Preliminary Design

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TCP/IP Packet Descriptor

Mirage Incorporated

"We are there…even if you cannot see us"
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Preliminary Design
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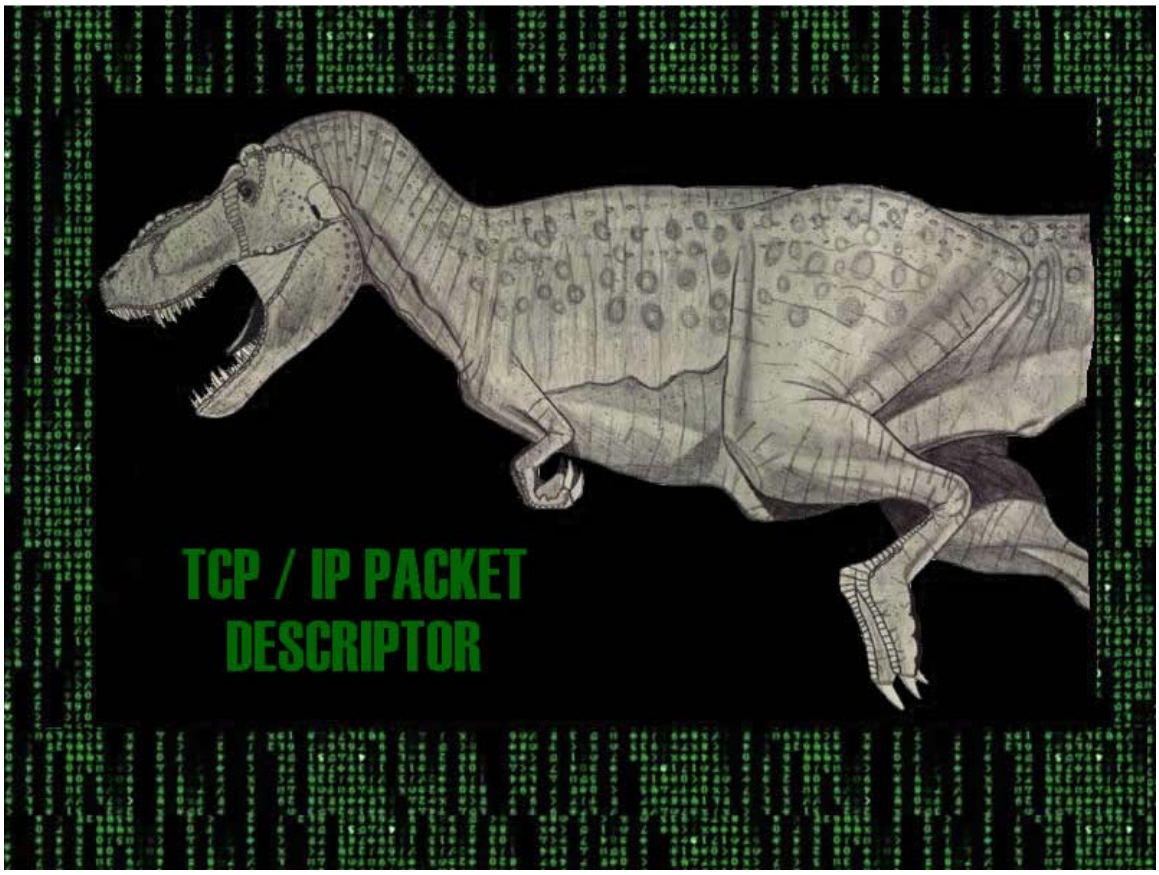
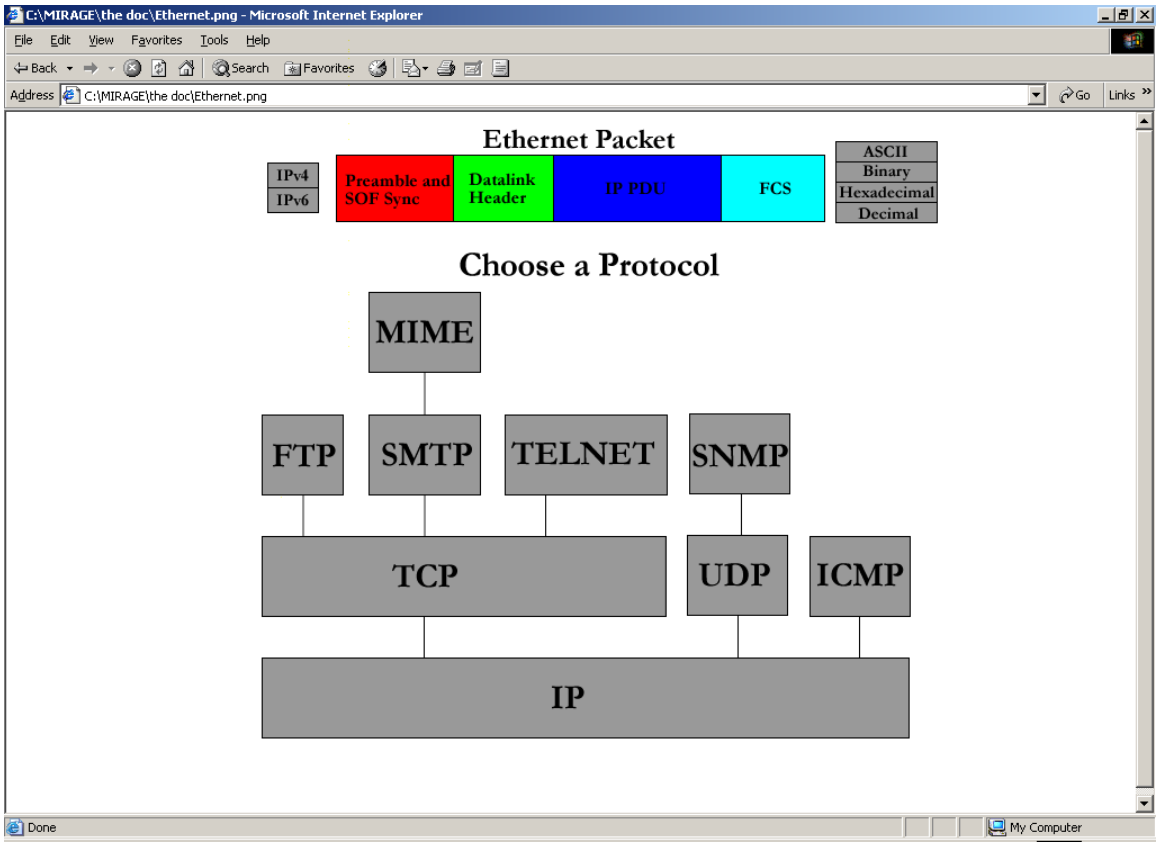
1.0 External Design Specifications

1.1 User displays

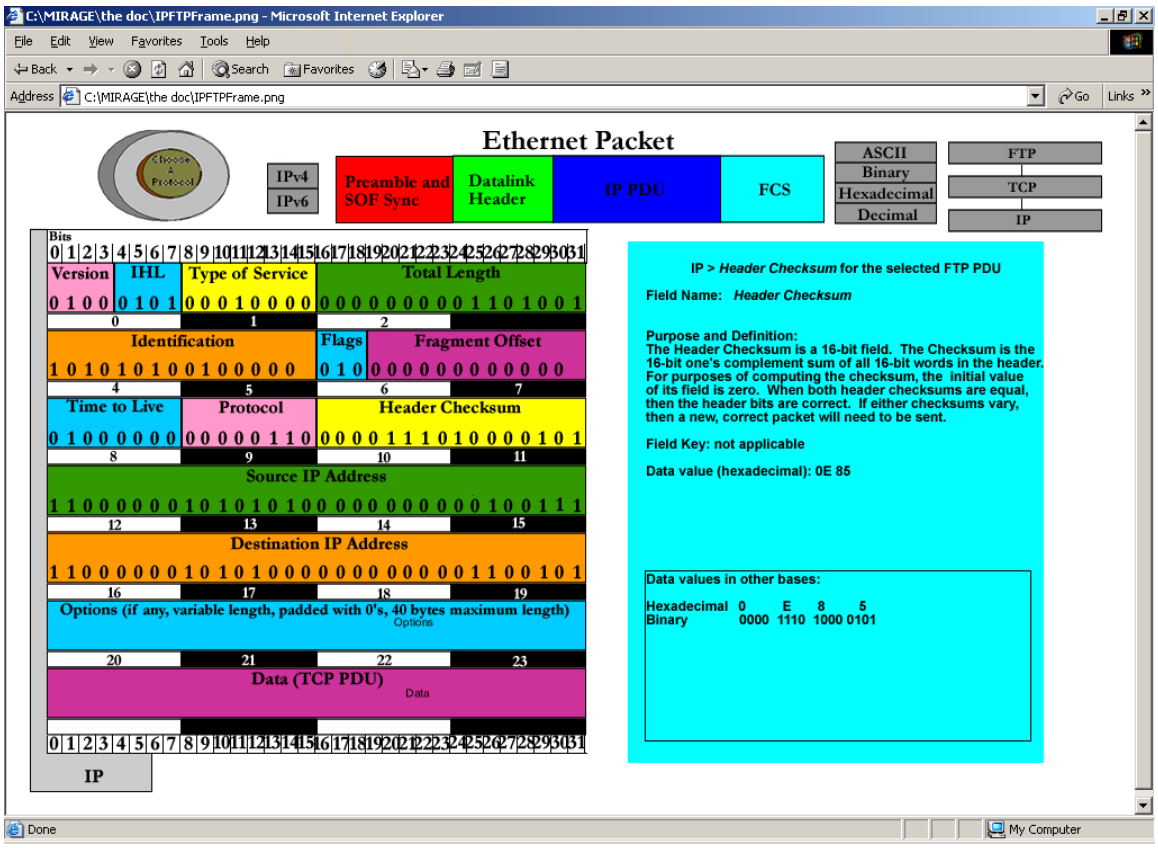


This will be the first screen the user sees. It is the introduction screen to our software, and presents our mascot, “The Descript-roar”.



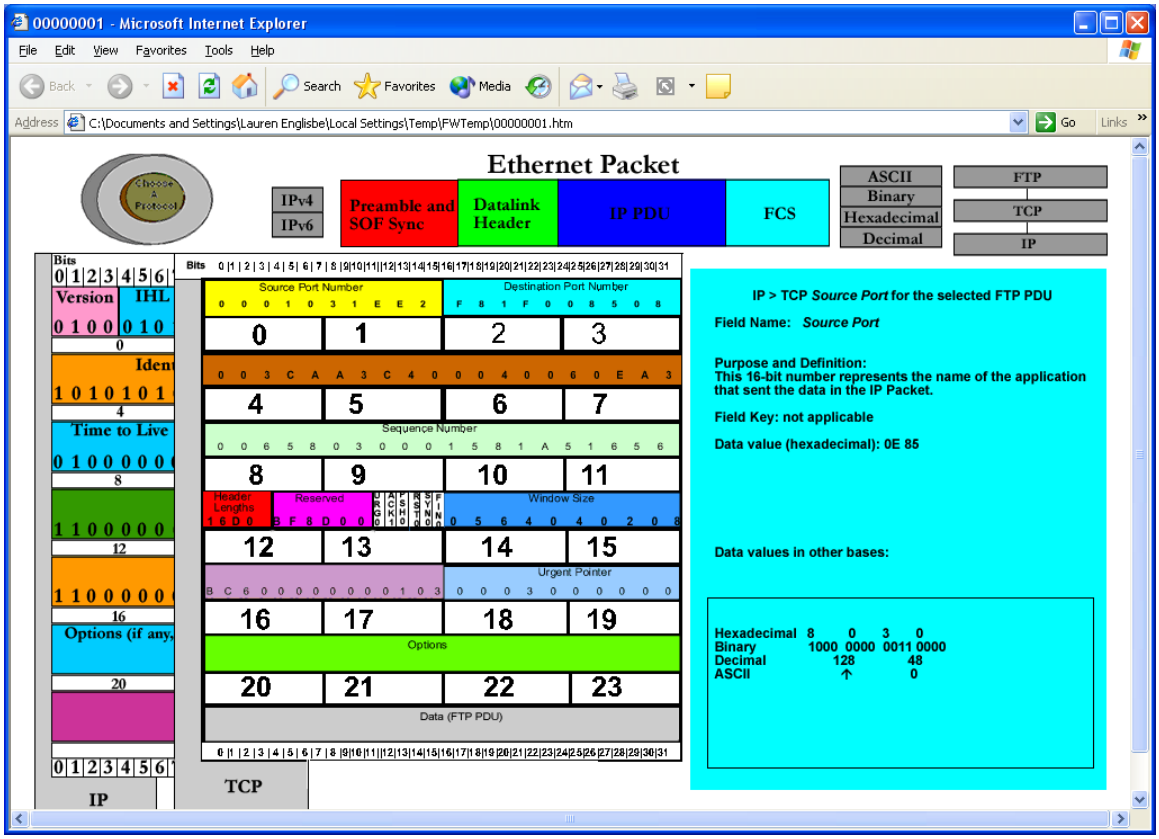
This is the first functional screen the user will see. It allows the user to see what an Ethernet Packet looks like, and eventually each frame within that packet will be clickable and able to display information about that frame.

The “Choose a Protocol” menu gives the user a graphical representation of how protocols are interrelated, and allows the desired protocol to be selected.

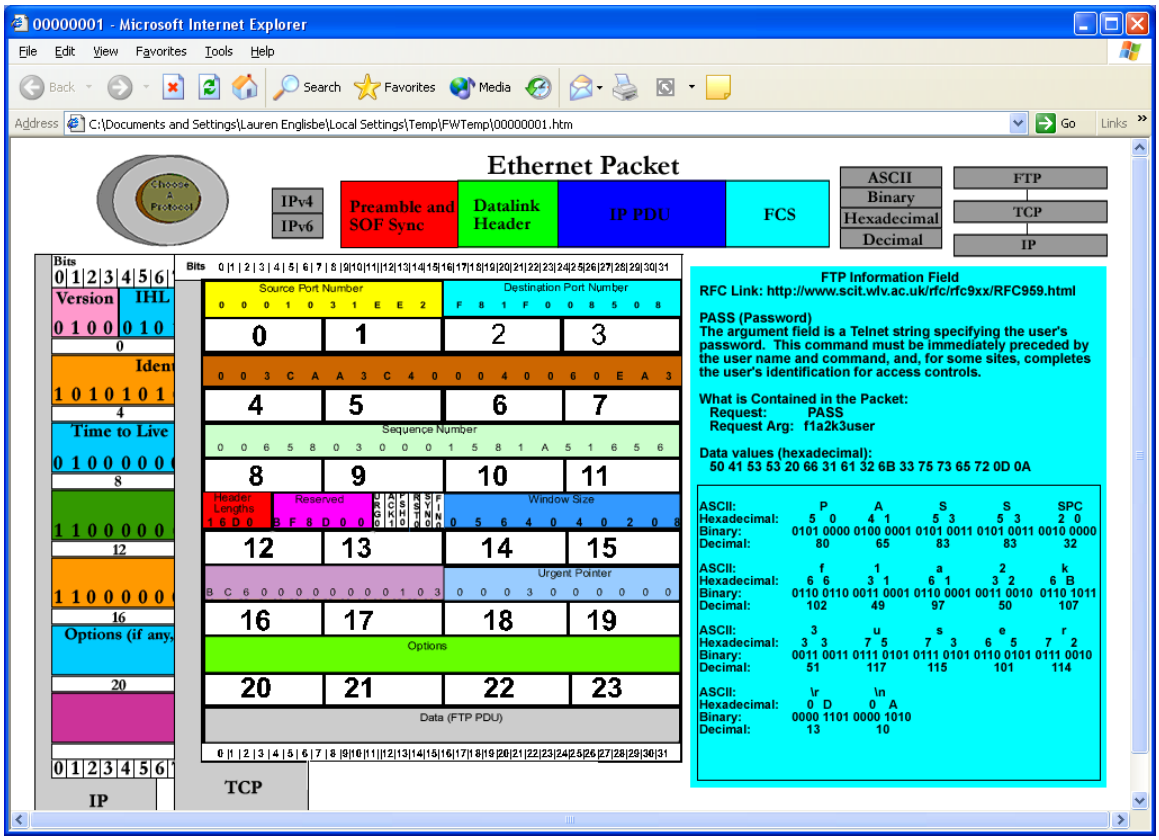


Once a protocol has been selected by the user, this screen will display. The basis for our protocol suite, the IP PDU is displayed on the left, filled in with the given data for the selected protocol. The user is able to click on any field in the IP PDU, and an information box will display on the right, describing that field. In the IP PDU Data field, "TCP PDU" is written – this indicates that the entire TCP PDU is contained within the IP Data field. If the user clicks on this field, the TCP PDU will be displayed.

The PDUs are tabbed on their lower left corners: this allows the user to navigate between them. Additionally, there is a key at the top right corner to display what PDUs make up the chosen protocol. The user may also click on any PDU in this map to navigate. If at any point, the user wants to choose a different protocol to view, he or she may click on the "Choose a Protocol" button in the top left corner.



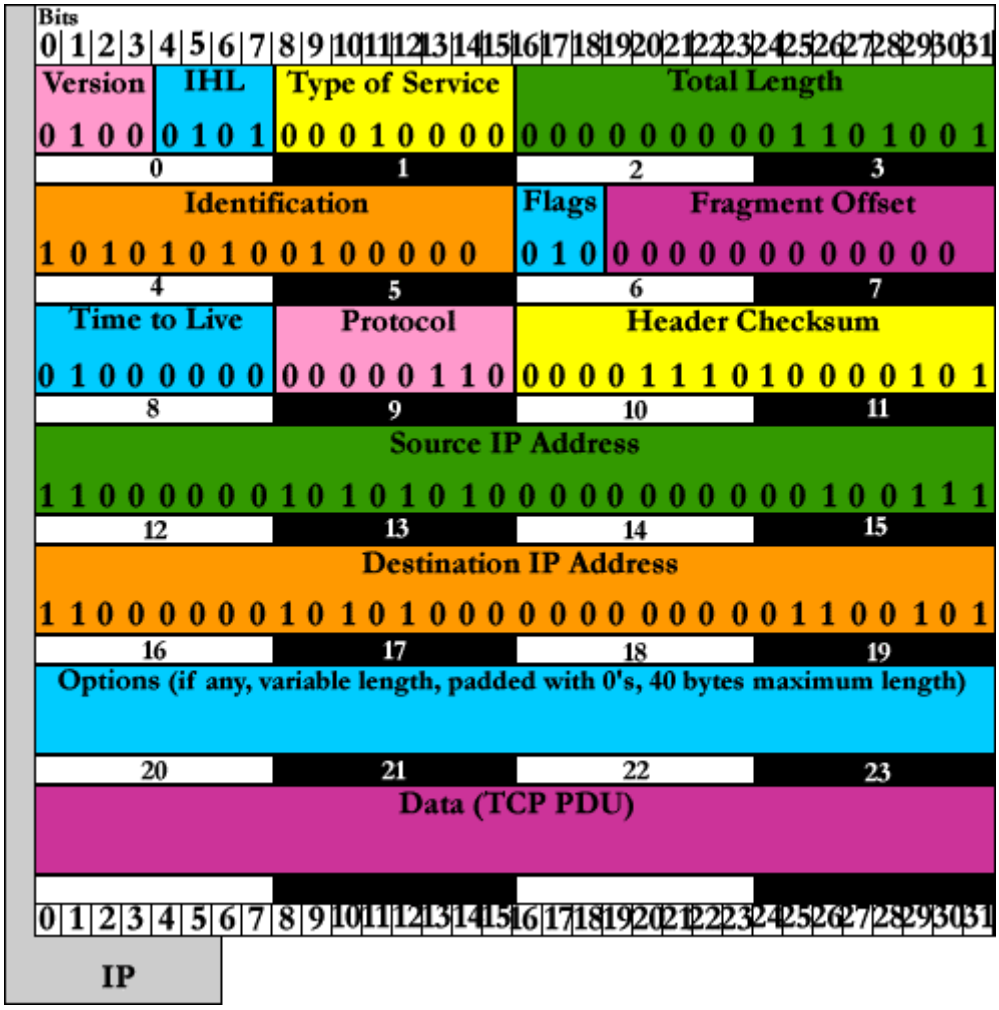
The next screen shows the TCP PDU on top of the IP PDU. This is meant to show that the TCP PDU is contained within the IP PDU. Additionally, the FTP PDU is contained within the TCP PDU Data field, so clicking on that field will display the FTP PDU. As with IP, if a TCP field is clicked, the information for that field will be displayed in the information box at the right.



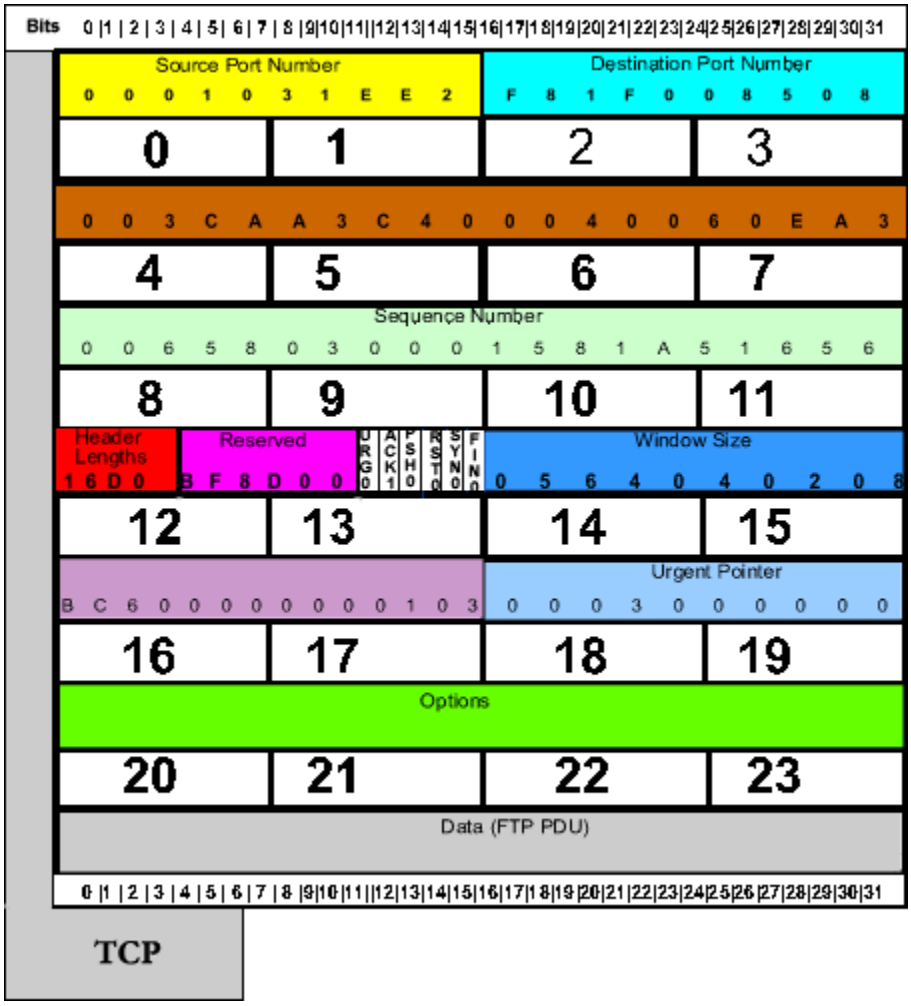
This is the software with all the information displayed for the selected FTP PDU. The IP PDU gives rise to the TCP PDU, and the TCP Data field has been clicked, which allows us to see the information field for the FTP PDU on the right.

Mirage has provided a number of prototype options, which will be chosen by the client at a later date.

Prototype Model Option 1 (IP PDU):

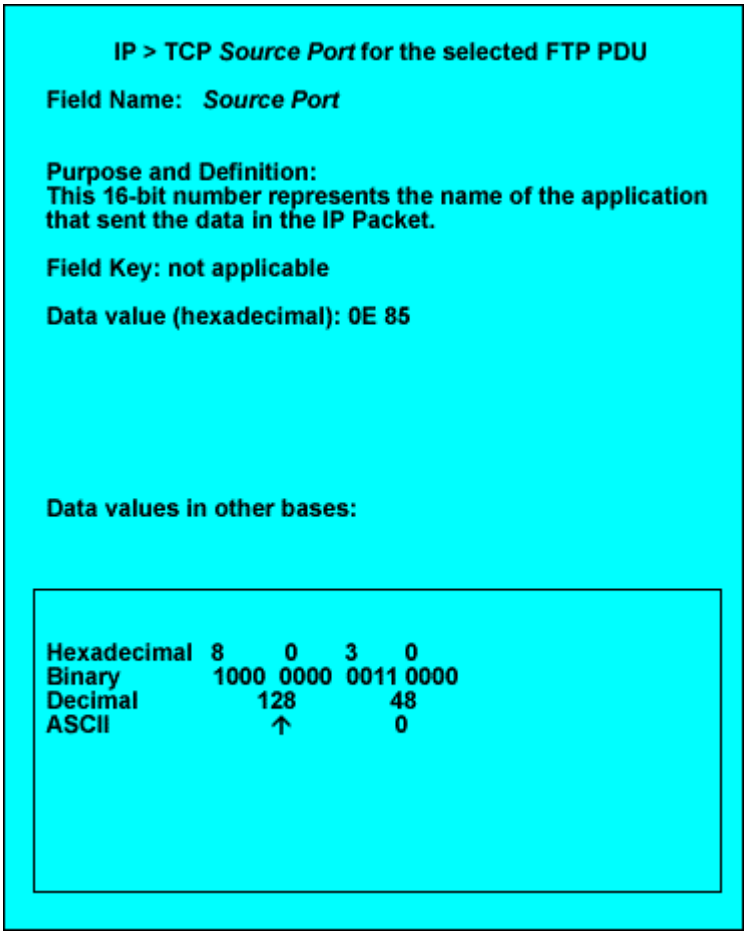


Prototype Model Option 2 (TCP PDU):



We also have two choices to allow for information display for a given field.

Information Field Option 1:



Information Field Option 2:

FTP INFORMATION FIELD

PASS (Password) RFC Link: http://www.scit.wlv.ac.uk/rfc/rfc9xx/RFC959.html

The argument field is a Telnet string specifying the user's password. This command must be immediately preceded by the user name and command, and, for some sites, completes the user's identification for access controls.

What Is Contained in the Packet:

Request: PASS
Request Arg: f1a2k3user

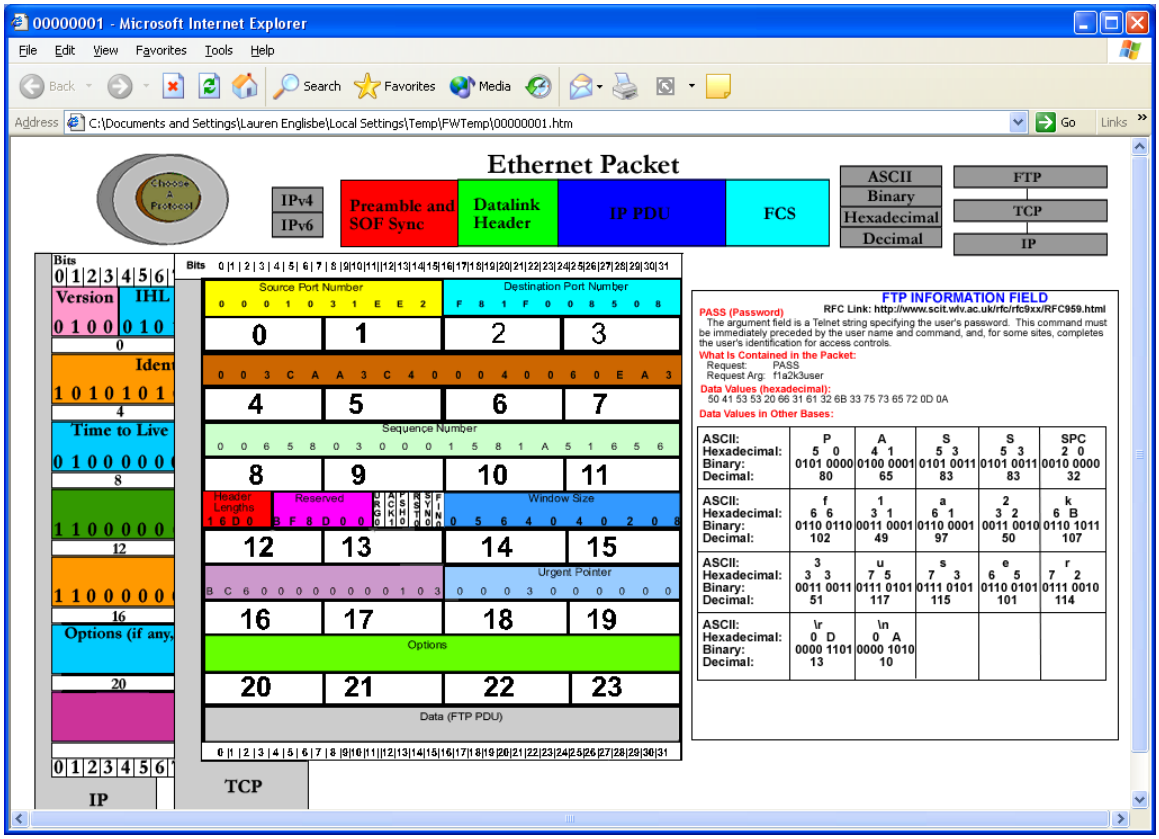
Data Values (hexadecimal):

50 41 53 53 20 66 31 61 32 6B 33 75 73 65 72 0D 0A

Data Values in Other Bases:

ASCII:	P	A	S	S	SPC
Hexadecimal:	5 0	4 1	5 3	5 3	2 0
Binary:	0101 0000	0100 0001	0101 0011	0101 0011	0010 0000
Decimal:	80	65	83	83	32
ASCII:	f	1	a	2	k
Hexadecimal:	6 6	3 1	6 1	3 2	6 B
Binary:	0110 0110	0011 0001	0110 0001	0011 0010	0110 1011
Decimal:	102	49	97	50	107
ASCII:	3	u	s	e	r
Hexadecimal:	3 3	7 5	7 3	6 5	7 2
Binary:	0011 0011	0111 0101	0111 0101	0110 0101	0111 0010
Decimal:	51	117	115	101	114
ASCII:	\r	\n			
Hexadecimal:	0 D	0 A			
Binary:	0000 1101	0000 1010			
Decimal:	13	10			

This is the user display using our second option for the Information Field:



1.2 User Command Summary

Main Screen
This is the screen giving the user the option to choose many different packets.

PDU Hierarchy Tree
Allows the user to see their progression through the many packets, and also able to choose their desired packet.

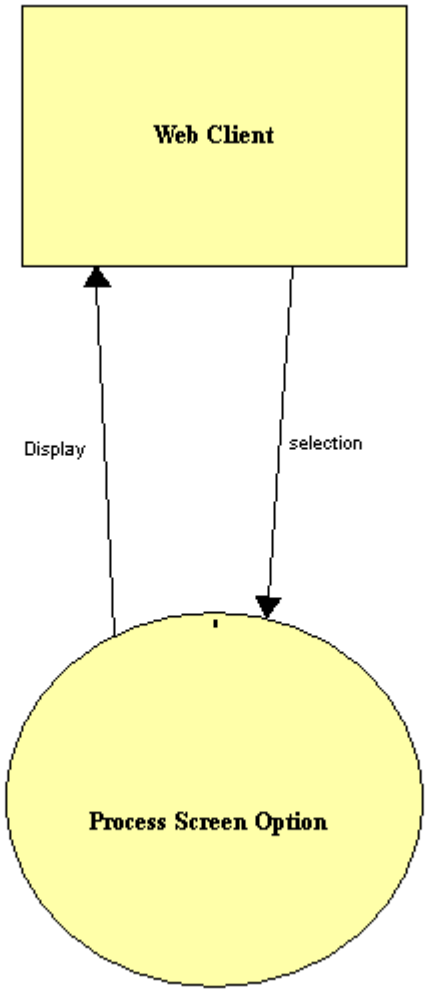
IP Version
Allows the user two chooses of two different IP Versions.

Radix (Base) Selection
Allows the user to select a radix to display.

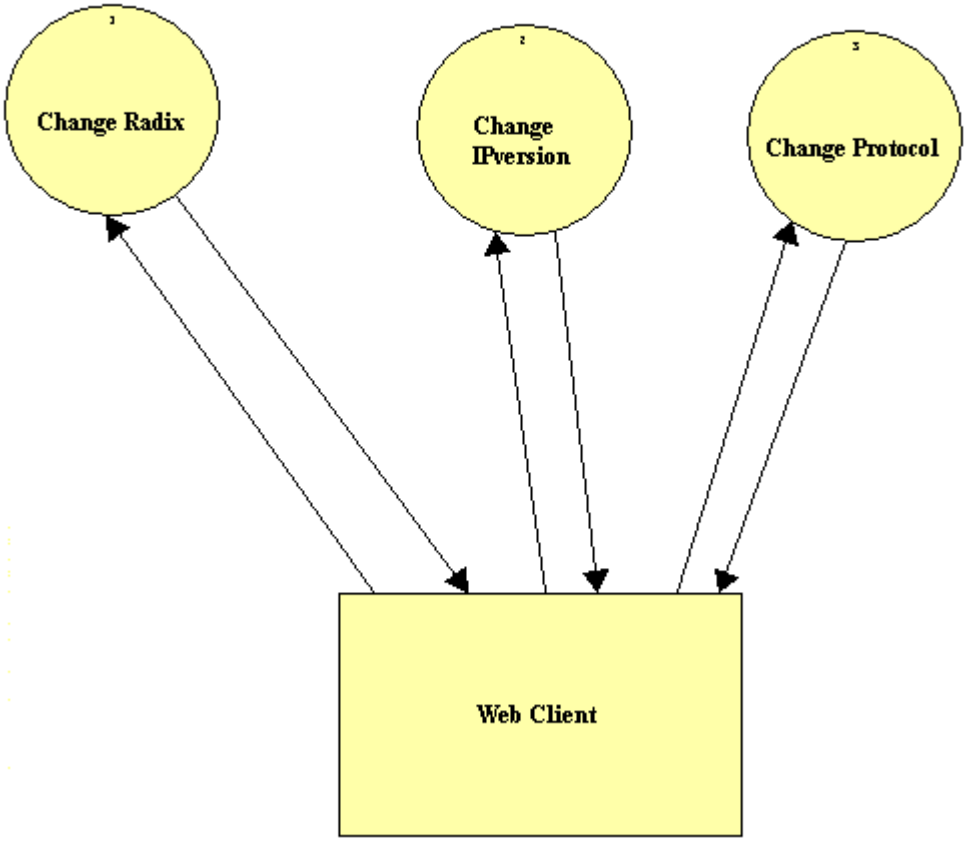
Information Box
Allows the user to see the given information for a selected field.

1.3 Detailed Data Flow Diagrams

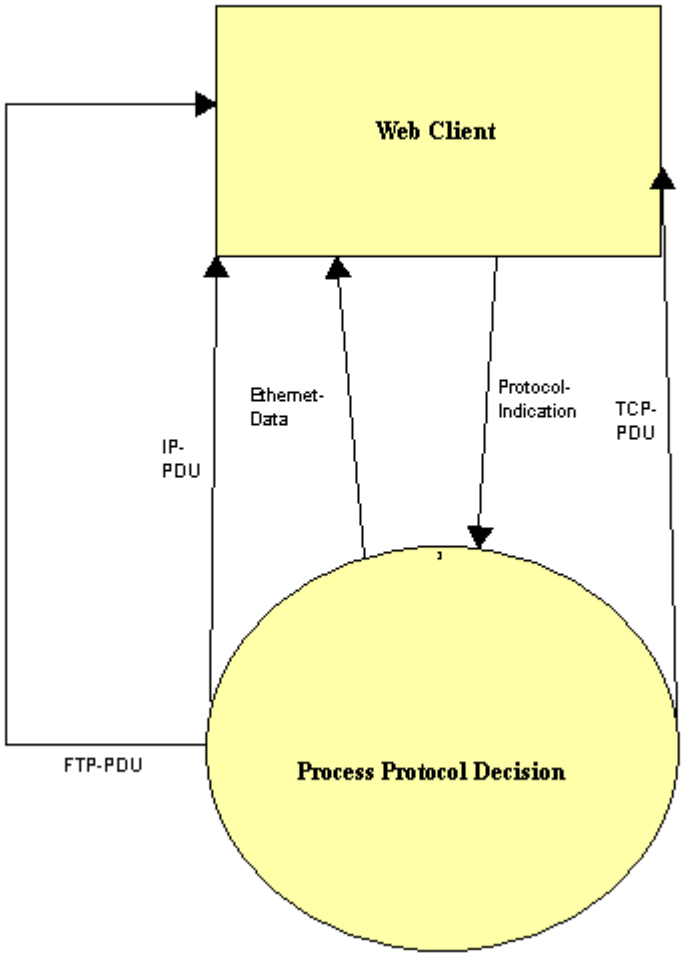
Level 0 Diagram:



Context Diagram:



Detailed Diagram:



1.4 Hardware, Software and Human Interfaces

The prototype was developed and designed on Macromedia Fireworks, a graphic design program.

The program will be written in HTML using Macromedia MX and perhaps PHP (PHP Hypertext Processor) Version 4.1.2.

The TCP/IP Packet Descriptor program will be hosted as a web site on the Siena College Computer Science Department's Oraserv Linux server (Red Hat version 7.1), running the Apache web server (version 1.3.19).

Any Netscape Navigator 7.x or greater and Internet Explorer 5.x or greater web browser may access the program.

2.0 Architectural Design Specification

2.1 User Commands (AKA “Clickable Buttons”)

IP PDU

IP Version
Internet Header Length
Type of Service
Total Length of Ethernet Frame
Identification
Flags
Fragment Offset
Time to Live
Protocol
Header Checksum
Source IP Address
Destination IP Address
Options
Data

TCP PDU

Source Port Number
Destination Port Number
Sequence Number
Acknowledgement Number
Header Lengths
Reserved
Window Size
TCP Checksum
Urgent Pointer
Options
Data

2.2 Functional Descriptions

2.2.1 IP PDU for the selected FTP PDU

IP PDU > *IP Version* for the selected FTP PDU

Field Name: *IP Version*

Purpose and Definition: Version is a 4-bit field that indicates the format of the internet header.

Field Key: 4 = IPv4
6 = IPv6

Data value (decimal): 4

Data values in other bases:

Hexadecimal	4
Binary	0100
Decimal	4

Programming Hint: The name for this variable in code will be IP_IPVersion_FTP.

IP PDU > *Internet Header Length* for the selected FTP PDU

Field Name: *Internet Header Length*

Purpose and Definition: The IHL field is a 4-bit field indicating the length of the internet header in 32 bit words, and thus points to the beginning of the data. The minimum value of a correct header is 5.

Field Key: *Not applicable*

Data value: The value contained in our field is 20 bytes. This is the hexadecimal and decimal value of 5 multiplied by 4 bits.

Data values in other bases:

Hexadecimal	0	5
Binary	0000	0101
Decimal	5	

Programming Hint: The name for this variable in code will be IP_IHL_FTP.

IP PDU > *Type of Service* for the selected FTP PDU

Field Name: *Type of Service*

Purpose and Definition: Type of Service is an 8-bit field that provides and indication of the abstract parameters of the quality of service desired. These parameters guide the selection of the actual service parameters when transmitting a datagram through a particular network.

Field Key: The major choice is a three-way tradeoff between low-delay, high-reliability, and high-throughput.

0 1 2	3	4	5	6	7
Precedence	D	T	R	0	0

Bits 0-2: Precedence
Bit 3: (D) 0 = Normal Delay 1 = Low Delay
Bit 4: (T) 0 = Normal Throughput 1 = High Throughput
Bit 5: (R) 0 = Normal Reliability 1 = High Reliability

Precedence:

111 = Network Control	011 = Flash
110 = Internetwork Control	010 = Immediate
101 = CRITIC/ECP	001 = Priority
100 = Flash Overrided	000 = Routine

Data value (hexadecimal): 10

Data values in other bases:

Hexadecimal	1	0
Binary	0001	0000
Decimal	16	

Programming Hint: The name for this variable in code will be IP_TypeOfService_FTP.

IP PDU > *Total Length of Ethernet Frame* for the selected FTP PDU

Field Name: *Total Length of Ethernet Frame*

Purpose and Definition: Total Length is a 16-bit field that indicates the length of the frame, measured in octets, including internet header and data. The maximum size is 2^{16}-1 or 65,535 octets; however, the recommended maximum size is 576 octets.

Field Key: *Not applicable*

Data values (hexadecimal): 69

Data values in other bases:

Hexadecimal	0	0	6	9
Binary	0000	0000	0110	1001
Decimal	0		105	
ASCII	©		i	

Programming Hint: The name for this variable in code will be IP_TotalLength_FTP.

IP PDU > *Identification* for the selected FTP PDU

Field Name: *Identification*

Purpose and Definition: Identification is a 16-bit field. An identifying value is assigned by the sender to aid in assembling the fragments of a datagram. The identifier is chosen based on the need to provide a way to uniquely identify the fragments and protocol for the time the datagram or any fragment could be alive in the internet.

Field Key: *Not applicable*

Data value (hexadecimal): AA 41

Data values in other bases:

Hexadecimal	A	A	4	1
Binary	1010	1010	0100	0001

Programming Hint: The name for this variable in code will be IP_Idenfification_FTP.

IP PDU > *Flags* for the selected FTP PDU

Field Name: *Flags*

Purpose and Definition: Flags is a 3-bit field that indicates directions for fragmentation.

Field Key:
Bit 0: reserved, must be 0
Bit 1: (DF) 0 = May Fragment 1 = Don't Fragment
Bit 2: (MF) 0 = Last Fragment 1 = More Fragment

Data value (binary): 010

Data values in other bases: *Not applicable*

Programming Hint: The name for this variable in code will be IP_Flags_FTP.

IP PDU > *Fragment Offset* for the selected FTP PDU

Field Name: *Fragment Offset*

Purpose and Definition: The Fragment Offset is a 13- bit field indicating where in the Ethernet frame this fragment begins. The Fragment Offset is measured in units of 8 octets, and the first fragment has offset 0.

Field Key: *Not applicable*

Data value (decimal): 0

Data values in other bases:
Binary: 0 0000 0000 0000

Programming Hint: The name for this variable in code will be IP_FragmentOffset_FTP.

IP PDU > *Time to Live* for the selected FTP PDU

Field Name: *Time to Live*

Purpose and Definition: Time to Live is an 8-bit field that indicates the maximum time the datagram is allowed to remain in the internet. If this field contains the value 0, then the datagram must be destroyed. This field is modified in internet header processing. The time is measure in units of seconds, and is set by the sender to the maximum time the datagram is allowed to be in the internet. This field is decreased at each point that the internet header is processed. The intention is to cause undeliverable packets to be discarded, and to bind the maximum datagram lifetime.

Field Key: *Not applicable*

Data value (decimal): 64

Data values in other bases:

Hexadecimal	4	0
Binary	0100	0000
Decimal	64	

Programming Hint: The name for this variable in code will be IP_TimeToLive_FTP.

IP PDU > *Protocol* for the selected FTP PDU

Field Name: *Protocol*

Purpose and Definition: Protocol is an 8-bit field that indicates the next level protocol that is used in the data portion of the internet diagram.

Field Key:

Dec	Hex	Protocol	Dec	Hex	Protocol
0	00	Reserved	22	16	Multiplexing
1	01	ICMP	23	17	DCN
2	02	Unassigned	24	18	TAC Monitoring
3	03	Gateway-to-Gateway	25-76	19-4C	Unassigned
4	04	CMCC Gateway Monitoring Message	77	4D	Any local network
5	05	ST	100	64	SATNET and Backroom EXPAK
6	06	TCP	101	65	MIT Subnet Support
7	07	UCL	102-104	66-68	Unassigned
10	0A	Unassigned	105	69	SATNET Monitoring
11	0B	Secure	106	6A	Unassigned
12	0C	BBN RCC Monitoring	107	6B	Internet Packet Core Utility
13	0D	NVP	110-113	6E-71	Unassigned
14	0E	PUP	114	72	Backroom SATNET Monitoring
15	0F	Pluribus	115	73	Unassigned
16	10	Telnet	116	74	WIDEBAND Monitoring
17	11	XNET	117	75	WIDEBAND EXPAK
20	14	Chaos	120-376	78-0178	Unassigned
21	15	User Datagram	377	0179	Reserved

Data value (hexadecimal): 06

Data values in other bases:

Hexadecimal	0	6
Binary	0000	0110
Decimal	6	

RFC Link: http://www.faqs.org/rfcs/rfc790.html

Programming Hint: The name for this variable in code will be IP_Protocol_FTP.

IP PDU > *Header Checksum* for the selected FTP PDU

Field Name: *Header Checksum*

Purpose and Definition: The Header Checksum is a 16-bit field. The Checksum is the 16-bit one's complement sum of all 16-bit words in the header. For purposes of computing the checksum, the initial value of its field is zero. When both header checksums are equal, then the header bits are correct. If either checksums vary, then a new, correct packet will need to be sent.

This is a simple way to compute the checksum and experimental evidence indicates that it is adequate, but it is provisional and may be replaced by a CRC procedure, depending on further experience.

Field Key: *Not applicable*

Data value (hexadecimal): 0E 85

Data values in other bases:

Hexadecimal	0	E	8	5
Binary	0000	1110	1000	0101

Programming Hint: The name for this variable in code will be IP_HeaderChecksum_FTP.

IP PDU > *Source Address* for the selected FTP PDU

Field Name: *Source Address*

Purpose and Definition: The Source Address is a 32-bit field that contains the IP address of the host that sent the IP Packet.

Field Key: *Not applicable*

Data value (decimal): 192.168.0.39

Data values in other bases:

Hexadecimal	C	0	A	8	0	0	2	7
Binary	1100	0000	1010	1000	0000	0000	0010	0111
Decimal	192		168		0		39	

Programming Hint: The name for this variable in code will be IP_SourceAddress_FTP.

IP PDU > *Destination Address* for the selected FTP PDU

Field Name: *Destination Address*

Purpose and Definition: The Destination Address is a 32-bit field that contains the address of the host that is to receive the data contained within the IP packet.

Field Key: *Not applicable*

Data value (decimal): 192.168.0.101

Data values in other bases:

Hexadecimal	C	0	A	8	0	0	6	5
Binary	1100	0000	1010	1000	0000	0000	0110	0101
Decimal	192		168		0		101	

Programming Hint: The name for this variable in code will be IP_DestinationAddress_FTP.

IP PDU > *Options and Padding* for the selected FTP PDU

Field Name: *Options and Padding*

Purpose and Definition: The options may or may not appear in Ethernet packets. They must be implemented by all IP modules (host and gateways). What is optional is their transmission in any particular packet, not their implementation.

The option field is variable in length. There may be zero or more options. There are two cases for the format of an option.

Case 1: A single octet of option type

Case 2: An option-type octet, an option-length octet, and the actual option-data octets.

Field Key: *Not applicable*

Data values: *Not applicable*

Data values in other bases: *Not applicable*

Programming Hint: The name for this variable in code will be IP_OptionsPadding_FTP.

IP PDU > *Data* for the selected FTP PDU

Field Name: *Data*

Purpose and Definition: The Data is a variable length field which contains the actual data that is being sent from one host to another. The data field may start with a Layer 4 header, which will give additional instructions to the application that will be receiving the data; alternately, it may be an ICMP header and not contain any user data at all.

Field Key: *Not applicable*

Data values (hexadecimal) : (TCP) 80 30 00 15 81 A5 16 6C 87 A3 53 5D 80 18 16 D0 11 F4 00 00 01 01 08 0A 1B 25 F3 A1 0b DD 73 58
(FTP) 50 41 53 53 20 66 31 61 32 6B 33 75 73 65 72 0D 0A

Data values in other bases:
Hexadecimal: (TCP) 0 x 80 30 00 15 81 A5 16 6C 87 A3 53 5D 80 18 16 D0 11 F4 00 00 01 01 08 0A 1B 25 F3 A1 0B DD 73 58
(FTP) 50 41 53 53 20 66 31 61 32 6B 33 75 73 65 72 0D 0A

ASCII: (TCP) ↑ 0 © © ↑ ↑ © ↑ ↑ S] ↑ © © ↑ © ↑ © © © © © © © % ↑ ↑ © ↑ s X
(FTP) P A S S S © f 1 a 2 k 3 u s e r © ©

Programming Hint: The name for this variable in code will be IP_Data_FTP.

2.2.2 TCP PDU for the selected FTP PDU

IP > TCP PDU > *Source Port* for the selected FTP PDU

Field Name: *Source Port*

Purpose and Definition:
This 16-bit number represents the name of the application that sent the data in the IP packet.

Field Key: *Not applicable*

Data value (decimal): 32816

Data values in other bases:

Hexadecimal	8	0	3	0
Binary	1000	0000	0011	0000
Decimal	128		48	
ASCII	↑		0	

Programming Hint: The name for this variable in code will be IP_TCP_SourcePort_FTP.

IP > TCP PDU > *Destination Port* for the selected FTP PDU

Field Name: *Destination Port*

Purpose and Definition:
This 16-bit number represents the name of the application that is to receive the data contained within the IP packet. This is one of the major differences between a Layer 3 and a Layer 4 header: the Layer 3 header contains the IP address of the computer that is to receive the IP packet; once that packet has been received, the port address in the Layer 4 header ensures that the data contained within that IP packet is passed to the correct application on that computer.

Field Key:
This key indicates assigned port number values:

Dec	**Port Numbers**
0	Reserved
1-32767	Internet registered ("well-known") protocols
32768-98303	Reserved, to allow TCPv7-TCPv4 conversion
98304 & up	Dynamic assignment

Data value (decimal): 21 (indicates FTP)

Data values in other bases:

Hexadecimal	0	0	1	5
Binary	0000	0000	0001	0101
Decimal	0		21	
ASCII	©		©	

Source: http://www.zvon.org/tmRFC/RFC1475/Output/chapter4.html

Programming Hint: The name for this variable in code will be IP_TCP_DestinationPort_FTP.

IP > TCP PDU > *Sequence Number* for the selected FTP PDU

Field Name: *Sequence Number*

Purpose and Definition:
TCP is responsible for ensuring that all IP packets sent are actually received. When an application's data is packaged into IP packets, TCP will give each IP packet a sequence number. Once all the packets have arrived at the receiving computer, TCP uses the number in this 32-bit field to ensure that all of the packets actually arrived and are in the correct sequence.

Field Key: *Not applicable*

Data value (decimal): 2175080044

Data values in other bases:

Hexadecimal	8	1	A	5	1	6	6	C
Binary	0000	0000	0011	1100	1010	1010	0011	1100
Decimal	0		60		176		60	
ASCII	©		‘		↑		‘	

Programming Hint: The name for this variable in code will be IP_TCP_SequenceNumber_FTP.

IP > TCP PDU > *Acknowledgement Number* for the selected FTP PDU

Field Name: *Acknowledgement Number*

Purpose and Definition:
This number is used by the receiving computer to acknowledge which packets have successfully arrived. This number will be the sequence number of the next packet the receiver is ready to receive.

Field Key: *Not applicable*

Data value: 2275627869

Data values in other bases:

Hexadecimal	8	7	A	3	5	3	5	D
Binary	1000	0111	1010	0011	0101	0011	0101	1101
Decimal	135		163		83		93	
ASCII	↑		↑		S		]	

Programming Hint: The name for this variable in code will be IP_TCP_AcknowledgementNumber_FTP.

IP > TCP PDU > *Header Length or Offset* for the selected FTP PDU

Field Name: *Header Length or Offset*

Purpose and Definition:
This is identical in concept to the header length in an IP packet, except this time it indicates the length of the TCP header.

Field Key: *Not applicable*

Data value (bytes): 32

Data values in other bases:

Hexadecimal	8	0
Binary	1000	0000
Decimal	128	
ASCII	↑	

Programming Hint: The name for this variable in code will be IP_TCP_HeaderLength_FTP.

IP > TCP PDU > *Reserved* for the selected FTP PDU

Field Name: *Reserved*

Purpose and Definition:
These 6 bits are unused and are always set to 0.

Field Key: *Not applicable*

Data value (binary): 0000 00

Data values in other bases:

Hexadecimal	0	0	0	0	0	0
Binary	0000	0000	0000	0000	0000	0000
Decimal	0		0		0	
ASCII	©		©		©	

Programming Hint: The name for this variable in code will be IP_TCP_Reserved_FTP.

IP > TCP PDU > *Control Flags* for the selected FTP PDU

Field Name: *Control Flags*

Purpose and Definition:
Every TCP packet contains this 6-bit value that indicates how many octets it can receive at once. When IP packets are received, they are placed in a temporary area of RAM known as a buffer until the receiving computer has a chance to process them; this value represents how big a buffer the receiving host has made available for this temporary storage of IP packets.

Field Key:

- Urgent (URG)
- Acknowledgement (ACK)
- Push (PSH)
- Reset (RST)
- Synchronize (SYN)
- Finish (FIN)

Data value (binary): 01 1000

Data values in other bases: *Not applicable*

Programming Hint: The name for this variable in code will be IP_TCP_ControlFlags_FTP.

IP > TCP PDU > *Window Size* for the selected FTP PDU

Field Name: *Window Size*

Purpose and Definition:
Every TCP packet contains this 16-bit value that indicates how many octets it can receive at once. When IP packets are received, they are placed in a temporary area of RAM known as a buffer until the receiving computer has a chance to process them; this value represents how big a buffer the receiving host has made available for this temporary storage of IP packets.

Field Key: *Not applicable*

Data value (decimal): 5840

Data values in other bases:

Hexadecimal	1	6	D	0
Binary	0001	0110	1110	0000
Decimal	22		224	
ASCII	©		↑	

Programming Hint: The name for this variable in code will be IP_TCP_WindowSize_FTP.

IP > TCP PDU > *Checksum* for the selected FTP PDU

Field Name: *Checksum*

Purpose and Definition:
Unlike IP, TCP is responsible for ensuring that the entire IP packet arrived intact. TCP will run a CRC on the entire IP packet (not just the header) and place the resulting checksum in this field. When the IP packet is received, TCP re-runs the CRC on the entire packet to ensure the checksum is the same.

Field Key: *Not applicable*

Data value (hexadecimal): 11 F4

Data values in other bases:

Hexadecimal	1	1	F	4
Binary	0001	0001	1111	0100
Decimal	17		244	
ASCII	©		©	

Programming Hint: The name for this variable in code will be IP_TCP_Checksum_FTP.

IP > TCP PDU > *Urgent Pointer* for the selected FTP PDU

Field Name: *Urgent Pointer*

Purpose and Definition:
If the Urgent flag is set to on, this value indicates where the urgent data is located.

Information Key: *Not applicable*

Data value: *Not applicable*

Data values in other bases: *Not applicable*

Programming Hint: The name for this variable in code will be IP_TCP_UrgentPointer_FTP.

IP > TCP PDU > *Options and Padding* for the selected FTP PDU

Field Name: *Options and Padding*

Purpose and Definition:
Like IP options, this field is optional and represents additional instructions not covered in the other TCP fields. Again, if an option does not fill up a 32-bit word, it will be filled in with padding bits.

Field Key: *Not applicable*

Data value (hexadecimal): 01 01 08 0A 1B 25 F3 A1 0B DD 73 58

Data values in other bases:

Hexadecimal	0	1	0	1	0	8	0	A	1	B
Binary	0000	0001	0000	0001	0000	1000	0000	1010	0001	1011
Decimal	1		1		8		10		27	
ASCII	©		©		©		©		©	

Hexadecimal	2	5	F	3	A	1	0	B	D	D
Binary	0010	0101	1111	0011	1010	0001	0000	1011	1101	1101
Decimal	37		243		161		11		221	
ASCII	%		↑		↑		©		↑	

Hexadecimal	7	3	5	8
Binary	0101	0011	0101	1000
Decimal	115		96	
ASCII	↑		↑	

Programming Hint: The name for this variable in code will be IP_TCP_OptionsPadding_FTP.

2.2.3 FTP PDU for the selected FTP PDU

IP >TCP > FTP PDU for the FTP Packet

RFC Link: http://www.ietf.org/rfc/rfc0959.txt?number=959

PASS (Password)

The argument field is a Telnet string specifying the user's password. This command must be immediately preceded by the user name command, and, for some sites, completes the user's identification for access control.

What is Contained in the Packet

Request: PASS

Request Arg: f1a2k3user

Data Values (hexadecimal): 50 41 53 53 20 66 31 61 32 6B 33 75 73 65 72 0D 0A

Data Values in Other Bases

ASCII	P	A	S	S	SPC	f	1	a	2
Hexadecimal	5 0	4 1	5 3	5 3	2 0	6 6	3 1	6 1	3 2
Binary	0101 0000	0100 0001	0101 0011	0101 0011	0010 0000	0110 0110	0011 0001	0110 0001	0011 0010
Decimal	80	65	83	83	32	102	49	97	59

ASCII	k	3	u	s	e	r	\r	\n
Hexadecimal	6 B	3 3	7 5	7 3	6 5	7 2	0 D	0 A
Binary	0110 1011	0011 0011	0111 0101	0111 0011	0110 0101	0111 0010	0000 1101	0000 1010
Decimal	107	51	117	115	101	114	13	10

Programming Hint: The name for this variable in code will be IP_TCP_FTP_PDU_FTP.

2.2.4 IP PDU for the selected ICMP PDU

IP PDU > *Version* for the selected ICMP PDU

Field Name: *Version*

Purpose and Definition: Version is a 4-bit field that indicates the format of the internet header.

Field Key: 4 = IPv4
6 = IPv6

Data value (decimal): 4

Data values in other bases:

Hexadecimal	4
Binary	0100
Decimal	4

Programming Hint: The name for this variable in code will be IP_Version_ICMP.

IP PDU > *Internet Header Length* for the selected ICMP PDU

Field Name: *Internet Header Length*

Purpose and Definition: The IHL field is a 4 bit field indicating the length of the internet header in 32 bit words, and thus points to the beginning of the data. The minimum value of a correct header is 5.

Field Key: *Not applicable*

Data value: The value contained in our field is 20 bytes. This is the hexadecimal and decimal value of 5 multiplied by 4 bits.

Data values in other bases:

Hexadecimal	0	5
Binary	0000	0101
Decimal	5	

Programming Hint: The name for this variable in code will be IP_Version_ICMP.

IP PDU > *Type of Service* for the selected ICMP PDU

Field Name: *Type of Service*

Purpose and Definition: Type of Service is an 8-bit field that provides and indication of the abstract parameters of the quality of service desired. These parameters guide the selection of the actual service parameters when transmitting a datagram through a particular network.

Field Key: The major choice is a three-way tradeoff between low-delay, high-reliability, and high-throughput.

0 1 2	3	4	5	6	7
Precedence	D	T	R	0	0

Bits 0-2: Precedence
Bit 3: (D) 0 = Normal Delay 1 = Low Delay
Bit 4: (T) 0 = Normal Throughput 1 = High Throughput
Bit 5: (R) 0 = Normal Reliability 1 = High Reliability

Precedence:

111 = Network Control	011 = Flash
110 = Internetwork Control	010 = Immediate
101 = CRITIC/ECP	001 = Priority
100 = Flash Overrided	000 = Routine

Data value (hexadecimal): 00

Data values in other bases:

Hexadecimal	0	0
Binary	0000	0000
Decimal	0	

Programming Hint: The name for this variable in code will be IP_TypeOfService_ICMP.

IP PDU > *Total Length of Ethernet Frame* for the selected ICMP PDU

Field Name: *Total Length of Ethernet Frame*

Purpose and Definition: Total Length is a 16-bit field that indicates the length of the frame, measured in octets, including internet header and data. The maximum size is 2^{16}-1 or 65,535 octets; however, the recommended maximum size is 576 octets.

Field Key: *Not applicable*

Data values (decimal): 84

Data values in other bases:

Hexadecimal	0	0	5	4
Binary	0000	0000	0101	0100
Decimal	0		84	
ASCII	©		T	

Programming Hint: The name for this variable in code will be IP_TotalLength_ICMP.

IP PDU > *Identification* for the selected ICMP PDU

Field Name: *Identification*

Purpose and Definition: Identification is a 16-bit field. An identifying value is assigned by the sender to aid in assembling the fragments of a datagram. The identifier is chosen based on the need to provide a way to uniquely identify the fragments and protocol for the time the datagram or any fragment could be alive in the internet

Field Key: *Not applicable*

Data value (hexadecimal): 00 00

Data values in other bases:

Hexadecimal	0	0	0	0
Binary	0000	0000	0000	0000

Programming Hint: The name for this variable in code will be IP_Identification_ICMP.

IP PDU > *Flags* for the selected ICMP PDU

Field Name: *Flags*

Purpose and Definition: Flags is a 3-bit field that indicates directions for fragmentation.

Field Key:
Bit 0: reserved, must be 0
Bit 1: (DF) 0 = May Fragment 1 = Don't Fragment
Bit 2: (MF) 0 = Last Fragment 1 = More Fragment

Data value (binary): 010

Data values in other bases: *Not applicable*

Programming Hint: The name for this variable in code will be IP_Flags_ICMP.

IP PDU > *Fragment Offset* for the selected ICMP PDU

Field Name: *Fragment Offset*

Purpose and Definition: The Fragment Offset is a 13- bit field indicating where in the Ethernet frame this fragment begins. The Fragment Offset is measured in units of 8 octets, and the first fragment has offset 0.

Field Key: *Not applicable*

Data value (decimal): 0

Data values in other bases:
Binary: 0 0000 0000 0000

Programming Hint: The name for this variable in code will be IP_FragmentOffset_ICMP.

IP PDU > *Time to Live* for the selected ICMP PDU

Field Name: *Time to Live*

Purpose and Definition: Time to Live is an 8-bit field that indicates the maximum time the datagram is allowed to remain in the internet. If this field contains the value 0, then the datagram must be destroyed. This field is modified in internet header processing. The time is measure in units of seconds, and is set by the sender to the maximum time the datagram is allowed to be in the internet. This field is decreased at each point that the internet header is processed. The intention is to cause undeliverable packets to be discarded, and to bind the maximum datagram lifetime.

Field Key: *Not applicable*

Data value (decimal): 64

Data values in other bases:

Hexadecimal	4	0
Binary	0100	0000
Decimal	64	

Programming Hint: The name for this variable in code will be IP_TimeToLive_ICMP.

IP PDU > *Protocol* for the selected ICMP PDU

Field Name: *Protocol*

Purpose and Definition: Protocol is an 8-bit field that indicates the next level protocol that is used in the data portion of the internet diagram.

Field Key:

Dec	Hex	Protocol	Dec	Hex	Protocol
0	00	Reserved	22	16	Multiplexing
1	01	ICMP	23	17	DCN
2	02	Unassigned	24	18	TAC Monitoring
3	03	Gateway-to-Gateway	25-76	19-4C	Unassigned
4	04	CMCC Gateway Monitoring Message	77	4D	Any local network
5	05	ST	100	64	SATNET and Backroom EXPAK
6	06	TCP	101	65	MIT Subnet Support
7	07	UCL	102-104	66-68	Unassigned
10	0A	Unassigned	105	69	SATNET Monitoring
11	0B	Secure	106	6A	Unassigned
12	0C	BBN RCC Monitoring	107	6B	Internet Packet Core Utility
13	0D	NVP	110-113	6E-71	Unassigned
14	0E	PUP	114	72	Backroom SATNET Monitoring
15	0F	Pluribus	115	73	Unassigned
16	10	Telnet	116	74	WIDEBAND Monitoring
17	11	XNET	117	75	WIDEBAND EXPAK
20	14	Chaos	120-376	78-0178	Unassigned
21	15	User Datagram	377	0179	Reserved

Data value (hexadecimal): 01

Data values in other bases:

Hexadecimal	0	6
Binary	0000	0001
Decimal	1	

RFC Link: http://www.faqs.org/rfcs/rfc790.html

Programming Hint: The name for this variable in code will be IP_Protocol_ICMP.

IP PDU > *Header Checksum* for the Selected ICMP PDU

Field Name: *Header Checksum*

Purpose and Definition: The Header Checksum is a 16-bit field. This CRC algorithm is the 16-bit one's complement sum of all the 16-bit words in the header. For purposes of computing the checksum, the value of the checksum field is initially zero. When both header checksums are the same, then the header bits are correct. If either checksums vary, then a packet will need to be resent.

This is a simple way to compute the checksum and experimental evidence indicates that it is adequate, but it is provisional and may be replaced by a CRC procedure, depending on further experience.

Field Key: *Not applicable*

Data value (hexadecimal): B8 CC

Data values in other bases:

Hexadecimal	B	8	C	C
Binary	1011	1000	1100	1100

Programming Hint: The name for this variable in code will be IP_HeaderChecksum_ICMP.

IP PDU > *Source Address* for the Selected ICMP PDU

Field Name: *Source Address*

Purpose and Definition: The Source Address is a 32-bit field that contains the IP address of the host that sent the IP Packet.

Field Key: *Not applicable*

Data value: 192.168.0.39

Data values in other bases:

Hexadecimal	C	0	A	8	0	0	2	7
Binary	1100	0000	1010	1000	0000	0000	0010	0111
Decimal	192		168		0		39	

Programming Hint: The name for this variable in code will be IP_SourceAddress_ICMP.

IP PDU > *Destination Address* for the selected ICMP PDU

Field Name: *Destination Address*

Purpose and Definition: The Destination Address is a 32-bit field that contains the address of the host that is to receive the data contained within the IP packet.

Field Key: *Not applicable*

Data value: 192.168.0.101

Data values in other bases:

Hexadecimal	C	0	A	8	0	0	6	5
Binary	1100	0000	1010	1000	0000	0000	0110	0101
Decimal	192.		168.		0.		101	

Programming Hint: The name for this variable in code will be IP_DestinationAddress_ICMP.

IP PDU > *Options and Padding* for the selected ICMP PDU

Field Name: *Options and Padding*

Purpose and Definition: The options may or may not appear in Ethernet packets. They must be implemented by all IP modules (host and gateways). What is optional is their transmission in any particular packet, not their implementation.

The option field is variable in length. There may be zero or more options. There are two cases for the format of an option.

Case 1: A single octet of option type

Case 2: An option-type octet, an option-length octet, and the actual option-data octets.

Field Key: *Not applicable*

Data values: *Not applicable*

Data values in other bases: *Not applicable*

Programming Hint: The name for this variable in code will be IP_OptionsPadding_ICMP.

2.2.5 ICMP PDU for the selected ICMP PDU

IP > ICMP Header > *Type* for the selected ICMP PDU

Field Name: *Type*

Purpose and Definition: The type is an 8-bit field that identifies what sort of message the ICMP protocol is sending.

Field Key:

Dec	Hex	Message Type	Dec	Hex	Message Type
0	00	Echo Reply	16	10	Information Reply
1	01	Unassigned	17	11	Address Mask Request
2	02	Unassigned	18	12	Address Mask Reply
3	03	Destination Unreachable	19	13	Reserved (for Security)
4	04	Source Quench	20-29	14-1D	Reserved (for Robustness Experiment)
5	05	Redirect	30	1E	Traceroute
6	06	Alternate Host Address	31	1F	Datagram Conversion Error
7	07	Unassigned	32	20	Mobile Host Redirect
8	08	Echo	33	21	IPv6 Where-Are-You
9	09	Router Advertisement	34	22	IPv6 I-Am-Here
10	0A	Router Solicitation	35	23	Mobile Registration Request
11	0B	Time Exceeded	36	24	Mobile Registration Reply
12	0C	Parameter Problem	37	25	Domain Name Request
13	0D	Timestamp	38	26	Domain Name Reply
14	0E	Timestamp Reply	39	27	SKIP
15	0F	Information Request	40	28	Photuris
			41-255	29-FF	Reserved

Data value: 8 (Echo (ping) Request)

Data values in other bases:

Hexadecimal	0	8
Binary	0000	1000
Decimal	8	

RFC Link: http://www.iana.org/assignments/icmp-parameters

Programming Hint: The name for this variable in code will be IP_ICMP_Type_ICMP.

IP > ICMP Header > *Code* for the selected ICMP PDU

Field Name: *Code*

Purpose and Definition: Code is an 8-bit field that provides further information about the associated type field.

Field Key:

Type	Name
0	Echo Reply (used by "PING")
	0 No Code
1	Unassigned
2	Unassigned
3	Destination Unreachable
	0 Net Unreachable
	1 Host Unreachable
	2 Protocol Unreachable
	3 Port Unreachable
	4 Fragmentation needed and Don't Fragment was Set
	5 Source Route Failed
	6 Destination Network Unknown
	7 Destination Host Unknown
	8 Source Host Isolated
	9 Communication with Destination Network is Administratively Prohibited
	10 Communication with Destination Host is Administratively Prohibited
	11 Destination Network Unreachable for Type of Service
	12 Destination Host Unreachable for Type of Service
4	Source Quench
	0 No Code
5	Redirect
	0 Redirect Datagram for the Network
	1 Redirect Datagram for the Host
	2 Redirect Datagram for the Type of Service and Network
	3 Redirect Datagram for the Type of Service and Host
6	Alternate Host Address
	0 Alternate Address for Host
7	Unassigned
8	Echo (used by "PING")
	0 No Code
9	Router Advertisement
	0 No Code
10	Router Selection
	0 No Code
11	Time Exceeded
	0 Time to Live exceeded in Transit
	1 Fragment Reassembly Time Exceeded
12	Parameter Problem
	0 Pointer indicates the error
	1 Missing a Required Option
	2 Bad Length
13	Timestamp
	0 No Code
14	Timestamp Reply
	0 No Code
15	Information Request
	0 No Code
16	Information Reply
	0 No Code
17	Address Mask Request
	0 No Code
18	Address Mask Reply
	0 No Code
19	Reserved (for Security)
20-29	Reserved (for Robustness Experiment)
30	Traceroute
31	Datagram Conversion Error
32	Mobile Host Redirect
33	IPv6 Where-Are-You
34	IPv6 I-Am-Here
35	Mobile Registration Request
36	Mobile Registration Reply

Data value (decimal): 0

Data values in other bases:

Hexadecimal	0	0
Binary	0000	0000
Decimal	0	
ASCII	©	

Programming Hint: The name for this variable in code will be IP_ICMP_Header_ICMP.

IP > ICMP Header > *Checksum* for the selected ICMP PDU

Field Name: *Checksum*

Purpose and Definition: The checksum is the 16-bit one's complement of the one's complement sum of the ICMP message, starting with the ICMP type. For computing the checksum, the checksum field should initially be zero.

Field Key: *Not applicable*

Data value (hexadecimal): C9 15

Data values in other bases:

Hexadecimal	C	9	1	5
Binary	1100	1001	0001	0101
Decimal	201		21	
ASCII	↑		©	

Programming Hint: The name for this variable in code will be IP_ICMP_Checksum_ICMP.

IP > ICMP Header > *Identifier* for the selected ICMP PDU

Field Name: Identifier

Purpose and Definition: The identifier is a 16-bit field that is used in matching echoes and replies for when the code field is zero.

Field Key: *Not applicable*

Data value (hexadecimal): 70 60

Data values in other bases:

Hexadecimal	7	0	6	0
Binary	0111	0000	0110	0000
Decimal	112		96	
ASCII	P		‘	

Programming Hint: The name for this variable in code will be IP_ICMP_Identifier_ICMP.

IP > ICMP Header > *Sequence* for the selected ICMP PDU

Field Name: *Sequence*

Purpose and Definition: The sequence is a 16-bit field that is used in matching echoes and replies for when the code field is zero.

Field Key: *Not applicable*

Data value (hexadecimal): 70 60

Data values in other bases:

Hexadecimal	0	0	0	0
Binary	0000	0000	0000	0000
Decimal	0		0	
ASCII	©		©	

Programming Hint: The name for this variable in code will be IP_ICMP_Sequence_ICMP.

IP > ICMP Header > *Data* for the selected ICMP PDU

Field Name: *Data*

Purpose and Definition: The data is a variable-length field that contains the actual information that is sent in the ping packet.

Field Key: *Not applicable*

Data value (hexadecimal): 42 B1 89 3F 00 00 00 00 2C C6 07 00 00 00 00 00 10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F 20 21 22 23 24 25 26 27 28 29 2A 2B 2C 2D 2E 2F 30 31 32 33 34 35 36 37

Data values in other bases:

Hexadecimal	4	2	B	1	8	9	3	F	0	0
Binary	0100	0010	1011	0001	1000	1001	0011	1111	0000	0000
Decimal	66		177		137		63		0	
ASCII	B		↑		↑		?		©	

Hexadecimal	0	0	0	0	0	0	2	C	C	6
Binary	0000	0000	0000	0000	0000	0000	0010	1100	1100	0110
Decimal	0		0		0		44		198	
ASCII	©		©		©		,		↑	

Hexadecimal	0	7	0	0	0	0	0	0	0	0
Binary	0000	0111	0000	0000	0000	0000	0000	0000	0000	0000
Decimal	7		0		0		0		0	
ASCII	©		©		©		©		©	

Hexadecimal	0	0	1	0	1	1	1	2	1	3
Binary	0000	0000	0001	0000	0001	0001	0001	0010	0001	0011
Decimal	0		16		17		18		19	
ASCII	©		©		©		©		©	

Hexadecimal	1	4	1	5	1	6	1	7	1	8
Binary	0001	0100	0001	0101	0001	0110	0001	0111	0001	1000
Decimal	20		21		22		23		24	
ASCII	©		©		©		©		©	

Hexadecimal	1	9	1	A	1	B	1	C	1	D
Binary	0001	1001	0001	1010	0001	1011	0001	1100	0001	1101
Decimal	25		26		27		28		29	
ASCII	©		©		©		©		©	

Hexadecimal	1	E	1	F	2	0	2	1	2	2
Binary	0001	1110	0001	1111	0010	0000	0010	0001	0010	0010
Decimal	30		31		32		33		34	
ASCII	©		©		SPACE		!		“	

Hexadecimal	2	3	2	4	2	5	2	6	2	7
Binary	0010	0011	0010	0100	0010	0101	0010	0110	0010	0111
Decimal	35		36		37		38		39	
ASCII	#		$		%		&		‘	

Hexadecimal	2	8	2	9	2	A	2	B	2	C
Binary	0010	1000	0010	1001	0010	1010	0010	1011	0010	1100
Decimal	40		41		42		43		44	
ASCII	(		)		*		+		,	

Hexadecimal	2	D	2	E	2	F	3	0	3	1
Binary	0010	1101	0010	1110	00010	1111	0011	0000	0011	0001
Decimal	45		46		47		48		49	
ASCII	-		.		/		0		1	

Hexadecimal	3	2	3	3	3	4	3	5	3	6
Binary	0011	0010	0011	0011	0011	0100	0011	0101	0011	0110
Decimal	50		51		52		53		54	
ASCII	2		3		4		5		6	

Hexadecimal	3	7
Binary	0011	0111
Decimal	55	
ASCII	7	

Programming Hint: The name for this variable in code will be IP_ICMP_Data_ICMP.

3.0 Appendix

3.1 Glossary

ASCII:
American Standard Code for Information Interchange: a code for representing English characters as numbers, with each letter assigned a number from 0 to 127.

Attribute:
A named value or relationship that exists for some or all instances of some entity and is directly associated with that instance.

Binary:
Pertaining to a number system that has just two unique digits, 0 and 1. Computers operate on a binary number system.

Code:
The symbolic arrangement of data or instructions in a computer program or the set of such instructions.

Data Flow Diagram:
A graphical notation used to describe how data flows between processes in a system. They are a representation of the functional decomposition of a system.

Decimal:
Refers to numbers in base 10—the numbers we use in everyday life.

Dynamic Combo Menu:
Menu showing all actions possible at the current moment.

Frame:
A feature that divides a browser's window into separate segments that can be scrolled independently of each other; a single step in a sequence of programmed instructions

GUI:
Graphical User Interface: A user interface based on graphics (icons, pictures, and menus) instead of text; uses a mouse as well as a keyboard as an input device.

Gantt Chart:
A chart that depicts progress in relation to time, often used in planning and tracking a project

HTML:

Hypertext Transfer Markup Language: A markup language used to structure text and multimedia documents and to set up hypertext links between documents, used extensively on the World Wide Web.

Hexadecimal:

Refers to the base-16 number system which consists of 16 unique symbols: the numbers 0 to 9 and the letters A to F.

Hypertext:

A computer-based text retrieval system that enables a user to access particular locations in web pages or other electronic documents by clicking on links within specific web pages or documents.

Internet:

An interconnected system of networks that connects computers around the world via the TCP/IP protocol.

Linear Sequential Model:

Sometimes called the *classic life cycle* or the *waterfall model*, this model suggests a systematic, sequential approach to software development that begins at the system level and progresses through analysis, design, coding, testing, and support.

Linux:

A trademark for an open-source version of the UNIX operating system.

Network:

A group of two or more computer systems linked together.

Open-Source:

A method and philosophy for software licensing and distribution designed to encourage use and improvement of software written by volunteers by ensuring that anyone can copy the source code.

PHP:

PHP Hypertext Preprocessor (server-side scripting language)

Packet:

A short block of data transmitted in a packet switching network.

PDU:

Protocol Data Unit: A packet of data passed across a network.

Protocol:

A set of formal rules describing how to transmit data, especially across a network.

Prototype:

An original type, form, or instance serving as a basis or standard for later stages.

RFC:

Request for Comments: One of a long-establish series of numbered Internet informational documents and standards widely followed by commercial software and freeware in the Internet and Unix communities.

Software:

The code executed by a computer, as opposed to the physical device which they run on.

TCP/IP:

Transmission Control Protocol/Internet Protocol: A suite of protocols for communication between computers, used as a standard for transmitting data over networks and as the basis for standard Internet protocols.

UNIX:

A powerful operating system developed at the ATT Bell Laboratories.

Use Case:

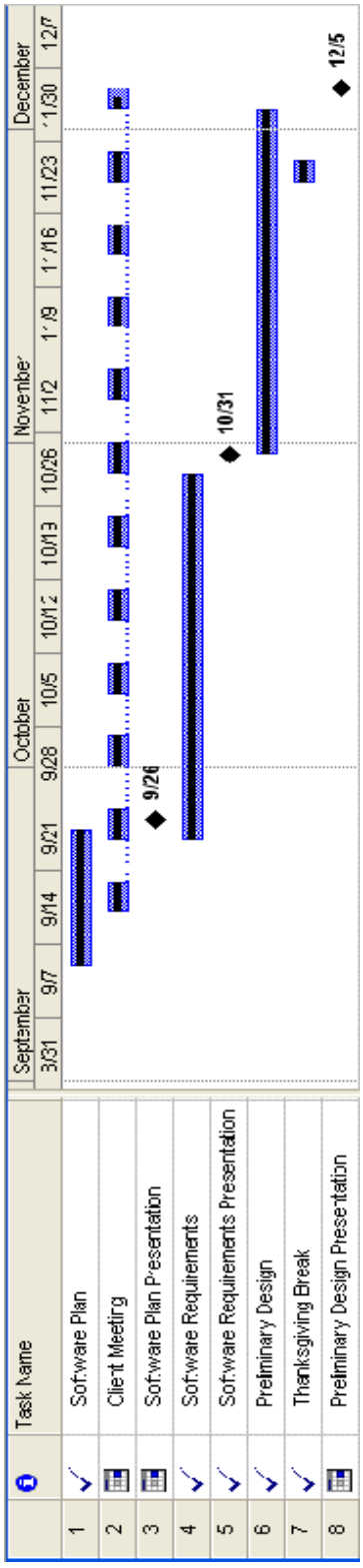
The specification of sequences of actions that a system, subsystem, or class can perform by interacting with outside actors.

Visible Analyst:

Project management software used in Computer-Aided Software Engineering (CASE) to create such illustrations as the data flow diagrams.

3.2 Gantt Charts

Fall Gantt Chart:



Yearlong Gantt Chart: