for establishing controls such as traffic shaping and firewalling from the same interface as allows visualization.

Acknowledgments

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References

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