使用cBR-8、TSDuck和VLC配置DVB-C实验室环境

目录

简介

本文档介绍如何使用TSDuck工具包、VLC和cBR-8配置数字视频广播 — 电缆(DVB-C)实验场景。

先决条件

要求

Cisco 建议您了解以下主题：

- DVB-C
- Symulcrypt
- 视频点播
- cBR-8

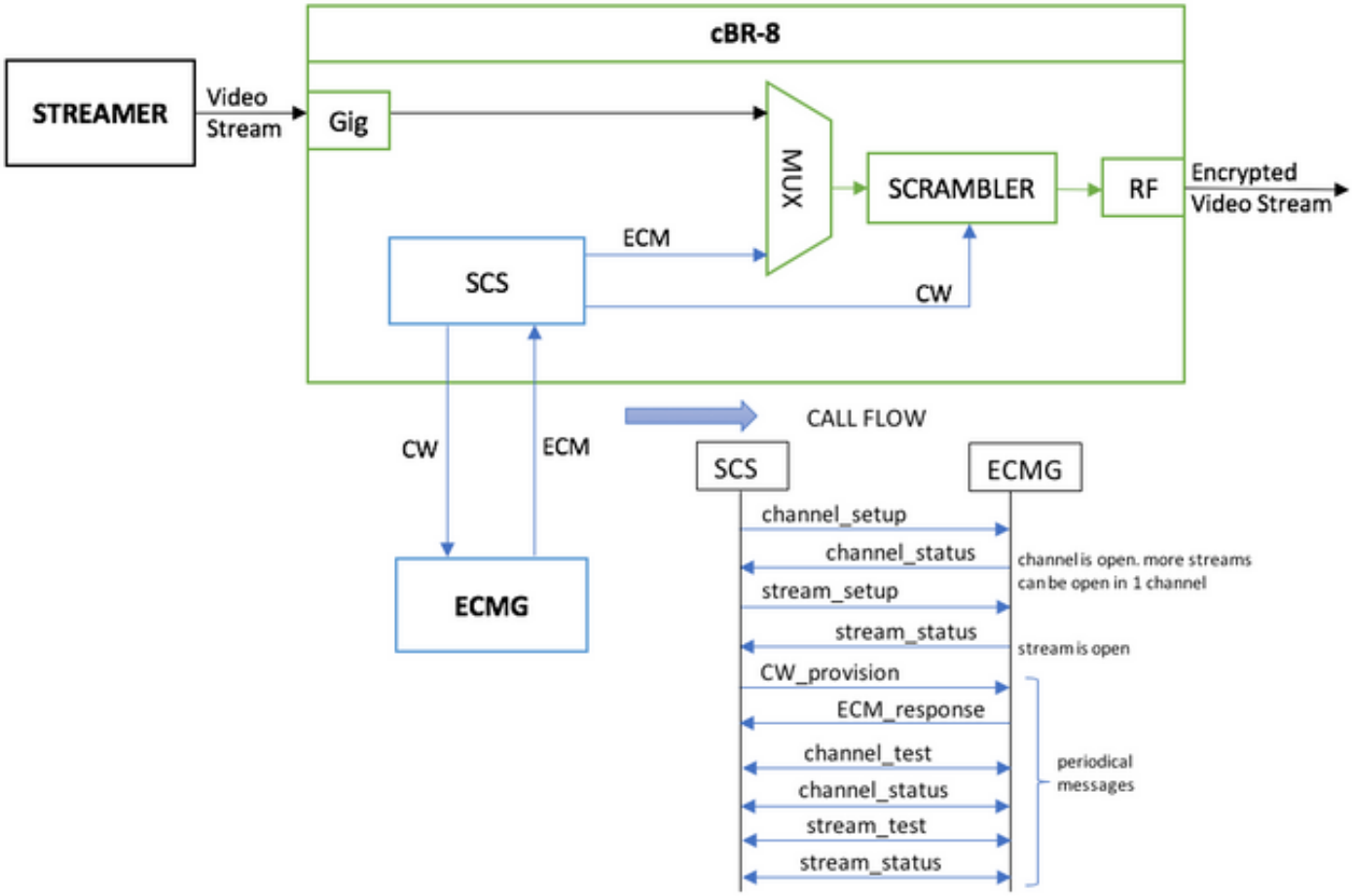
使用的组件

本文档不限于特定的软件和硬件版本。

本文档中的信息都是基于特定实验室环境中的设备编写的。本文档中使用的所有设备最初均采用原始（默认）配置。如果您的网络处于活动状态，请确保您了解所有命令的潜在影响。

背景信息

本文档中介绍的场景（如下图所示）包括cBR-8作为iCMTS、用作带VLC的视频流处理器的Linux虚拟机(VM)和带TSDuck的Linux虚拟机。DVB-Symulcrypt加密系统被重新创建，其中cBR8充当同步器(SCS)，而TSDuck VM充当授权控制消息生成器(ECMG)角色，就像它充当Nagra服务器一样。



充当流处理器的VM只发送本地存储的视频唇，该视频唇为模拟连续流而循环。cBR-8为此模拟配置了一个基于表的（静态）会话，并且没有机顶盒(STB)或调制解调器请求VoD流，它在流处理器上手动启动。

收到流后，cBR-8会尝试与已配置的ECMG服务器通信，以加密视频流，并交换上图中呼叫流中描述的消息。这些消息与TSDuck清除交换，这有助于分析消息和调试的内容。此外，TSDuck对发送的所有请求做出回复，而不检查参数的正确性，如ca-system-id、access-criteria等。

如果cBR-8无法与ECMG通信，则由于指令fail-to-clear，流将以明文形式发送出去。

在实例场景中，需要向STB发送授权管理消息(EMM)，该消息授权接收方解密特定控制字(CW)。EMM可通过cBR-8或通过单独的通道发送到接收器，TSDuck还具有模拟EMM生成器(EMMG)的功能

配置

cBR-8视频会话

以下是如何在cBR-8上配置DVB视频会话的示例。访问标准通常由条件访问系统(CAS)提供，在本模拟例中，您可以生成随机十六进制数以及ca-system-id。

virtual-edge-input-ip是流的IP目标，在本例中，它不是真正的目标，但必须是用于从流处理器发送视频流的相同IP。

```
cable video
  encryption
    linecard 1/0 ca-system dvb scrambler dvb-csa
    dvb
      ecmg NAGRA_ELK id 1
        mode tier-based
        type nagra
        ca-system-id 2775 3
        auto-channel-id
        ecm-pid-source auto 48 8190
        connection id 1 priority 1 10.48.88.12 3337
        overrule
          min-cp-duration 300000
      tier-based
        ecmg name NAGRA_ELK access-criteria c972bfd7701e6d28069ae85f5d701d63ac1aec4a
        fail-to-clear
        enable
  service-distribution-group SDG-ACDC-LAB-TEST1 id 1
    onid 100
    rf-port integrated-cable 1/0/3
  virtual-carrier-group VCG-ACDC-LAB-TEST1 id 1
    encrypt
    service-type narrowcast
    rf-channel 32-35 tsid 42496-42499 output-port-number 1-4
  bind-vcg
    vcg VCG-ACDC-LAB-TEST1 sdg SDG-ACDC-LAB-TEST1
  logical-edge-device LED-ACDC-LAB-TEST1 id 1
    protocol table-based
      virtual-edge-input-ip 10.10.10.10 input-port-number 1
      vcg VCG-ACDC-LAB-TEST1
      active
  table-based
    vcg VCG-ACDC-LAB-TEST1
      rf-channel 32
        session vod1 input-port 1 start-udp-port 65 num-sessions-per-qam 1 processing-type remap
start-program 1
!
controller Integrated-Cable 1/0/3
 max-carrier 44
 base-channel-power 40
 rf-chan 32 35
  type VIDEO
  frequency 850000000
  rf-output NORMAL
  power-adjust 0.0
  qam-profile 3
```

流处理器

在此设备上，您只需从命令行安装VLC，然后启动本地存储的视频文件流。
您可以参阅官方文[档。](#)

安装VLC后，以下命令行显示如何启动名为cisco-tac-lab.mov的文件流，指定cBR-8上的目标IP和端口、tsid和端口，并循环视频以模拟连续流（ — 重复）：

cvlc cisco-tac-lab.mov —sout
'#duplicate{dst=udp{mux=ts，dst=10.10.10:65,tsid=42496,port=65}}' — 重复和

ECMG

从官方网站下载TSDuck:TSDuck，请参阅用户指南文档以安装和查找功能信息。

安装TSDuck后，可以在特定端口(-p)上运行ECMG功能，并使用详细选项(-v)和所需的调试级别(-d#)。

示例：

```
sudo tsecmg -p 3337 -v -d7
```

验证

在cBR-8上

在cBR-8上配置视频会话后，可以验证会话是否已创建，因为这是基于表的配置，会话始终存在，并且不显示输入流：

```
acdc-cbr8-2#show cable video session all

Session    Output Frequency  Streaming   Sess Session Source                  UDP   Output
Input      Output  Input    Output   Encrypt  Encrypt        Low PMV   Session
Id         Port   Hz         Type        Type Ucast Dest IP/Mcast IP (S,G)    Port  Program
State      State   Bitrate  Bitrate  Type     Status         Lat NUM   Name
-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------
1048576    1      850000000  Remap       UDP  10.10.10.10                     65    1       OFF
ON      0        0        DVB      Pending        N   -     vod1.1.0.1.32.65
```

启动视频流后，您会看到该视频流以明文形式发送，如果ECMG尚未启动，则cBR-8上的指令“fail-to-clear”：

```
acdc-cbr8-2#show cable video sess logical-edge-device id 1

Session    Output Frequency  Streaming   Sess Session Source                  UDP   Output
Input      Output  Input    Output   Encrypt  Encrypt        Low PMV   Session
Id         Port   Hz         Type        Type Ucast Dest IP/Mcast IP (S,G)    Port  Program
State      State   Bitrate  Bitrate  Type     Status         Lat NUM   Name
-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------
1048576    1      850000000  Remap       UDP  10.10.10.10                     65    1
ACTIVE-PSI ON      15403951 15164562 DVB      Clear          N   -     vod1.1.0.1.32.65
```

当您也启动ECMG时，您可以看到视频会话现在已加密：

```
acdc-cbr8-2#sh cable video sess logical-edge-device id 1

Session    Output Frequency  Streaming   Sess Session Source                  UDP   Output
Input      Output  Input    Output   Encrypt  Encrypt        Low PMV   Session
Id         Port   Hz         Type        Type Ucast Dest IP/Mcast IP (S,G)    Port  Program
State      State   Bitrate  Bitrate  Type     Status         Lat NUM   Name
-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------
1048576    1      850000000  Remap       UDP  10.10.10.10                     65    1
ACTIVE-PSI ON      15353613 15476997 DVB      Encrypted      N   -     vod1.1.0.1.32.65
```

加密会话的详细信息：

```
acdc-cbr8-2#sh cable video sess logical-edge-device id 1 session-id 1048576
Session Name        : vod1.1.0.1.32.65
Session Id          : 1048576
Creation Time       : Thu Dec  6 14:12:54 2018

Output Port         : 1
TSID                : 42496
ONID                : 100
Number of Sources   : 1
  Destination IP    : 10.10.10.10
  UDP Port          : 65
Config Bitrate      : not specified
Jitter              : 100 ms
Processing Type     : Remap
Stream Rate         : VBR
Program Number      : 1
Idle Timeout        : 2000 msec
Init Timeout        : 2000 msec
Off Timeout         : 60 sec
Encryption Type     : DVB
Encryption Status   : Encrypted

Input Session Stats:
====================
  State: ACTIVE-PSI, Uptime: 0 days 00:31:33
  IP Packets: In 899927, RTP 0, Drop 0
  TP Packets: In 6299489, PCR 6408, PSI 4424, Null 0
              Unreference 2212, Discontinuity 0
  Errors: Sync loss 0, CC error 795, PCR Jump 7,
          Underflow 215, Overflow 4, Block 0
  Bitrate: Measured 16483732 bps, PCR 17930489 bps

Output Session Stats:
=====================
  State: ON, Uptime: 0 days 00:31:33
  TP Packets: In 6297330, PCR 6395, PSI 4416,
              Drop 12801, Forward 6280113, Insert 6029
  Errors: Info Overrun 0, Info Error 0, Block 0, Overdue 54210,
          Invalid Rate 0, Underflow 0, Overflow 0
  Bitrate: Measured 16433824 bps

PAT Info:
=========
  Version 26, TSID 8724, len 16, section 0/0
  Program 1: PMT 32

Input PMT Info:
===============
  Program 1, Version 28, PCR 100, Info len 0
  PID 100: Type 27, Info len 6, (lang eng)

Output PMT Info:
================
  Program 1, Version 5, PCR 49, Info len 6, (CA SYS-ID 10101, PID 79)
  PID 49: Type 27, Info len 6, (lang eng)

Output PID Map:
===============
  PID 32 -> 48
  PID 100 -> 49
```

显示ECMG连接状态的命令：

```
acdc-cbr8-2#show cable video encryption dvb ecmg id 1 connection
-------------------------------------------------------------------------------------------------
-------------------------------------------------
ECMG ECMG                 ECMG     CA Sys     CA Subsys  PID     Lower  Upper  Streams/   Open
Streams/   Auto Chan  Slot  ECMG         ECMG
ID   Name                 Type     ID         ID         Source  limit  limit  ECMG       ECMG
ID              Connections  Application
-------------------------------------------------------------------------------------------------
-------------------------------------------------
1    NAGRA_ELK            nagra    0x2775     0x3        auto    48     8190   1          1
Enabled    RP    1            Tier-Based

ECMG Connections for ECMG ID = 1

-----------------------------------------------------------------
Conn Conn     IP               Port    Channel Conn       Open
-ID  Priority Address          Number  ID      Status     Streams
-----------------------------------------------------------------
1    1        10.48.88.12      3337    1       Open       1
-----------------------------------------------------------------
```

注意：一旦cBR-8接收到ECM，ECM将存储在缓存中，如果与ECMG的连接丢失，则缓存的ECM将用于加密，直到收到新的ECM。

论ECMG

由于启用了调试，您可以看到ECMG和SCS之间交换的所有消息（请参阅初始图中所示的呼叫流）：

```
cisco@simulcrypt:~$ sudo tsecmg -p 3337 -v -d7
debug level set to 7
* Debug: setting socket reuse address to 1
* Debug: binding socket to 0.0.0.0:3337
* Debug: server listen, backlog is 5
* TCP server listening on 0.0.0.0:3337, using ECMG <=> SCS protocol version 2
* Debug: server accepting clients
* Debug: received connection from 88.88.88.89:56102
* Debug: server accepting clients
* 88.88.88.89:56102: 2018/12/06 14:38:35: session started
* Debug: received message from 88.88.88.89:56102
    channel_setup (ECMG<=>SCS)
    protocol_version = 0x02
    message_type = 0x0001
    ECM_channel_id = 0x0001
    Super_CAS_id = 0x27750003

* Debug: sending message to 88.88.88.89:56102
    channel_status (ECMG<=>SCS)
    protocol_version = 0x02
    message_type = 0x0003
    ECM_channel_id = 0x0001
    section_TSpkt_flag = 1
    AC_delay_start = 200
    AC_delay_stop = 200
    delay_start = 200
    delay_stop = 200
    transition_delay_start = -500
    transition_delay_stop = 0
    ECM_rep_period = 100
```

```
    max_streams = 0
    min_CP_duration = 10
    lead_CW = 1
    CW_per_msg = 2
    max_comp_time = 100

* Debug: received message from 88.88.88.89:56102
    stream_setup (ECMG<=>SCS)
    protocol_version = 0x02
    message_type = 0x0101
    ECM_channel_id = 0x0001
    ECM_stream_id = 0x0001
    ECM_id = 0x0001
    nominal_CP_duration = 100

* Debug: sending message to 88.88.88.89:56102
    stream_status (ECMG<=>SCS)
    protocol_version = 0x02
    message_type = 0x0103
    ECM_channel_id = 0x0001
    ECM_stream_id = 0x0001
    ECM_id = 0x0001
    access_criteria_transfer_mode = 0

* Debug: received message from 88.88.88.89:56102
    CW_provision (ECMG<=>SCS)
    protocol_version = 0x02
    message_type = 0x0201
    ECM_channel_id = 0x0001
    ECM_stream_id = 0x0001
    CP_number = 0
    access_criteria (20 bytes) =
        C9 72 BF D7 70 1E 6D 28 06 9A E8 5F 5D 70 1D 63 AC 1A EC 4A
    CP = 0
    CW (8 bytes) = 4E 0A 45 9D DC 10 4A 36
    CP = 1
    CW (8 bytes) = AB FF 00 AA 9C 4F 11 FC

* Debug: sending message to 88.88.88.89:56102
    ECM_response (ECMG<=>SCS)
    protocol_version = 0x02
    message_type = 0x0202
    ECM_channel_id = 0x0001
    ECM_stream_id = 0x0001
    CP_number = 0
    ECM_datagram (188 bytes) =
        47 5F FF 10 00 80 70 35 80 AA 03 00 30 00 10 00 08 4E 0A 45 9D DC
        10 4A 36 00 11 00 08 AB FF 00 AA 9C 4F 11 FC 00 12 00 14 C9 72 BF
        D7 70 1E 6D 28 06 9A E8 5F 5D 70 1D 63 AC 1A EC 4A FF FF FF FF FF
        FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
        FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
        FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
        FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
        FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
        FF FF FF FF FF FF FF FF FF FF FF FF

* Debug: received message from 88.88.88.89:56102
    channel_test (ECMG<=>SCS)
    protocol_version = 0x02
    message_type = 0x0002
    ECM_channel_id = 0x0001

* Debug: sending message to 88.88.88.89:56102
    channel_status (ECMG<=>SCS)
```

```
    protocol_version = 0x02
    message_type = 0x0003
    ECM_channel_id = 0x0001
    section_TSpkt_flag = 1
    AC_delay_start = 200
    AC_delay_stop = 200
    delay_start = 200
    delay_stop = 200
    transition_delay_start = -500
    transition_delay_stop = 0
    ECM_rep_period = 100
    max_streams = 0
    min_CP_duration = 10
    lead_CW = 1
    CW_per_msg = 2
    max_comp_time = 100

* Debug: received message from 88.88.88.89:56102
    stream_test (ECMG<=>SCS)
    protocol_version = 0x02
    message_type = 0x0102
    ECM_channel_id = 0x0001
    ECM_stream_id = 0x0001

* Debug: sending message to 88.88.88.89:56102
    stream_status (ECMG<=>SCS)
    protocol_version = 0x02
    message_type = 0x0103
    ECM_channel_id = 0x0001
    ECM_stream_id = 0x0001
    ECM_id = 0x0001
    access_criteria_transfer_mode = 0
```

故障排除

在cBR-8上，您可以使用设置为调试或噪音级别的相应管理引擎平台跟踪排除加密问题（不要忘记在末尾恢复通知级别）：

```
set platform software trace sup-veman rp active scs debug
```

cBR-8和ECMG之间正确交换消息的过程如下所示：

```
show platform software trace message sup-veman rp active reverse

12/07 15:34:43.963 [scs]: [47872]: (debug): ECMG Send channel_setup for channel_id 1

12/07 15:34:43.965 [scs]: [47872]: (debug): ECMG Received channel_status for channel_id 1

12/07 15:34:43.965 [scs]: [47872]: (info): ECMG Channel 0 setup to ip 10.48.88.12 port 3337

12/07 15:34:43.965 [scs]: [47872]: (debug): Open stream 1

12/07 15:34:43.965 [scs]: [47872]: (debug): ECMG Send stream_setup for channel_id 1, stream_id 1

12/07 15:34:43.965 [scs]: [47872]: (debug): ECMG Received stream_status for channel_id 1,
stream_id 1

12/07 15:34:43.965 [scs]: [47872]: (info): ECMG Stream 1 setup to ip 10.48.88.12 port 3337

12/07 15:34:43.965 [scs]: [47872]: (debug): Request ECM for CP 0
```

```
12/07 15:34:43.965 [scs]: [47872]: (debug): ECMG Send CW_provision with 20 AC bytes for
channel_id 1, stream_id 1

12/07 15:34:43.966 [scs]: [47872]: (debug): Received ECM_response for channel_id 1, stream_id 1

12/07 15:34:43.966 [scs]: [47872]: (debug): ECMGp: Forward ECM pkts to SCS

12/07 15:34:43.966 [scs]: [47872]: (debug): Received ECM for CP 0

12/07 15:34:56.015 [scs]: [47872]: (debug): ECMG Send channel_test for channel_id 1

12/07 15:34:56.016 [scs]: [47872]: (debug): ECMG Received channel_status for channel_id 1

12/07 15:35:18.039 [scs]: [47872]: (debug): ECMG Send stream_test for channel_id 1, stream_id 1

12/07 15:35:18.042 [scs]: [47872]: (debug): ECMG Received stream_status for channel_id 1,
stream_id 1
```

相关信息

- DVB同密技术规范，本文创建时的最新技术规范：ETSI TS 103 197 V1.5.1(2008-10)
- **技术支持和文档 - Cisco Systems**