Working with CobraNet®

Introduction

CobraNet is a reliable and proven technology that enables transport of high quality, real-time digital audio over a standard Ethernet infrastructure.

Note: CobraNet is a technology developed and owned by Cirrus Logic, which sells and/or licenses the technology to third parties. The information contained in this section is subject to change without notice.

CobraNet is an isochronous data delivery system at its core but, Ethernet is not an isochronous data delivery system. Ethernet is a first come, first served, best effort system and will not even guarantee delivery of data. Knowing that, it is easy to see why CobraNet technology represents such an achievement and why certain constraints and operational parameters must be understood in provisioning the Ethernet that CobraNet uses. CobraNet uses Ethernet to perform tasks that Ethernet does not normally do. Therefore, real understanding and proper care are required to ensure consistently good performance.

The primary differences between a CobraNet network and a data network, that an IT professional should note, are as follows:

- Data network traffic is typically *bursty*, whereas CobraNet network traffic is largely consistent.
- CobraNet networks can use far more multicast traffic than normally seen on data networks.
- CobraNet is intolerant of data errors or bandwidth over-subscription that data networks can often tolerate.
- The CobraNet audio protocol itself is strictly layer 2 (Ethernet). It cannot be routed.
- Management functions used by CobraNet are implemented with high-level IP protocols, such as SNMP and TFTP.

介绍

CobraNet 是一种经证明的可靠技术,使得高质量实时的数字音频得以在一个标准以太网架构下传输.

注意:CobraNet 是 Cirrus Logic 开发并拥有的一项技术，出售许可给第三方。这部分的信息如有变更恕不另行通知。

CobraNet 的核心是一种同步的数据传输系统，但是以太网不是一种同步的数据传输系统。Ethernet 先入为主，不会担保数据的传输完整。了解这些后，就容易明白为什么 CobraNet 技术代表这样一个的成就以及为什么必须要理解 CobraNet 所用的 Ethernet 的某些限制和操作参数。CobraNet 使用 Ethernet 来实现正常情况下 Ethernet 不能实现的任务。因此，真正的理解与正确的考虑是必须的，以此确保一贯的优良表现。
IT 专家应该注意到，一个 CobraNet 和一个数据网络最基本的不同在于如下几点：

- 数据网络通信量是典型的突发性的，然而 CobraNet 是持续的大流量通信。
- CobraNet 网络能够使用比已知的数据网络多得多的多路广播通信。
- CobraNet 无法“容忍”数据错误和带宽“超额认购”，然而数据网络能够经常“容忍”。
- CobraNet 音频协议自身是严格的 2 层（Ethernet）。它不能被路由。
- CobraNet 使用高级 IP 协议比如 SNMP、TFTP 来做管理功能。

Connections

- CobraNet must operate on a full-duplex network. Repeater hubs in the network are forbidden. Collisions cannot be tolerated.
- The connection to a CobraNet device is 100 BASETX copper.
- The switch to which it is connected can communicate with other switches by any standard full duplex Ethernet medium, including copper, fiber, 100 Mbit, gigabit and 10 gigabit.
- CobraNet can be successfully bridged over other transport mediums, such as SONET. As long as the end links are IEEE 802.3 compliant and timing constraints are observed, it will work. Timing constraints are covered in the section Timing.
- CobraNet will work with dedicated full-duplex wireless links, such as Tsunami.
- Wi-fi, Powerline and Homeplug are alternative Ethernet technologies that operate in half-duplex mode. CobraNet will not work properly with these technologies. However, a PC connected to the CobraNet network through one of these types of links can properly manage the CobraNet devices using SNMP.
- The connection to a CobraNet device must be able to auto-negotiate the connection type.
- If you are using an optical to copper media converter in the link attached to a CobraNet device, make sure it can bridge auto-negotiation. Not all will do this, although absence of this feature is becoming less common.

Notes:

- Low bandwidth, half-duplex links such as these can be overloaded by the large amount of traffic that can exist on a CobraNet network. These links will support SNMP, but may still not work well due to the bandwidth they are exposed to.
- Although CobraNet requires a 100 BASETX full duplex link, never explicitly set switch ports to operate in this mode. This will disable auto-negotiation on the port and the attached CobraNet device will not work.

连接

- CobraNet 必须操作于全双工的网络。网络中禁止使用中继集线器。不允许冲突。

- CobraNet 设备的连接采用 100 BASETX copper。
- 交换机与它相连的交换机之间通信可以采用任何标准全双工以太网媒介,包括铜线,光纤,100Mbit,gigabit 和 10gigabit。
- CobraNet 可以成功与其他传输媒介桥接,比如同步光纤网(SONET),只要中断连接符合 IEEE802.3，并且可察觉到时序限制,它就能工作。时序限制在时间部分详细叙述。
- CobraNet 可以通过全双工的无线连接工作,比如"海啸"(Tsunami)。
- Wi-fi,动力线路和家庭线路是可选的以半双工模式工作的以太网技术。CobraNet 不能在这些技术下正确地工作。但是，一台通过上述其中一种连接类型连接到 CobraNet 的 PC 能够使用 SNMP 来正确地管理 CobraNet。
- 与 CobraNet 设备的连接必须能够自适应连接类型。
- 如果你在 CobraNet 设备的连接使用了光学转铜介质的转换器，确保它能够自动桥接。并非所有人会这么做，尽管缺乏这个特性变得较不常见。

注意

- 像较窄带宽，半双工之类的连接能够被 CobraNet 中大量的流量引起过载。这些连接支持 SNMP，但是由于它们的带宽，他们可能仍然不能很好的工作。
- 尽管 CobraNet 需要一个 100 BASET 全双工连接，永远不要明确地设置交换机的端口为这个模式。这会使端口失去自动适应的能力，连接的 CobraNet 设备将不能工作。

Traffic

- CobraNet is an IEEE registered protocol that has a protocol number (Ethertype) of 0x8819.
- There are four types of Ethernet frames used by CobraNet that will be seen on the network:
  - *Beat packet* – only sent by a single *Conductor* device.

    Sent 750 times per second (1 1/3 mS); the isochronous cycle.

    The size of the beat packet depends on the number of CobraNet devices and audio bundles in use on the network.

    It can be as small as approx 200 bytes or can be as large as a full frame

    The beat packet is always multicast

    Identified by 0x00 following the Ethertype field.

    Typically, any CobraNet device on the network can become the Conductor.

  - *Reservation packet* – Sent by all CobraNet devices.

Sent every 1 ½ to 8 seconds depending on network size.

Usually small.

The Reservation packet is always multicast.

Identified by 0x01 following the Ethertype field.

- *Audio bundle packet* – Sent by any or all CobraNet devices.

  Can be large or small depending on configuration.

  Each device can send and receive multiple bundle packets every isochronous cycle.

  Can be multicast or unicast depending on configuration.

  Identified by 0x10 following the Ethertype field.

- *Serial bridge packet* – Sent by any or all CobraNet devices.

  Use is optional; will not be seen in all cases.

  Can be multicast or unicast; typically multicast

  Usually smaller frames.

  Use to bridge low data rate asynchronous (RS-232) traffic.

  Identified by 0x20 following the Ethertype field.

- CobraNet also generates and uses other types of traffic:
  - SNMP is used to monitor and configure the device.
  - TFTP is used to update the device's firmware.
  - Packet bridge – The CobraNet device can be used as a NIC by an attached host processor.

    Some products or implementations will use this feature in which case any type of traffic may be seen sent or received by the CobraNet device.

    No more than one bridge packet per device per every 2 isochronous cycles (2 2/3 mS) should be seen sent or received.

- From the above, it can be seen that a CobraNet network will usually contain a finite amount of traffic of known types.
- This traffic can vary widely in makeup between multicast and unicast
- The makeup of the traffic (multicast vs. unicast) will be consistent in an operational installation.
- Total multicast CobraNet traffic on a network can range from less than 1 Mbit/s to all of the traffic that can be supported on the net.
- In a small network, expect to see less than 1 Mbit of multicast beat packets.

- As a general rule, more than four 8 channel multicast bundles on a network will not work. The contractor should be aware of this constraint. If you, as an IT professional, see more than four multicast bundles on the net point this out to the audio contractor and make sure this condition is known and intended. A multicast bundle can be identified by: destination MAC address is multicast, Ethertype = 0x8819, 1st data byte = 0x10.
- In the largest network, expect to see as much as 10 Mbit of multicast beat packets.

  Note: Do not configure a switch to filter multicast traffic. CobraNet depends on multicast traffic.

- A CobraNet device should not require more than 50 Mbits of bandwidth in each direction. Iin most cases, half that bandwidth is typical.
- Links between switches can require far more than 50 Mbits of bandwidth. Use gigabit links between switches. The system contractor can relate what the bandwidth requirements of each link will be. Over-provision between switches to insure good performance and to accommodate future changes.

通信量

- CobraNet 是一个注册的 IEEE 协议，协议号（以太网类型）是 0x8819。
- 在网络中可以看到，CobraNet 使用了 4 种以太网框架：

  - 同步数据包-由单一的 Conductor 设备发送

  每秒发送 750 次（1 1⁄3 mS）；同步周期

  同步数据包的尺寸大小取决于网络中 CobraNet 设备以及使用的音频 bundle 的数量。

  它可以小到大约 200 字节，也可以大到一个完整的帧。

  同步数据包总是多路广播的。

  由以太网字段之后的 0x00 来识别。

  典型地，网络中任何一个 CobraNet 设备都可以成为 Conductor。

  - 预留数据包—所有 CobraNet 设备都发送。

  根据网络大小，每 1 1⁄2 到 8 秒发送一次。

  通常是较小的。

预留数据包总是多路广播的。

由以太网字段之后的 0x01 来识别。

- 音频 bundle 数据包—由某些或者全部的 CobraNet 设备发送。

根据配置，它可大可小。

每个设备都可以在每个同步周期内发送和接受多个 bundle 数据包。

根据配置，可以是多播或单播。

由以太网字段之后的 0x10 来识别。

- 串行桥接数据包—由某些或者全部的 CobraNet 设备发送。

可选的使用；并非所有的情况都使用。

可以是多播或单播；典型的是多播。

通常是较小的帧。

用于桥接低速率同步（RS-232）通信。

由以太网字段之后的 0x20 来识别。

- CobraNet 也可以产生和使用其它类型的通信。
  - SNMP 可用来监视和配置设备。
  - TFTP 可用来更新设备的固件版本。
  - 数据桥 – 附加一个主处理器的 CobraNet 设备可以用作一个网络信息中心（NIC）。

  当 CobraNet 设备需要发送和接受任何类型的通信的情况下，某些产品或者设施会使用这个特性。

  每个设备每 2 个同步周期（2 2/3 mS）内不会产生多于一个的桥接数据包。
- 由以上几点来看，一个 CobraNet 网络中只包含有限定的数据类型通信。
- 这些通信可以广泛地由多播和单播组成。
- 这些通信的组成部分(多播 vs. 单播)将始终是可操作的。

- 网络中总的多播 CobraNet 通信能够从不到 1Mbit/s 到 网络可以支持的所有通信。
- 在一个小的网络中，多播的同步数据包一般小于 1Mbit。
- 作为一般的规定，多于 4 个 8 通道的多播 bundle，网络中就无法工作了。承包商应该意识到有这个约束。如果你作为一个 IT 专业人员，发现多于 4 个多播 bundle，你应该向音频承包商指明，并确信这种情况是已知的并且有意而为的。识别多播 bundle 的方法有：目的 MAC 地址是多个的，以太网协议类型=0x8819 ,第一个数据字节=0x10。
- 在一个大型网络中，多播的同步数据包最多可达 10Mbit。

注意：不可配置交换机来过滤多播通信。CobraNet 依赖于多播通信。

- 一台 CobraNet 设备无需要求每个方向上都多于 50Mbits 的带宽。在大多数情况下，典型值是一半的带宽。
- 交换机之间的连接需要远远多于 50 Mbits 的带宽。在交换机之间使用千兆连接。系统承包商可以叙述每个链接需求的带宽。在交换机之间提供充裕的带宽冗余来确保好的表现，并且适应将来的改变。

Bandwidth allocation

- CobraNet can theoretically share a network with data traffic.
- Provided that the data traffic is predominately unicast and any links shared by CobraNet and the data traffic are provisioned to insure that CobraNet will always have adequate bandwidth, then sharing network infrastructure can work.

  Note: It is very difficult to insure what type of data traffic will exist on a network and it is very difficult to insure enough available bandwidth on all links given the inconsistent and bursty nature of data traffic. For this reason, segregation of data and CobraNet networks is recommended.

- Networks can be segregated by using separate switches for each network.
- Networks can be segregated by using VLANs.
- CobraNet does not support tagged VLANs. Managed switches with port based VLAN capabilities are used to implement a CobraNet VLAN.
- CobraNet VLANs should be given higher priority on shared links between switches.

带宽分配

- 理论上 CobraNet 能够和数据通信共享一个网络。
- 如果数据通信多数是单播的，并且任何与 CobraNet 共享的连接和数据通信都是预分配好的，能确保 CobraNet 始终拥有充足的带宽，那么共享的网络基础设施可以正常工作。

注意：确定一个网络中存在哪些数据通信是比较困难的。考虑到数据通信的不一致和突发性，确保所有连接都拥有足够的带宽也是比较困难的。为此，推荐把数据和 CobraNet 网络进行隔离。

- 可以分别为每个网络使用交换机，以此来分隔不同网络。
- 可以通过划分 VLAN 来分隔网络。
- CobraNet 不支持标记的 VLAN。使用基于交换机端口划分的 VLAN 来实现一个 CobraNet VLAN。
- 在交换机的共享连接中，CobraNet VLAN 应该拥有较高的优先级。

Switches

- Although any 802.3 compliant switch should work with CobraNet, some less expensive switches cannot operate at wire speed or have limited queue buffer sizes and can cause problems when a large amount of traffic exists.
- Some less expensive gigabit switches will not operate at 1 Gigabit if any port is in use at 100 Mbit.
- It is best to avoid bargain switches and use good quality switches from reputable manufacturers.
- We strongly encourage the use of managed switches in larger projects for the following reasons:
    - They can be configured to limit broadcast storms or otherwise throttle the data rate on specific ports. This can be a benefit to CobraNet. Do not limit the bandwidth to less than the CobraNet device needs to operate properly.
    - Port mirroring capability is very useful if debugging is necessary.
    - Statistics logging is very useful if debugging is necessary.
    - Use of VLANs can be very useful in large applications.
    - Link aggregation can be very useful to increase bandwidth between switches and to provide a measure of redundancy.
    - STP, RSTP and MSTP can be used to create fault tolerant topologies.
    - QoS can be implemented to insure that CobraNet has the highest priority.

      CobraNet devices themselves cannot generate or process tagged QOS packets.

      Some protocols, such as VOIP, will also attempt to secure the highest priority. Be sure to consider the types of protocols and priorities that will exist on the network in order to insure that sufficient bandwidth and priorities are in place for CobraNet.

交换机

- 尽管任何兼容 802.3 协议的交换机都应该可以与 CobraNet 协同工作，但是一些便宜的交换机不能在*全线速下操作*或者只有有限大小的序列缓冲区，当通信量较大时可能会出现问题。
- 假如有任何一个端口是在 100Mbit 下使用，某些便宜的千兆网交换机将不能在千兆位操作。
- 最好避免使用廉价交换机，使用那些制造商信誉较好的高质量的交换机。

- 我们强烈建议在较大项目中使用可管理的交换机，理由如下：
  - 它们可以通过配置来限制广播风暴，或者限制特定端口的数据速率。这对 CobraNet 有利。一定不能限制 CobraNet 设备少于正确操作所需求的带宽。
  - 出于调试需求，端口反射能力是非常有用的。
  - 出于调试需求，统计日志是非常有用的。
  - 在大的应用中，使用 VLAN 会非常有用。
  - 链接聚合会非常有用，可以提高交换机之间的带宽，并且提供一个可测量的冗余。
  - STP，RSTP 以及 MSTP 能够被用来创建容错拓扑。
  - 实施 QoS 来确保 CobraNet 有用最高的优先级。

  CobraNet 设备本身不能产生或者处理标记的 QoS 包。

  某些协议，如 VOIP（网络语音电话业务），也会尝试获取最高优先级。一定要考虑存在于网络中的协议类型和优先级类型，确保 CobraNet 拥有足够的带宽以及合适的优先级。

Timing

CobraNet causes a best effort network technology to perform as an isochronous delivery system. In order for this to work, certain timing constraints must be met.

- Every hop a frame takes through a switch introduces forwarding delay.
- This delay is not always consistent.
- CobraNet cannot tolerate large inconsistencies in forwarding delay.
- Total variation of forwarding delay can worsen with each switch hop.
- The maximum forwarding delay that can be tolerated is no more than 3800 uS (3.8 mS) between the network diameter extremes.
- Whatever this delay is, up to the 3800 uS maximum, it must be relatively consistent between any two CobraNet devices and must not vary by more than –0/+250 uS. Occasional violations of this rule can be tolerated; chronic violations will prevent proper operation of the network.
- It has been empirically determined that the forwarding delay variability in typical 100 BASETX switches limits the number of hops to a maximum of six between any two CobraNet devices.
- Use of gigabit links between switches increases the hop limitation due to a reduction in forwarding delay between switches. However, the forwarding delay can still be variable and this variability, as opposed to the average aggregate delay, is the important factor. Therefore, although more hops can be tolerated when they are gigabit hops, it is still wise to limit the number of hops as much as possible. A properly designed network with a balanced hierarchical layout can contain a huge number of end points while still remaining within the six hop guideline. If your network is using more than this number of hops, it would be useful to reexamine and optimize its layout.
- If the contractor chooses to use lower latency CobraNet settings, the number of hops that can be tolerated will be reduced to two or three hops at 2 2⁄3 mS latency (or 10-15 with gig links) and one or two at 1 1⁄3 mS latency. Consult with the system contractor on this issue to determine how CobraNet will be configured.

Note: The above switch hop rules are guidelines only. Different results can be obtained depending on the characteristics of an individual switch and the nature of the traffic on the network.

时钟

CobraNet 网络技术尽可能地表现为一个同步传输系统。为此，某些时间约束条件必须满足。

- 一个框架通过交换机花费的每个跳跃都会引入转发延时。
- 这个延时并非始终如一。
- CobraNet 无法容忍转发延时存在大的不一致。
- 转发延时的总变差会随着交换机的跳跃而恶化。
- 能够允许的最大转发延时是网络直径的极限不能多于 3800 uS (3.8 mS)。
- 不管这个延时是多少，最多 3800 uS，它必须在任何两个 CobraNet 设备之间是相对恒定的，并且一定不能变化多于–0/+250 uS。偶然地违反这个规则是可以接受的，长期的违反规则将会妨碍网络的正确运转。
- 经验表明，在典型的 100 BASETX 交换机中的转发延时在任何两个 CobraNet 设备之间的可变性限制跳跃数最大为 6。
- 在交换机之间使用千兆连接，以增加跳跃限制，这样可以减少交换机之间的转发延时。然而，转发延时依然是可变的，并且这种可变性与平均的总延时相比来说是更重要的因素。因此，尽管较多的千兆位跳跃能够被容忍，尽可能多地限制跳跃的数量仍然是明智的。一个正确设计的网络带有一个平衡的分层设计，能够包含一个巨大的中端点数量，同时保持在 6 个跳跃点之内的指导方针。如果你的网络使用了多于这个数量的跳跃，最好是重新检查并优化它的设计。
- 如果承包商选择使用低延时的 CobraNet 设置，可以容忍的跳跃数量将会减少至 2 到 3 个跳跃在 2 2⁄3 mS 延时（或者 10-15 带千兆位连接）以及 1 到 2 个跳跃在 1 1⁄3 mS 延时。与系统承包商协商这个问题，以决定如何配置 CobraNet。

注意：上面有关交换机跳跃规则仅仅是一些指导。取决于每个交换机的角色以及网络通信的特点，可能会得到不同的结果。

Wiring

Data networks are more tolerant of data errors than CobraNet networks. Typical layer three and above protocols will retransmit and retry unsuccessful transmissions. CobraNet does not do this. By the time a dropped frame is detected, it is too late to retransmit; that isochronous cycle is gone. For this reason it is important to ensure the integrity of the wiring prior to commissioning. Data error rates that may go unnoticed on a typical data network cannot be tolerated on a CobraNet network.

- Make sure all cables are properly terminated.

- Do not use *kinked* cables. If a cable is kinked during installation, do not straighten it out; use a new cable. The sensitive internal wiring twist which influences noise rejection and maximum data rate has been damaged.
- Do not run cables parallel to AC mains lines.
- Do not run cables close to noise sources, such as motors, fans, compressors, dimmer circuits, A/C lines etc..
- If running longer links or in noisy environments, use optical fiber.
- Use Cat 5e or above for copper 100 BASETX links.
- Use Cat 6 for copper gigabit links when copper must be used. Use fiber instead of copper on gigabit links whenever possible. The way in which data is modulated on gigabit copper makes it more sensitive to outside interference. Therefore, when copper gigabit links must be used, pay particular attention to cable routing and insure that the cables are not in proximity to any potential noise or interference sources. A data integrity problem on a gigabit link may go unnoticed on a data network but will cause audio dropouts on a CobraNet network.
- If possible, perform bit error rate tests on each link and correct problems before commissioning.
- Check switch statistics for indications of errors and dropped or malformed frames. Find the root cause and correct it before commissioning.
- Do not exceed the maximum recommended run length of the media in use, i.e. no more than 100 meters for copper Ethernet cables. Fiber run lengths can vary depending on cable and switch manufacturer. Typically lengths of no more than 2 km are recommended for 100 megabit multimode fiber, 600 meters for gigabit and 300 meters for 10 gigabit. Single mode fiber supports much longer runs but is also more expensive and seldom used in LAN applications. Consult the documentation for the particular equipment and wiring used in order to insure maximum lengths are not exceeded.

  Note: A large CobraNet network can sometimes be complex to commission. Make sure the systems contractor only has to focus on his own tasks and does not have data integrity issues to debug as well. Insure that the network is operating as required before handing it over to the contractor.

连线

数据网络的容错能力要比 CobraNet 好。典型地，三层及以上的协议将中继转发重试不成功的发送。CobraNet 不会这么做。在检测到丢弃的帧的时候已经太晚而不能重新发送；同步周期已经过去了。由于这个原因，在试运行之前确保连线的完整，这一点很重要。在数据通信网络中可能被忽略的数据误码率在 CobraNet 网络中无法容忍。

- 确保所有的电缆都被正确地终止。
- 不要使用扭结的电缆。如果一根电缆在安装时被扭结，不要把它矫正；使用一根新的电缆。影响噪声抑制和最大数据速率的内部敏感的双绞线已经被破坏。
- 不要与交流电主线并行布设。
- 不要在与噪声源如电动机、风扇、压缩机、调光电路、交流电线路等 很接近的地方布设电缆。
- 如果距离较长或者环境嘈杂，那么使用光纤。

- 铜介质的 100 BASETX 连接使用 CAT 5e 或者更高规格的电缆。
- 铜介质的千兆位连接必须使用 CAT 6。任何可能情况下，在千兆位连接中使用光纤替代铜。铜介质千兆网的数据调制方式使得它对外界干扰更加敏感。因此，当必须使用铜介质千兆位时，要特别注意电缆路由，并且确保电缆与任何潜在的噪声和干扰源保持一定的距离。在数据网络中，千兆网连接的一个数据完整性问题可能被忽略，但是在 CobraNet 网络中将会引起音频掉包。
- 如果可能，在试运行之前对每个连接执行比特误码率测试并纠正错误。
- 检查交换机统计数据的错误、掉包、畸形帧的指示。在试运行之前找出根本原因并解决问题。
- 不要使用超过推荐的最大介质运行长度值，也就是说，铜介质以太网电缆不能超过 100 米。光纤的运行长度取决于电缆和交换机制造商。典型地，100 兆多模光纤推荐不超过 2km，千兆网的不超过 600 米，10 吉兆网的不超过 300 米。单模光纤支持的距离更长，但是较少用于 LAN 应用。查阅相关设备的文档，以确保连线没有超过最大允许长度。

注意：一个大的 CobraNet 网络有时会比较复杂。确定系统承包商只需要聚焦于他自己的任务，并且也没有数据完整性调试的问题。在移交给承包商之前，确保网络可以按照需求来进行操作。

朱建业
zhujy09@163.com
2011-01-17