Bluetooth Virtual Sniffing

Introduction

The ComProbe software Virtual sniffing function simplifies Bluetooth® development and is easy to use. Frontline's Virtual sniffing with Live Import provides the developer with an open interface from any application to ComProbe software so that data can be analyzed and processed independent of sniffing hardware. Virtual sniffing can also add value to other Bluetooth development tools such as Bluetooth stack SDKs (Software Development Kits) and Bluetooth chip development kits.

This white paper discusses:

- Why HCI sniffing and Virtual sniffing are useful.

- Bluetooth sniffing history.

- What is Virtual sniffing?

- Why Virtual sniffing is convenient and reliable.

- How Virtual sniffing works.

- Virtual sniffing and Bluetooth stack vendors.

- Case studies: Virtual sniffing and Bluetooth mobile phone makers.

- Virtual sniffing and you. • Where to go for more information.

Why HCI Sniffing and Virtual Sniffing are Useful

Because the Bluetooth protocol stack is very complex, a Bluetooth protocol analyzer is an important part of all Bluetooth development environments. The typical Bluetooth protocol analyzer "taps" a Bluetooth link by capturing data over the air. For many Bluetooth developers sniffing the link between a Bluetooth Host CPU and a Bluetooth Host Controller—also known as HCI-sniffing—is much more useful than air sniffing.

HCI-sniffing provides direct visibility into the commands being sent to a Bluetooth chip and the responses to those commands. With air sniffing a software engineer working on the host side of a Bluetooth chip has to infer and often guess at what their software is doing. With HCI-sniffing, the software engineer can see exactly what is going on. HCI-sniffing often results in faster and easier debugging than air sniffing.

ComProbe software's Virtual sniffing feature is a simple and easy way to perform HCI-sniffing. Virtual sniffing is not limited to just HCI-sniffing, but it is the most common use and this white paper will focus on the HCI-sniffing application of Virtual sniffing.

It is also important to understand that ComProbe software is a multi-mode product. ComProbe software does support traditional air sniffing. It also supports serial HCI sniffing (for the H4 (HCI UART), H5 (3-wire UART) , and BCSP (BlueCore Serial Protocol) protocols), USB HCI (H2) sniffing, SDIO sniffing, and Virtual sniffing. So with ComProbe software nothing is sacrificed—the product is simply more functional than other Bluetooth protocol analyzers.

Bluetooth Sniffing History

Frontline has a strong appreciation for the importance of HCI sniffing because of the way we got involved with *Bluetooth*. Because of our company history, we are uniquely qualified to offer a multi-mode analyzer that provides many ways to sniff and supports a wide variety of protocols. This brief *Bluetooth* sniffing history should help you understand our approach to *Bluetooth* protocol analysis.

In the early days of *Bluetooth*, there were no commercially available *Bluetooth* protocol analyzers, so developers built their own debug tools and/or used protocol analyzers that weren't built for *Bluetooth*. Many developers built homegrown HCI analyzers—basically hex dumps and crude traces—because they recognized the need for visibility into the HCI interface and because it was too difficult to build air sniffers. Several companies developed air sniffers because they saw a market need and because they realized that they could charge a high price (USD $25,000 and higher).

Two *Bluetooth* chip companies, Silicon Wave and Broadcom were using Frontline's Serialtest® serial analyzer to capture serial HCI traffic and then they would manually decode the HCI byte stream. This manual decoding was far too much work and so, independently, Silicon Wave and Broadcom each requested that Frontline produce a serial HCI *Bluetooth* analyzer that would have all the features of Serialtest. In response to these requests Frontline developed SerialBlue®—the world's first commercially available serial HCI analyzer.

The response to SerialBlue was very positive. When we asked our *Bluetooth* customers what they wanted next we quickly learned that there was a need for an affordable air sniffer that provided the same quality as SerialBlue. We also learned that the ultimate *Bluetooth* analyzer would be one that sniff air and sniff HCI simultaneously.

As work was progressing on our combination air sniffer and HCI sniffer the functional requirements for *Bluetooth* analyzers were changing. It was no longer good enough just to decode the core *Bluetooth* protocols (LMP, HCI, L2CAP, RFCOMM, and OBEX). Applications were beginning to be built on top of *Bluetooth* and therefore application level protocol decoding was becoming a requirement. For example, people were starting to browse the Internet using *Bluetooth*-enabled phones and PDAs therefore a good *Bluetooth* analyzer would need to support TCP/IP, HTTP, hands-free, A2DP, etc.

For Frontline to support for these higher levels protocols was no problem since they were already in use in other Frontline analyzer products. People have been using Frontline Serialtest serial analyzers and Ethertest™ Ethernet analyzer to troubleshoot TCP/IP and Internet problems for many years.

As we continued to work closely with the *Bluetooth* community we also came across one other requirement: sniffing itself had to be made easier. We took a two-pronged approach to this problem. We simplified air sniffing (and we continue to work on simplifying the process of air sniffing) and we invented Virtual sniffing.

Virtual Sniffing—What is it?

Historically, protocol analyzers have physically tapped the circuit being sniffed. For example, an Ethernet circuit is tapped by plugging into the network. A serial connection is sniffed by passively bridging the serial link. A *Bluetooth* air sniffer taps the piconet by synchronizing its clock to the clock of the piconet Master.

Not only is there a physical tap in traditional sniffing, but the sniffer must have some knowledge of the physical characteristics of the link being sniffed. For example, a *Bluetooth* air sniffer must know the BD_ADDR of at least one piconet member to allow it perform clock synchronization. A serial sniffer must know the bit rate of the tapped circuit or be physically connected to the clock line of the circuit.

With Virtual sniffing the protocol analyzer itself does not actually tap the link and the protocol analyzer does not require any knowledge of the physical characteristics of the link.

In computer jargon, "virtual" means "not real". Virtual memory is memory that doesn't actually exist. Virtual reality is something that looks and feels real, but isn't real. So we use the term Virtual sniffing, because there is sniffing taking place, but not in the traditional physical sense.

The Convenience and Reliability of Virtual Sniffing

Virtual sniffing is the most convenient and reliable form of sniffing and should be used in preference to all other forms of sniffing whenever practical. Virtual sniffing is convenient because it requires no setup to use except for a very small amount of software engineering (typically between one and four hours) that is done once and then never again. Once support for Virtual sniffing has been built into application or into a development environment none of the traditional sniffing setup work need be done.

This means:

- NO piconet synchronization.

- NO serial connection to tap.

- NO USB connection to tap.

Virtual sniffing is reliable because there is nothing that can fail. With Virtual sniffing all data is always captured.

How Virtual Sniffing Works

ComProbe software Virtual sniffing works using a feature called Live Import. Any application can feed data into ComProbe software using Live Import. A simple API provides four basic functions and a few other more advanced functions. The four basic Live Import functions are:

- Open a connection to ComProbe software.

- Close a connection to ComProbe software.

- Send an entire packet to ComProbe software.

- Send a single byte to ComProbe software.

All applications that send data to ComProbe software via Live Import use the first two functions. Usually only one of the two Send functions is used by a particular application. When ComProbe software receives data from the application via Live Import, the data is treated just as if it had been captured on a Frontline ComProbe sniffer. The entire protocol stack is fully decoded.

With Virtual sniffing the data can literally be coming from anywhere. ComProbe software does not care if the data being analyzed is being captured on the machine where ComProbe software is running or if the data is being captured remotely and passed into ComProbe software over an Internet connection.

Virtual Sniffing and *Bluetooth* Stack Vendors

As the complexity of the *Bluetooth* protocol stack increases *Bluetooth* stack vendors are realizing that their customers require the use of a powerful *Bluetooth* protocol analyzer. Even if the stack vendor's stack is bug free, there are interoperability issues that must be dealt with.

The homegrown hex dumps and trace tools from the early days of *Bluetooth* just are not good enough anymore. And building a good protocol analyzer is not easy. So stack vendors are partnering with Frontline. This permits the stack vendors to concentrate of improving their stack.

The typical *Bluetooth* stack vendor provides a Windows-based SDK. The stack vendor interfaces their SDK to ComProbe software by adding a very small amount of code to the SDK, somewhere in the transport area, right about in the same place that HCI data is sent to the Host Controller.

If ComProbe software is installed on the PC and the Virtual sniffer is running then the data will be captured and decoded by ComProbe software, in real-time. If ComProbe software is not installed or the Virtual sniffer is not running then no harm is done. Virtual sniffing is totally passive and has no impact on the behavior of the SDK.

One Frontline stack vendor partner feels so strongly about ComProbe software that not only have they built Virtual sniffing support in their SDK, but they have made ComProbe software an integral part of their product offering. They are actively encouraging all customers on a worldwide basis to adopt ComProbe software as their protocol analysis solution.

Case Studies: Virtual Sniffing and *Bluetooth* Mobile Phone Makers

Case Study # 1

A *Bluetooth* mobile phone maker had been using a homemade HCI trace tool to debug the link between the Host CPU in the phone the *Bluetooth* chip. They also were using an air sniffer. They replaced their entire sniffing setup by moving to ComProbe software.

In the original test setup the Host CPU in the phone would send debug messages and HCI data over a serial link. A program running on a PC logged the output from the Host CPU. To implement the new system using Virtual sniffing, a small change was made to the PC logging program and it now sends the data to ComProbe software using the Live Import API. The HCI traffic is fully decoded and the debug messages are decoded as well.

The decoder for the debug messages was written using ComProbe software's DecoderScript feature. DecoderScript allows ComProbe software user to write custom decodes and to modify decodes supplied with ComProbe software. DecoderScript is supplied as a standard part of ComProbe software. In this case, the customer also created a custom decoder for HCI Vendor Extensions.

The air sniffer that was formerly used has been replaced by the standard ComProbe software air sniffer.

Case Study # 2

A second *Bluetooth* mobile phone maker plans to use Virtual sniffing in conjunction with a Linux-based custom test platform they have developed. Currently they capture serial HCI traffic on their Linux system and use a set of homegrown utilities to decode the captured data.

They plan to send the captured serial HCI traffic out of the Linux system using TCP/IP over Ethernet. Over on the PC running ComProbe software they will use a simple TCP/IP listening program to bring the data into the PC and this program will hand the data off to ComProbe software using the Live Import API.

Virtual Sniffing and You

If you are a *Bluetooth* stack vendor, a *Bluetooth* chip maker, or a maker of any other products where integrating your product with ComProbe software's Virtual sniffing is of interest please contact Frontline to discuss your requirements. There are numerous approaches that we can use to structure a partnership program with you. We believe that a partnership with Frontline is an easy and cost-effective way for you to add value to your product offering.

If you are end customer and you want to take advantage of Virtual sniffing, all you need to do is buy any Frontline *Bluetooth* product. Virtually sniffing comes standard with product.

Technical Support

Technical support is available in several ways. The online help system provides answers to many user related questions. Frontline's website has documentation on common problems, as well as software upgrades and utilities to use with our products.

Web: http://www.fte.com, click Support

Email: tech_support@fte.com

If you need to talk to a technical support representative, support is available between 9am and 5pm, U.S. Eastern time, Monday through Friday. Technical support is not available on U.S. national holidays.

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