Vocia network communications

Vocia hardware is designed to communicate over an Ethernet network. The Vocia hardware will use, to varying degrees, CobraNet® digital audio, raw Ethernet, and TCP/IP protocols for system networking and control. Because it is network bandwidth intensive, Vocia CobraNet traffic should usually be separated from non-Vocia Ethernet communications. When designing or assessing whether existing network infrastructure will be satisfactory for a Vocia system there are specific points to be considered.

Vocia network communications

There are five types of network communications used in a Vocia network:

- Audio over CobraNet (within one world only)
- Control over CobraNet (within one world only)
- VoIP (within one world only)
- Control over TCP/IP (within local world and to other worlds)
- Audio over TCP/IP (between worlds only – recorded live messages and pre-recorded messages between MS-1 devices)

The Vocia software Graphic User Interface (GUI) uses two modes of communication, depending upon the network topology:

- Mode 1—Direct Ethernet connection to a CobraNet network
- Mode 2—An IP-based connection to access a local Vocia world and remote worlds (Universe)

The Vocia GUI will automatically select the correct mode of communication. It will only switch to Mode 2 after an MS-1 is added and given an IP address (Figure 1).

![Figure 1: Different Communication modes used by Vocia software](image-url)
Vocia IP addressing

In general, Vocia CobraNet devices do not require or use IP network address assignment. All data and audio communication between Vocia hardware is performed directly over Ethernet (Layer 2). However, for full-featured operation, three Vocia devices do require IP address assignments—the MS-1, TTS-1 and the LSI-16 devices.

Overview of Audio over Ethernet

In audio and broadcast engineering, Audio over Ethernet (sometimes referred to as AoE) is the use of an Ethernet-based network to distribute real-time digital audio. It is designed to replace bulky snake cables and fixed wiring, and instead use standard Ethernet network structured cabling in a facility, providing a reliable backbone for any audio application, such as for large-scale sound reinforcement in stadiums, airports, convention centers and educational facilities.

While on the surface AoE bears a resemblance to Voice over IP (VoIP), AoE is intended for high-fidelity, low-latency professional audio. Because of the fidelity and latency constraints, audio over Ethernet systems generally do not utilize audio data compression. AoE systems use a much higher bit rate (typically 1.5 Mbit/s or higher per audio channel) and much lower latency (typically less than 5 milliseconds) than VoIP.

Audio over Ethernet requires a high performance network. Performance requirements may be met through use of a dedicated local area network (LAN) or Virtual LAN (Layer 2 VLAN). Such networks can be used over copper or fiber optic cabling to accommodate requirements of existing or new infrastructure.

CobraNet

CobraNet is the Audio over Ethernet protocol used by Vocia. It is transmitted using standard Ethernet packets. Instead of using TCP/IP packets, CobraNet transfers data using data link layer packets (OSI Layer 2), which travel quickly through switches, and are not as susceptible to the latency and Quality of Service (QoS) problems commonly found in streaming protocols using a higher transport layer (i.e. Layer 3 or 4).

However, an important point to remember is that since CobraNet uses Layer 2 technology and not an IP protocol, its packets cannot travel through routers, and therefore it is limited to use on a LAN. Consequently all CobraNet devices are required to be on the same network subnet otherwise they will not communicate with each other.

The network over which CobraNet is transmitted must be able to operate at a minimum of 100 Mbit/s. It is recommended that no Ethernet hubs are used on a CobraNet network; instead Ethernet switches should be used. If a unified physical network is desirable, the Ethernet switches involved should be of the 'managed' type. Managed Ethernet switches offer the ability to segregate CobraNet traffic from other Ethernet traffic by means of VLANs. Also, they may offer Spanning Tree Protocol (STP) which is used for creating redundant network links, as well as trunking to increase network bandwidth between switches. If sharing any trunked links over a VLAN, then the total network bandwidth requirements need to be calculated. Typically it is recommended that trunk ports on a shared network are 1000 Mbit/s. CobraNet audio channels may be unicast (point-to-point) or multicast (broadcast). The channel allocation is dependent on the system configuration.
Vocia and CobraNet

Many people see CobraNet simply as a multi-channel audio transport, and, indeed, virtually all CobraNet-based applications to date have leveraged this capability. Applications that utilize CobraNet as an audio transport typically utilize static network audio routing. Under operator control, these paths are determined for the life of a particular system configuration and may be reconfigured as desired. System integrators rightly enjoy this flexibility – they can reconfigure an entire system and not have to pull a single additional cable. In addition, equipment and applications from multiple vendors can achieve interoperability – audio inputs from a device by Vendor ‘A’ can appear as outputs on a device from Vendor ‘B.’ However, while audio interoperability is achievable, control interoperability is less common and often problematic.

In Vocia, CobraNet is used for audio transmission as well as a foundation for data delivery; it uses a control layer that is designed to communicate routing and configuration requirements between intelligent nodes. A Vocia system establishes audio paths on-the-fly in response to changing user requirements. These intelligent networked devices make optimum use of network bandwidth using dynamic CobraNet channel assignment. While idle, a Vocia system has few predetermined audio paths. When activity is required of the system, participating devices will use the network to communicate the routing requirements amongst themselves and automatically configure the required audio paths. At the conclusion of the activity, the paths are closed down. Audio paths exist only when required and many such audio paths may exist simultaneously, starting and stopping as required. Systems may be very complex, yet the Vocia devices cooperate intelligently to keep the entire system operating smoothly. Network bandwidth is allocated only as needed. This differs from a traditional CobraNet system where bandwidth may be exhausted by excessive simultaneous static audio routes (Figure 2).

Within Vocia, CobraNet traffic is predominantly multicast. With a few exceptions, transmitting devices send on a fixed bundle number, defined as a function of the Vocia device type (e.g. DS-10 Desk Station) and the Device ID. Receiving devices are configured dynamically by the Vocia protocol to receive audio from the applicable bundle for a particular event, but only for the duration of that event. CobraNet audio as used in Vocia make use of a 48kHz sample rate and 20 bits of resolution.

External CobraNet devices

Vocia can be “bridged” to receive and send bundles from non-Vocia devices. Vocia inputs allow multicast bundles to be used as background sources. Vocia outputs utilize a VO-4 that assigns a unicast bundle which can be received by another CobraNet enabled device. The degree to which Vocia’ capabilities can be achieved by non-Vocia devices will depend on the capabilities of those devices. It is possible to place other devices on a Vocia network provided that bundle numbers for these devices are set outside the range of 256 to 59,999. Meaning explicit bundles between other
CobraNet devices must be allocated between bundles 60,000 to 65,279. If using Audia implicit CobraNet bundles, these will not impact Vocia devices as they are in the reserved bundle range above 65,280. Care should be taken with the number of non-Vocia CobraNet devices sharing the network. As other non-vocia CobraNet devices cannot participate in Vocia’s bandwidth optimization, this will therefore compromise the audio and communication bandwidth available to Vocia.

**Vocia inter-world paging**

All inter-world pages are performed between MS-1 Servers. These are transported via TCP/IP (OSI Layer 4). As this data is routable, this allows all the MS-1 devices to communicate amongst each other while residing on different networks, even across WANs. It also gives the ability for remote access for maintenance via the internet. When an inter-world live page is made, the paging station stores the entire page, which is then transmitted over CobraNet to the local MS-1. This message is then packaged and sent using TCP/IP packets to the MS-1 servers assigned to other worlds. Once the page is received by the MS-1 it is played out to the CobraNet network devices in the selected zones in the relevant worlds. Any inter-world recorded pages are stored on the MS-1 in each world and will play as soon as they receive a message to page.

**Ethernet Network topology requirements**

Depending on how and where a Vocia audio system is deployed, the IT infrastructure being used should also cater to the system requirements. A switch configuration used for a shopping precinct may not be required to have the same level of redundancy as a system being used as a life safety system. For further information regarding CobraNet-compliant network topologies and protocols, please refer to [http://www.cobranet.info/support/design/switched_networks](http://www.cobranet.info/support/design/switched_networks).

**Supported network topologies when using Vocia**

**Single world topology (without MS-1)**

The control PC is used to communicate with CobraNet and IP enabled devices via the Vocia Software interface (Figure 3).

![Figure 3: Simple single world topology](image)

**Single world topology (with MS-1)**

The control PC network card is configured on the same IP range as the MS-1. The control PC then communicates with
the MS-1 via the Vocia software. The MS-1 communicates with other Vocia network devices over CobraNet (Figure 4).

**Figure 4: Single world Topology using MS-1**

**Multi-world topology (multiple MS-1)**

The control PC is used to communicate over the IP network to the MS-1 servers via the Vocia Software Interface. The MS-1 servers then communicate with the Vocia CobraNet enabled hardware on the network. The MS-1 servers are used to perform pages between worlds (Figure 5). The Worlds may reside on the same LAN segment or on different LAN / WAN segments. Each World must contain an MS-1.

**Figure 5: Multi-world topology**

**Switches**

Links between switches, and between a switch and CobraNet devices must run in duplex mode.

The CobraNet network should be segregated by using dedicated switches or managed switches using a Virtual Local Area Network (VLAN) feature allowing the switch to be partitioned into non-interacting network domains. Typically, individual ports on the switch are able to be assigned to different network domains.

Fiber Optic connections between switches supported if Switch hardware supports fiber-optic ports.

Fiber media converters can be used to interface fiber-optic cable with standard RJ-45 ports.

Multi-mode fiber shall be usable for distances up to 2,000 meters per link.
Single-mode fiber shall be usable for distances beyond 2,000 meters depending upon the fiber system in use.

Standard switched Ethernet techniques for building higher capacity and highly available networks shall be usable, including Spanning Tree Protocol, Trunking and Quality of Service.

If managed switches are used with Rapid Spanning tree enabled any Switch ports connected to Vocia devices should be set as an Edge port (PortFast) This means the switch port will immediately transitions to the forwarding state when enabled.

Network Topology:

Please review the Vocia Network Topologies for more configuration details. Typically up to three LAN's will be used:

- CobraNet - Layer 2
- Control - MS-1 and TTS-1 Control shared VoIP Network - Layer 3.
- VoIP - MS-1 dedicated VoIP Network - Layer 3.

Without MS-1

Single Layer 2 CobraNet network connecting all Vocia devices in a 'World' and a control PC. The network must be its own closed network or be segregated by using Virtual LAN (VLAN) on a managed switch.

With MS-1

- Network 1 - Control - IP network for Vocia Control to MS-1, Control PC, External Control System. Network must be its own closed network or be segregated by using Virtual LAN (VLAN) on a managed switch.
- Network 2 - CobraNet - Network connecting all Vocia devices in a 'World'. Network must be its own closed network or be segregated by using Virtual LAN (VLAN) on a managed switch.
- Network 3 - VoIP - Network connecting MS-1 VoIP trunk to the facility call manager and proxy.

MS-1 and TTS-1 IP addressing

The computer used for Vocia does not need to be assigned a fixed IP to function with a Vocia system unless an MS-1 is being used. The Vocia MS-1 and TTS-1 do not support DHCP and so will require manual IP assignment, which is performed via the Vocia software interface (see "MS-1 IP Configuration" in the Vocia software Help file). Each MS-1 and TTS-1 must be assigned a unique IP address.

The factory default IP address for all Vocia MS-1 devices is 192.168.1.101 with a subnet of 255.255.255.0

The factory default IP address for all Vocia TTS-1/TTS-1nc devices is 192.168.1.201 with a subnet of 255.255.255.0
CobraNet Network Diameter limits

Due to network delay, Vocia CobraNet has a limitation of 7 'hops' (one-way transmissions) within a 100Mb network. For larger systems the use of Gigabit uplinks between switches will allow more hops.

If Gigabit uplinks are used between switches cabling must be Cat 5e or better.

Vocia CobraNet settings:

All Vocia devices use a factory configured sample rate, latency and bit depth. These are not user configurable.

Sample Rate: 48kHZ

Latency: 5.33ms

Bit depth: 20bits