Managed Diffie-Hellman

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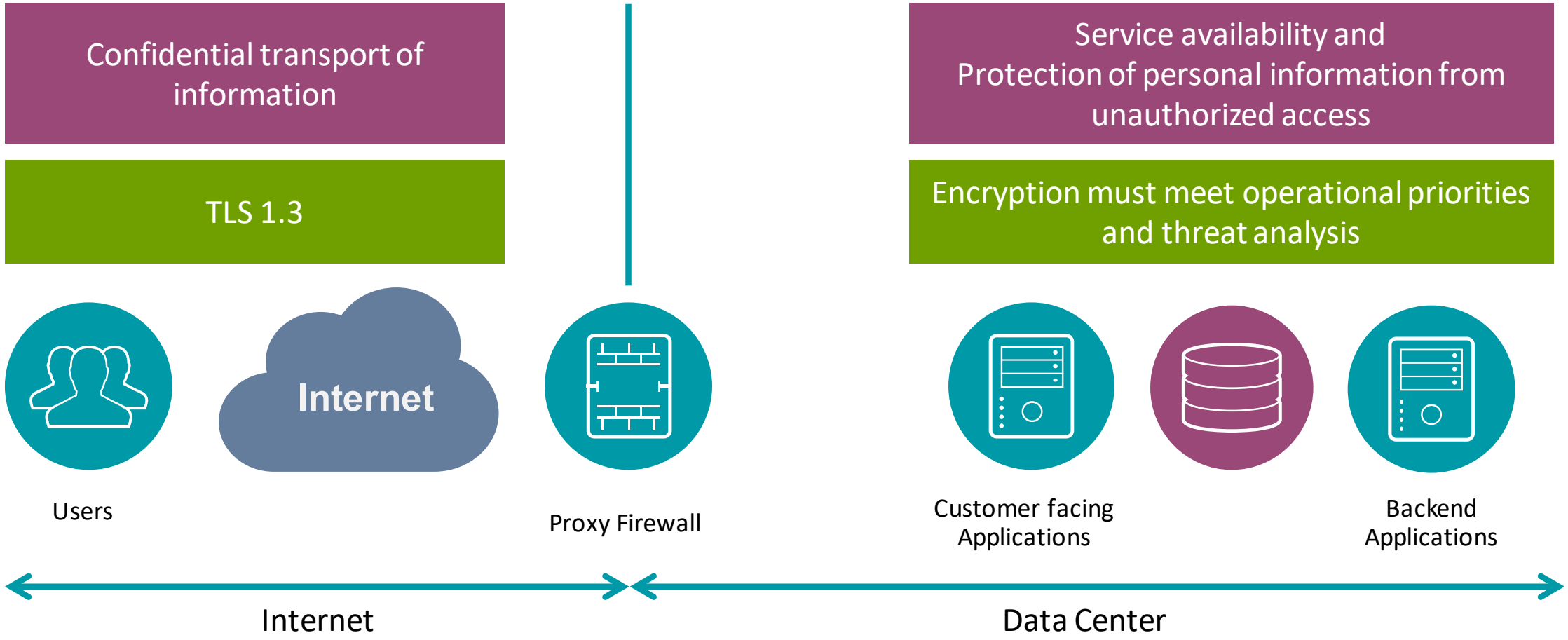
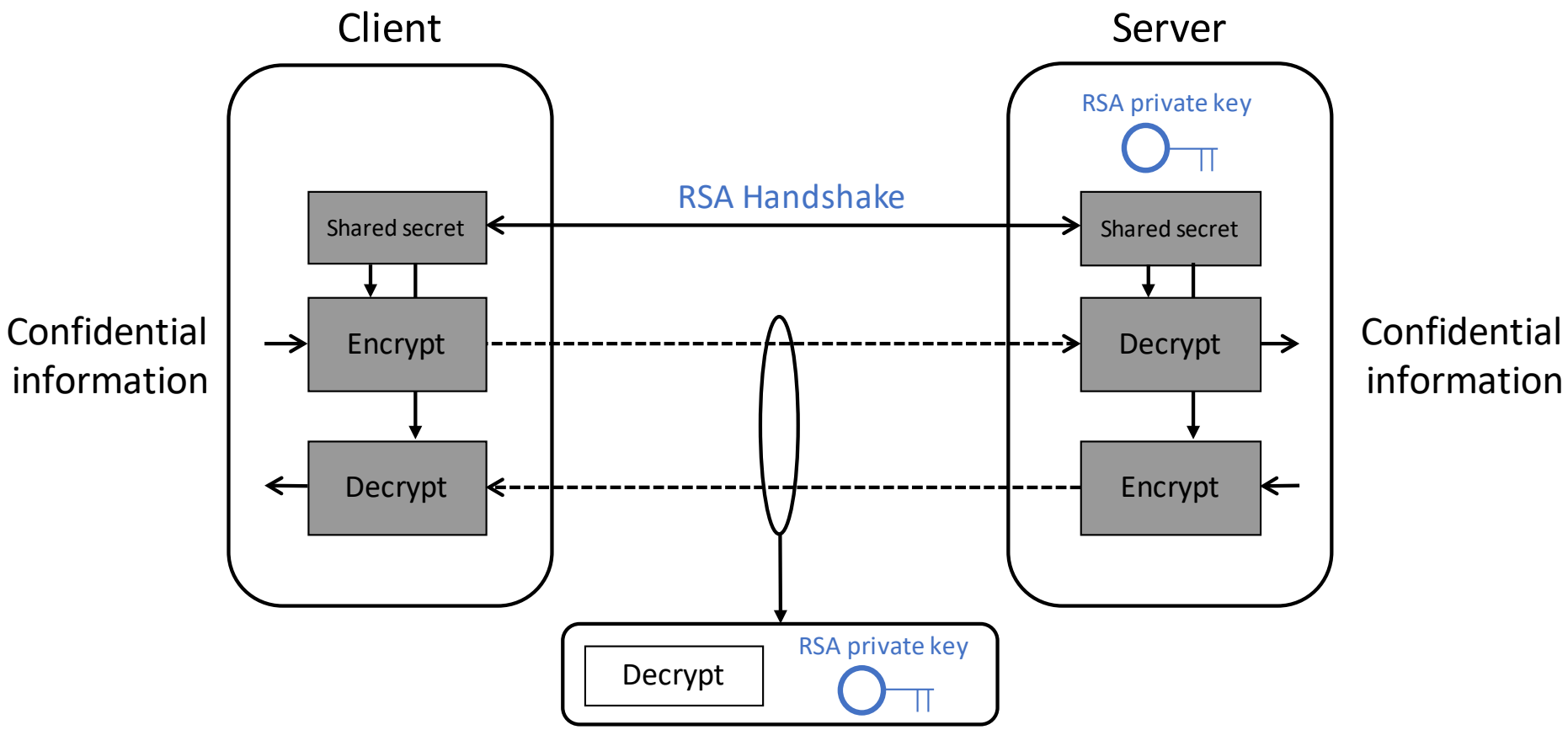
Encryption in the Data Center

Encryption considerations for the Internet are different from the Data Center

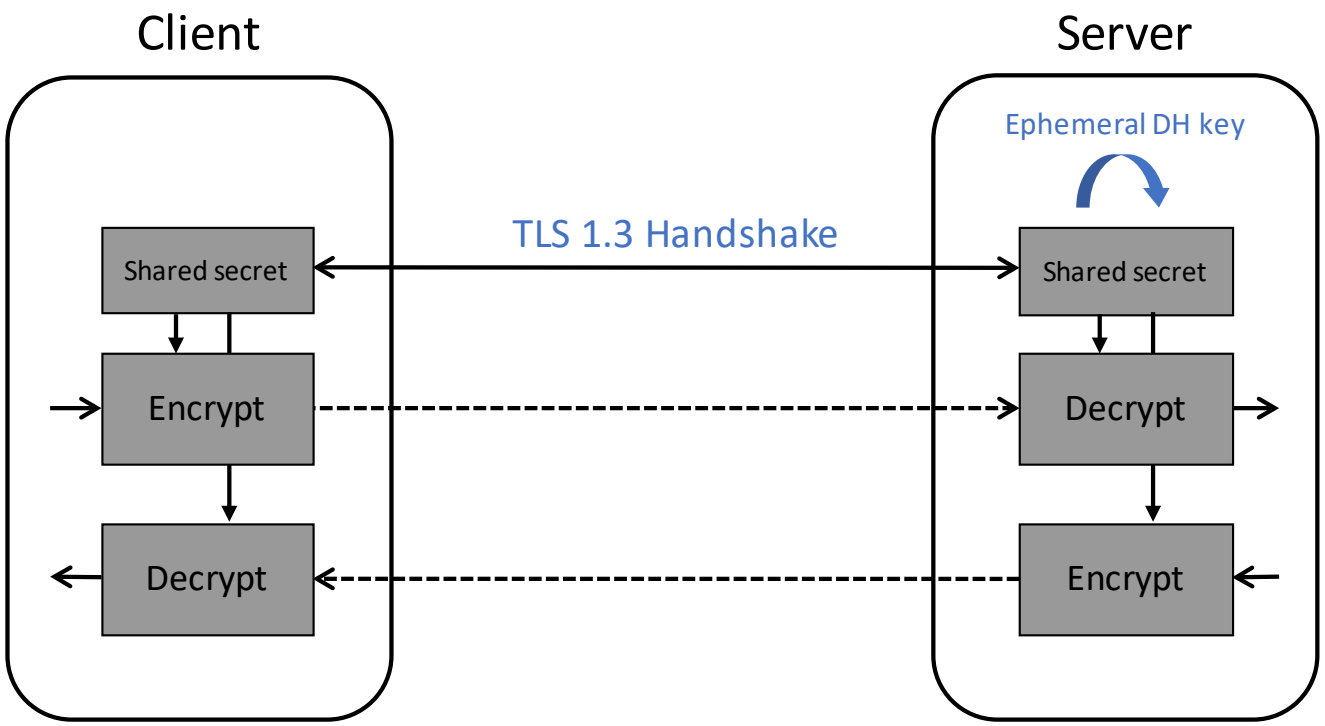


Decrypting traffic with RSA

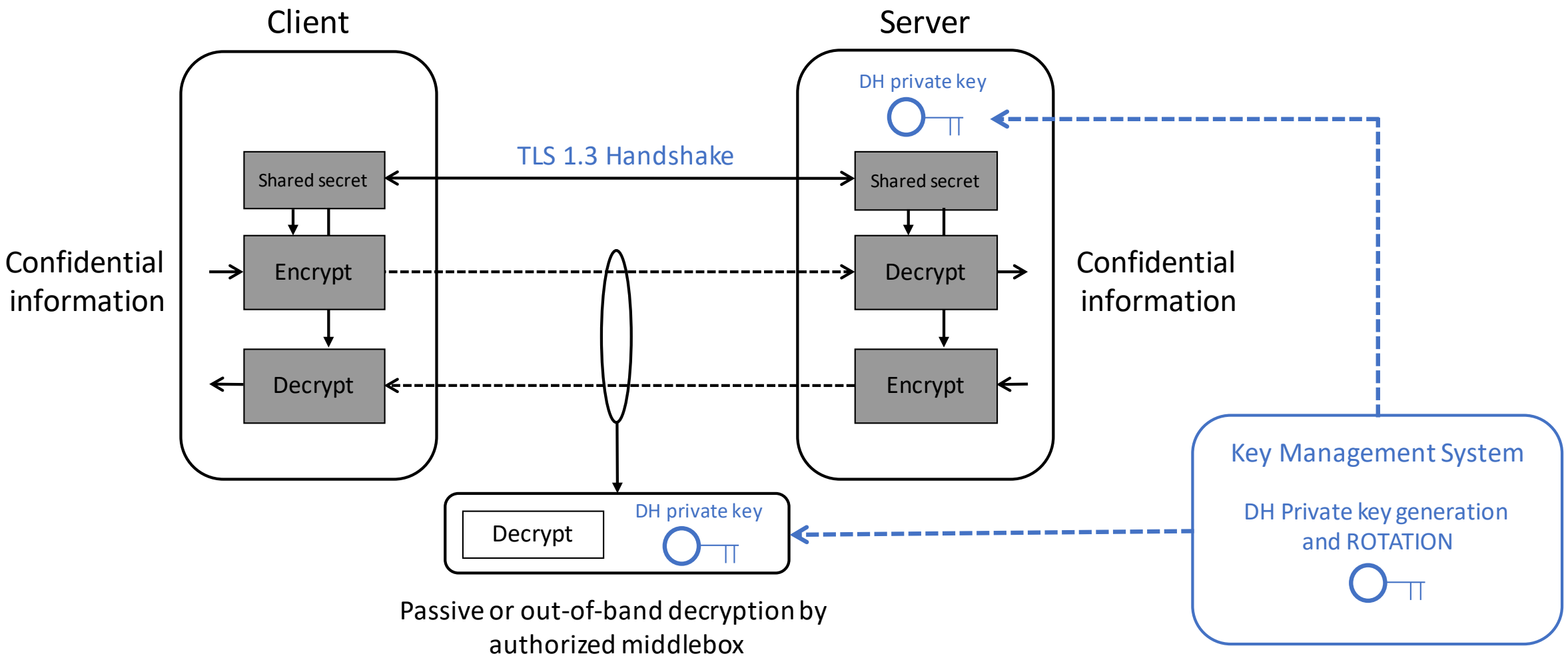


Passive or out-of-band decryption by authorized middlebox

TLS 1.3 and Ephemeral DH



Managed Diffie-Hellman



TLS 1.3 and Managed DH

Features	TLS 1.3	Managed DH
Compatible with all TLS 1.3 clients	✓	✓
Diffie-Hellman Handshake	✓	✓
Fast session re-establishment	✓	✓
Encrypted certificate information	✓	✓
Immune to masquerading	✓	✓
Per-session forward secrecy	✓	
Forward secrecy through key rotation		✓

FAQ

- Does this work with standard TLS implementations?
  - Works with all TLS 1.3 clients
  - Requires TLS server stack that supports TLS 1.3 with an externally provided Private DH key
- What is the exposure from key retention?
  - Devices performing real-time decryption only need current key and next key
  - Keys for post-capture decryption can be securely stored centrally
- Isn't searching for the correct key slow?
  - No: the Client Hello Random can be used an index into a hash table
- What is the correct key rotation period?
  - That is for the data center operator to decide
- When is true Forward Secrecy achieved?
  - When all copies of the private DH key are deleted
  - However, key rotation is far more robust than static keys with lifetimes of months or years

Status

- Managed Diffie-Hellman
  - Requires TLS 1.3 server stack with support for externally provided Diffie-Hellman keys
  - OpenSSL fork available on ETSI git repository with required functionality
- Proof of Concepts using ETSI implementation include
  - Use of ETSI TLS stack to provide web pages over TLS 1.3 to a commercially available browser
  - Secure key distribution of rotating Diffie-Hellman private keys to web server using Venafi Trust Protection Platform
  - Post Capture decryption of web pages using rotating Diffie-Hellman private keys in NETSCOUT nGeniusONE Service Assurance Platform

Packet decode in nGeniusONE

nGeniusONE | All Modules | Data Mining | Device Configuration | ADMINISTRATOR

Packet Decode

Filter - 1 | 11:29:59.207 AM - 11:29:59.337 AM BST | Filtered Packets : 17 | Processed Packets: 358 | Filter Complete

Packet	Absolute Time	Delta Time	Length	Source	Destination	Interpretation	Status
114	11:29:59.207.674.503 AM BST	0.009.965.147	74	10.20.53.134			
116	11:29:59.207.951.268 AM BST	0.000.230.913	74	10.20.53.136			
117	11:29:59.208.010.035 AM BST	0.000.058.767	66	10.20.53.134			

```
PACKET: #126 2020/10/16 10:29:59.329.854.672(UTC); Length=321 byt
ETHERNET: S=[00-50-56-97-56-C4], D=[00-50-56-97-01-2C], EtherType
IP:  S=10.20.53.136 D=10.20.53.134 LEN=287,  ID=38190, Offset=0,
TCP: S=443 D=42086 LEN=255  SEQ=382833516 ACK=2336210776 WIN<<7=3
SSL: v=1.3 Application Data #1
  Record Layer :Application Data
    Content Type = 23 (Application Data)
    Version = 0x303 (TLS1.2)
    Content Length = 250
    Encrypted Application Data Message[250 data bytes]
```

Interpretation	Status
TCP: S=42086 D=443 LEN=0 SYN SEQ=2336210541 WIN=29200	SYN
TCP: S=443 D=42086 LEN=0 SYN SEQ=382831312 ACK=2336210542 WIN=28960	ACK/SYN
TCP: S=42086 D=443 LEN=0 SEQ=2336210542 ACK=382831313 WIN<<7=29312	ACK
SSL: v=1.3 Client Hello	ACK/PSH
TCP: S=443 D=42086 LEN=0 SEQ=382831313 ACK=2336210718 WIN<<7=30080	ACK
SSL: v=1.3 Server Hello, Change Cipher Spec, Application Data #4	ACK/PSH
TCP: S=42086 D=443 LEN=0 SEQ=2336210718 ACK=382833516 WIN<<7=33664	ACK
SSL: v=1.3 Application Data #1	ACK/PSH
SSL: v=1.3 Application Data #1	ACK/PSH
SSL: v=1.3 Application Data #1	ACK/PSH
SSL: v=1.3 Application Data #1	ACK/PSH
SSL: v=1.3 Application Data #1	ACK/PSH
TCP: S=42086 D=443 LEN=0 SEQ=2336210874 ACK=382839121 WIN<<7=49664	ACK
SSL: v=1.3 Application Data #1	ACK/PSH
TCP: S=42086 D=443 LEN=0 FIN SEQ=2336210898 ACK=382839121 WIN<<7=49664	ACK/FIN
TCP: S=443 D=42086 LEN=0 FIN SEQ=382839121 ACK=2336210899 WIN<<7=30080	ACK/FIN
TCP: S=42086 D=443 LEN=0 SEQ=2336210899 ACK=382839122 WIN<<7=49664	ACK

Packet 126 of 17

```
PACKET: #126 2020/10/16 10:29:59.329.854.672(UTC); Length=321 bytes; Captured=321 bytes
ETHERNET: S=[00-50-56-97-56-C4], D=[00-50-56-97-01-2C], EtherType=0x0800
IP:  S=10.20.53.136 D=10.20.53.134 LEN=287,  ID=38190, Offset=0, Proto=TCP;
TCP: S=443 D=42086 LEN=255  SEQ=382833516 ACK=2336210776 WIN<<7=30080
SSL: v=1.3 Application Data #1
  Record Layer :Application Data
    Content Type = 23 (Application Data)
    Version = 0x303 (TLS1.2)
    Content Length = 250
    Encrypted Application Data Message[250 data bytes]
```

EBCDIC

Decryption in nGeniusONE

nGeniusONE | All Modules | Data Mining | Device Configuration | ADMINISTRATOR

Packet Decode

Filter - 1 | 11:29:59.207 AM - 11:29:59.337 AM BST | Filtered Packets : 17 | Processed Packets: 358 | Filter Complete

Packet	Absolute Time	Delta Time	Length	Source	Destination	Interpretation	Status
114	11:29:59.207.674.503 AM BST	0.009.965.147	74	10.20.53.134			
116	11:29:59.207.951.268 AM BST	0.000.230.913	74	10.20.53.136			
117	11:29:59.208.010.035 AM BST	0.000.058.767	66	10.20.53.134			
120	11:29:59.312.555.878 AM BST	0.015.797.120	242	10.20.53.134			
121	11:29:59.312.793.487 AM BST	0.000.237.609	66	10.20.53.136			

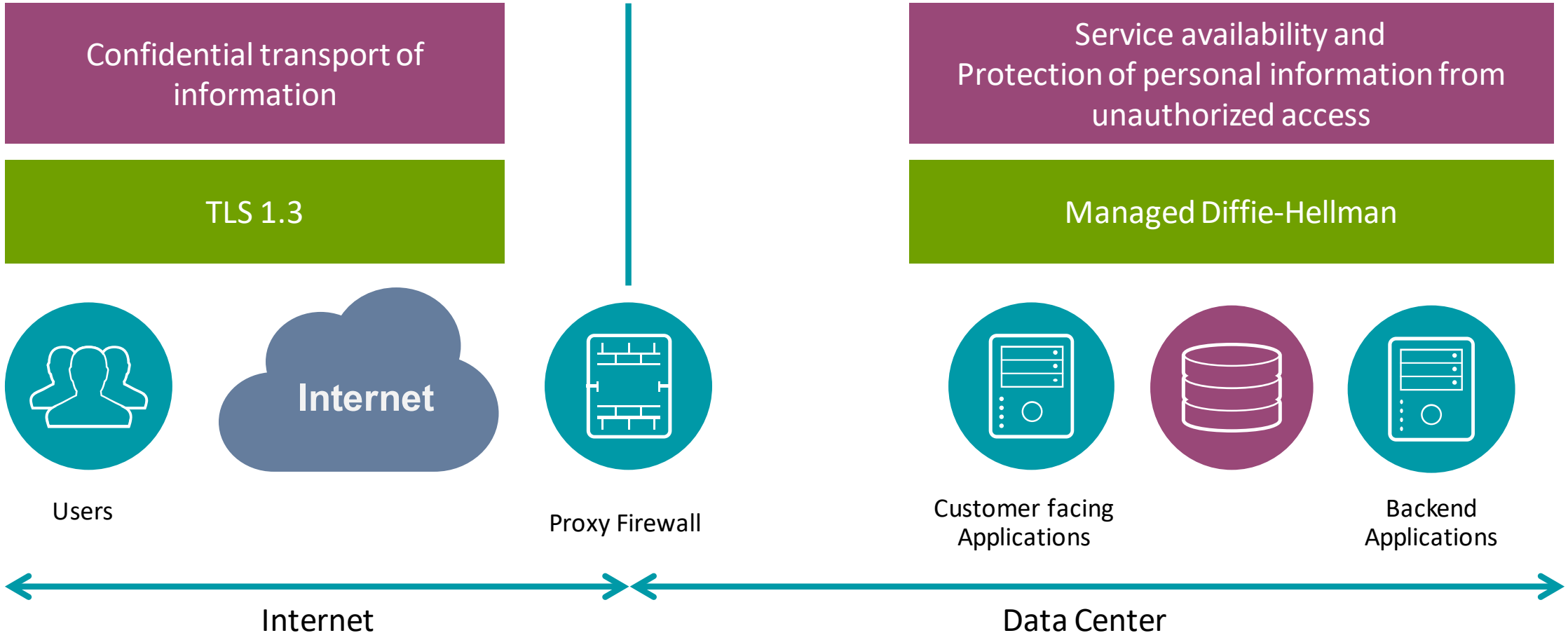
```
PACKET: #129 2020/10/16 10:29:59.330.373.210(UTC); Length=5161 bytes; Ca
ETHERNET: S=[00-50-56-97-56-C4], D=[00-50-56-97-01-2C], Type=802.3
IP:  S=10.20.53.136 D=10.20.53.134 LEN=5105,  ID=5424, Offset=0, Proto=T
TCP: S=80 D=42086 LEN=5073  SEQ=382834026 ACK=2336210852 WIN=235
HTTP: R  HTTP/1.1 Status=OK; 4833 bytes of content
HTML: [HTTP]   R  HTTP/1.1 Status=OK; 4833 bytes of content; !DOCTYPE, h
  DOCTYPE
    HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
    html
      head
        title = Welcome to CentOS
      style
        rel="stylesheet"
        type="text/css"
        style = html {background-image:url(img/html-background.png
      body
        div
```

Interpretation	Status
TCP: S=42086 D=443 LEN=0 SYN SEQ=2336210541 WIN=29200	SYN
TCP: S=443 D=42086 LEN=0 SYN SEQ=382831312 ACK=2336210542 WIN=28960	ACK/SYN
TCP: S=42086 D=443 LEN=0 SEQ=2336210542 ACK=382831313 WIN<<7=29312	ACK
SSL: v=1.3 Client Hello	ACK/PSH
TCP: S=443 D=42086 LEN=0 SEQ=382831313 ACK=2336210718 WIN<<7=30080	ACK
SSL: v=1.3 Server Hello, Change Cipher Spec, Application Data #4	ACK/PSH
TCP: S=42086 D=443 LEN=0 SEQ=2336210718 ACK=382833516 WIN<<7=33664	ACK
SSL: v=1.3 Finished	ACK/PSH
SSL: v=1.3 New Session Ticket	ACK/PSH
SSL: v=1.3 New Session Ticket	ACK/PSH
HTTP: C GET / HTTP/1.1	ACK/PSH
HTML: [HTTP] R HTTP/1.1 Status=OK; 4833 bytes of content; !DOCTYPE, html	ACK/PSH
TCP: S=42086 D=80 LEN=0 SEQ=2336210852 ACK=382839099 WIN=388	ACK
SSL: v=1.3 Alert (Encrypted)	ACK/PSH
TCP: S=42086 D=443 LEN=0 FIN SEQ=2336210898 ACK=382839121 WIN<<7=49664	ACK/FIN
TCP: S=443 D=42086 LEN=0 FIN SEQ=382839121 ACK=2336210899 WIN<<7=30080	ACK/FIN
TCP: S=42086 D=443 LEN=0 SEQ=2336210899 ACK=382839122 WIN<<7=49664	ACK

```
rel="stylesheet"
type="text/css"
style = html {background-image:url(img/html-background.png);background-color: white;font-family: "DejaVu Sans", "Liberation Sans", sans-serif;font-size: 0.85em;line-height: 1.25em;margin: 0 4% 0 4%;}body {border: 10px solid #fff;margin:0;paddin
body
div
```

Encryption in the Data Center

Encryption considerations for the Internet are different from those in the Data Center



Thank you