HDLC Analysis and Emulation
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What is HDLC?

High Level Data Link Control is a protocol, which operates at the data link layer. The HDLC protocol embeds information in a data frame that allows devices to control data flow and correct errors.

Frame Structure:

HDLC data is formatted into frames. A frame of data is encapsulated by flags. The beginning and end of an HDLC frame are marked by flag characters.
HDLC Playback
• Transmits HDLC frames in the pre-recorded files over T1/E1 channels
• Provides the option to reverse or inverse bits in the selected data during transmission
• Frames can be transmitted on selected time slots (contiguous or non-contiguous), sub-channels or full bandwidth
HDLC Tx / Rx Test
• The HDLC Automated Test System consists of two applications:
  ➢ HDLC Tx Application
  ➢ HDLC Rx Application
• Both applications can function real-time and off-line
HDLC Tx / Rx Test Application…

- Generates HDLC test frames, and transmits them over T1/E1 or records them to an HDLC file for subsequent use with other applications
HDLC Rx Test

- Receive frames in real-time over T1/E1 or can verify an off-line HDL file for correct frame order and data integrity
HDLC Link Impairment Utility (HLIU)
HDLC Link Impairment Utility…
Features

- Verifies the proper working of HDLC protocols by simulating various scenarios taking place in a real-time network
- The HLIU application has the following features:
  - Logic Error insertion
  - CRC Error insertion
  - Drop a Frame
  - Change Frame Order
  - Duplicate a Frame
  - Insert a Frame
  - Delay a Frame
HDLC Emulation using Windows Client Server
HDLC Emulation using Windows Client Server…

**Modules**

- Tx/Rx of Files and digits
- w/ CAS Simulator and Traffic Classifier
- DSP Operations
- Emulation & Analysis of TRAU / HDLC / MLPPP / SS7 / ISDN / MLFR Frames
- FDL / SA Bits Encode/Decode
- MC Rx BERT
- Pulse Mask Display
HDLC Emulation using Windows Client Server…
# Features

<table>
<thead>
<tr>
<th>Feature</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Remote operation</td>
<td>✓</td>
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<tr>
<td>Automation</td>
<td>✓</td>
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<tr>
<td>Multi-site connectivity</td>
<td>✓</td>
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<td>Simultaneous testing of high capacity T1/E1 systems through a single Client</td>
<td>✓</td>
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<tr>
<td>Integration of T1/E1 testing into more complex testing systems</td>
<td>✓</td>
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<tr>
<td>Intrusive / Non-Intrusive T1/E1 Testing</td>
<td>✓</td>
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</tbody>
</table>
• WCS module XX634 - Multi-Channel HDLC Emulation and Analysis & File based High Throughput HDLC Record/Playback
  ➢ Offers high throughput file–based HDLC record and playback (support for various bandwidth over multiple links and option to speed up /slow down the transmission)
  ➢ Performs multi-channel HDLC emulation and analysis

• WCS module XX640, XX641 - File based HDLC Record/Playback & Remote Record/Playback
  ➢ Allows transmission/reception of *.HDL frames files located on the server and on client
Key Features…

- Client side consists of a PC with Ethernet connectivity and GUI Remote Protocol Analysis software – no special T1 or E1 hardware is required

- Multiple T1/E1 servers may be simultaneously connected to a single remote client using a single GUI

- Multiple remote clients may access a single T1/E1 server. Also, the T1/E1 server is fully functional while being accessed as a server. Thus, a user may perform T1/E1 operations locally on the server while a remote client is accessing the same server, in real time

- Supports real-time and offline analysis at the remote client location
Impairments

- Various impairments can be introduced before frames are transmitted. Global impairments (effective for all the HDL streams) can be specified as well as impairments can be introduced per stream basis before frame transmission.
- One can specify a limited number of impairments, set continuous impairment in each frame, or apply impairment to each Nth frame leaving some frames intact.
- The following types of Impairments can affect an entire HDL frame:
  - Frame deletion
  - Frame insertion
  - Frame duplication
Impairments...

- Impairments can also modify some octets in a frame at a certain offset and these include:
  - Inserting octets
  - Deleting octets
  - Bitwise ANDing octets
  - Bitwise ORing octets
  - Bitwise XORing octets
  - In addition the following frame structure impairments can be introduced:
    - CRC (FCS) errors
    - Frame errors (non-integral number of octets between flags)
    - Abort sequences
Sample Script performing HDLC record / playback

```
latency = 3.0;
run task "HdlcFuncE1:TxServerFile" using "hdlc_isdn\dcossr\test\rx.hdlc" 100" #1:1..3;
Task 1: Task 1 started
Task 1: Task 1 terminated
run task "HdlcFuncE1:RxServerFile" using "hdlc_isdn\test\rx.hdlc" 10000" #2:1..3;
Task 2: Task 2 started

run task "HdlcFuncE1:TxServerFile" using "hdlc_isdn\dcossr\test\rx.hdlc" 100" #1:1..3;

//receive on the server into file hdlc_isdn\test_rx.hdlc (allocate
//space for the file) up to 10000 frames on 1..3 timeslots
run task "HdlcFuncE1:RxServerFile" using "hdlc_isdn\test\rx.hdlc" 10000" #2:1..3;
```

Card2 TimeSlot=3 Frame=73 at 00:00:00.135876 OK Len=2

HDLC Frame Data + PCS

```
  C/R
  SAPI
  TEI

Hex Dump of the Frame Data
+----------------+-----------------+----------------+-----------------+-----------------+-----------------+-----------------+----------------+-----------------+-------------------+
| 02 57          | 02 57           | 02 57          | 02 57           | 02 57           | 02 57           | 02 57           | 02 57           | 02 57             |
```

Running, Utilization 0.12%, C event, Captured USB frames, Errors CRC, 704 Frame
HDLC Analysis
Key Features

- Perform real-time / offline / remote analysis
- Consolidated GUI – Summary of all decodes, detail & hex-dump views of each frame, statistics view, & call detail record views
- Multiple streams of HDLC traffic on various T1/E1 channels can be simultaneously decoded with different GUI instances
- Captured frames can later be used for traffic simulation using HDLC Transmit / Receive / Playback application
- Remote monitoring capability using GL's Network Surveillance System
Key Features…

- Fine tune results with filtering and search capability
- Trace File Saving Options
- Extensive statistics measurement ability
- Remote-access capability
Supported Protocols

- The HDLC analyzer supports the following type of protocols:
  - LAPD - ITU Q.921
  - LAPF - ITU Q.922
  - LAPD+IP - ITU Q.921 & Layer 3 as Internet Protocol (IP)
  - LAPX+IP
  - Cisco HDLC (cHDLC)
  - X.25, LAPB - ITU-T Recommendation X.25
Different Views

- **Summary View**: This pane displays the columns that contain Card Number, Timeslots, Frame Number, Time, Frame Error Status, Command/Response, Length, Error, C/R, SAPI, CTL, P/F, FUNC, and more in a tabular format.

- **Detail View**: This pane displays in detail about a frame in order to analyze and decode by selecting it in the summary view.

- **Hex Dump View**: This pane displays the frame information in HEX and ASCII format.

- **Statistics View**: This pane displays the Statistics that are calculated based on the protocol fields.
Real-time Analysis…

- Streams can be captured on the selected time slots (contiguous or non-contiguous), sub-channels (fractional DS0 to DS1), Hyper-channels(n x 64 kbps, or n x 56 kbps), or Full bandwidth (56kbps, or 64kbps)
- Frames may also be captured based on their FCS (16 bits, 32 bits, none), bit inversion, octet bit reversion, user/network side options
- Recorded trace file can then be analyzed offline
- Capability to export summary view details to comma separated values (CSV) format for subsequent import into a database or spreadsheet
- Capability to export detail decode information to an ASCII file
Real-time Analysis...

### HDLC Protocol Analysis LAPD

<table>
<thead>
<tr>
<th>Dev</th>
<th>Tsk</th>
<th>Sub</th>
<th>Frame#</th>
<th>TIME (Relative)</th>
<th>Len</th>
<th>Error</th>
<th>C/R</th>
<th>SAII</th>
<th>TEI</th>
<th>CTL</th>
<th>P/F</th>
<th>N(S)</th>
<th>N(R)</th>
<th>FL</th>
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</tr>
</tbody>
</table>

- **Response(User)**: 33 84 Information: 0 64 64
- **Command(User)**: 32 84 Information: 0 64 64
- **Response(User)**: 33 84 Information: 0 64 64
- **Response(User)**: 33 84 Information: 0 64 64
- **Response(User)**: 33 84 Information: 0 64 64
- **Response(User)**: 33 84 Information: 0 64 64
- **Response(User)**: 33 84 Information: 0 64 64
- **Response(User)**: 33 84 Information: 0 64 64

### HDLC Frame Data + FCS

- **LAPD Layer**
  - C/R
  - SAII
  - TEI
  - Ctrl
  - H(S)
  - P
  - H(R)

### Hex Dump of the Frame Data

```
86 80 80 80 80 80 80 80 80 80 80 80 10 79
```

Running, Utilization 14.39%  C:\Temp\Hdl  Captured 13425 frames  Errors 0 CRC, 4151 Frame
Offline Analysis...

- Off-line analysis is equivalent to capturing a file in pre-defined timeslots
- Captured frames or only the filtered frames can be exported to *.HDL file for the further off-line analysis
- Trace file for offline analysis can be loaded either through analyzer GUI or through simple command-line arguments

![Image of HDLC Protocol Analysis GUI]

Open dialog box showing the HDLC files available for selection.
Offline Analysis

- Trace files for offline analysis can be loaded through simple command-line arguments as below:
- **Command Syntax:** `hdlcprot hdlc\Filename.hdl`
Filters - Real-time Capture Filter

- Real-time capture filter can be set prior to capturing frames
- Real-time filter for HDLC based protocols is done by excluding LSSU (Link Status Signal Unit), FISU (Fill-in Signal Unit), or any other user-defined frame
Filters - Offline View Filter

- Isolates required frames from all frames in real-time / remote / offline
- Filter applies to the captured frames and is based on the data link and other decoded protocol field values: CTL, C/R, Modifier Function, N(R), N(S), P, P/ F, SAPI, supervisory function and TEI
Search Options

- Search features help users to search for a particular frame based on specific search criteria.
Statistics

- Statistics is an important feature available in HDLC analyzer and can be obtained for all frames both in real-time as well as offline mode.
- Numerous statistics can be obtained to study the performance and trend in the HDLC network based on various protocol fields and parameters.

![Statistics Image](image-url)
Captured trace files can be controlled by saving the trace using different conventions such as –

- Trace files with user-defined prefixes
- Trace file with date-time prefixes
- Slider control to indicate the total number of files, file size, frame count, or time limit
Define Summary Columns

- Required protocol fields can be added through Define summary column option
- User can remove the protocol field which is not required

![Diagram showing the selection of summary columns and output display in analyzer]
TCP Connection Options

- Used for Network Surveillance and Monitoring
- Designed to send protocol summary information and binary frame data via TCP-IP connection to a Database Loader to load data into a database
HDLC Analysis...

Save/Load All Configuration Settings

- Protocol configuration window provides a consolidated interface for all the settings required in the analyzer such as protocol selection, stream/interface selection, and so on.
- Configuration settings can be saved to a file, loaded from a configuration file, or user may just revert to the default values using the default option.
Remote HDLC Analyzer
What are Remote Protocol Analyzers?

• “HDLC based protocols can be monitored remotely via a set of hardware and software features available with our T1 or E1 based protocol analyzers”

• The RPA functionality permits:
  ➢ unattended and 24/7 operation
  ➢ remote accessibility for difficult connection situations
  ➢ remote non-intrusive operation
  ➢ remote detailed diagnostic capability

• Supported protocols for remote analysis includes:
  ➢ HDLC
  ➢ ISDN
  ➢ SS7
  ➢ GR303
  ➢ Frame Relay
  ➢ V5.x
Remote ISDN Analyzer

Key Features

- Client side consists of a PC with Ethernet connectivity and GUI Remote Protocol Analysis software – no special T1 or E1 hardware is required

- Multiple T1/E1 servers may be simultaneously connected to a single remote client using a single GUI

- Multiple remote clients may access a single T1/E1 server. Also, the T1/E1 server is fully functional while being accessed as a server. Thus, a user may perform T1/E1 operations locally on the server while a remote client is accessing the same server, in real time

- Supports real-time and offline analysis at the remote client location

- Remote analyzers support capturing of encapsulated protocols and long frames

- Common filtering criteria can be set for T1/E1 cards located on multiple servers
Pre-requisites

• At the site of monitoring
  ➢ Dual T1/E1 PCI based cards or USB based T1/E1 units
  ➢ T1/E1 Server software with HDLC capture software

• At the client location
  ➢ Appropriate GUI based “Remote Protocol Analyzer” such as ISDN, SS7, and others – licensed via “Dongle”
  ➢ LAN/WAN TCP/IP Network with sufficient bandwidth to transport HDLC frames
Remote Analysis

- Users are required to enter IP address of the WCS server and an IP Port
- Multiple Server IP Addresses can be added to connect simultaneously to all T1E1 cards.
- Lists an IP addresses and the IP port numbers
- Option is provided for an user to select the desired IP address of the server
Stream Selection

Remote Protocol Analyzers
Stream Selection

- Streams can be captured on the selected time slots (contiguous or non-contiguous), sub-channels (fractional DS0 to DS1) or full bandwidth

- Frames may also be contained in n x 64 kbps

- Recorded trace file can then be analyzed offline, exported to ASCII file, or printed
Capture Filter

All | Any | XALL | XANY | NONE

LenghOrOffsetMaskValueList

LenghOrOffsetMaskValueList ::= LEN or ItemList | DMV offset mask or ItemList

Examples:

XANY LEN 5.7 - exclude all frames with length 5 and 7

ALL LEN 15:17 20+ DM V12 MSB1 5 7 x64
- length equal 15.17 or equal or greater than 20
  - and byte value at offset 12 is equal to 5 or 7 or 100 (hex 64)
Capture Filter

- Real-time capture filter can be set prior to capturing frames
- Real-time filter for HDLC based protocols is done by excluding LSSU (Link Status Signal Unit), FISU (Fill-in Signal Unit), or any other user-defined frame
Thank You