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## Dante™ Audio to Video Sync in Visionary's AV-over-IP Ecosystem

### Introduction

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The proliferation of Audio-Visual over Internet Protocol (AV-over-IP) technologies has revolutionized the way audio and video content is distributed and managed. In professional and commercial settings, maintaining precise audio-to-video synchronization is critical for delivering a seamless user experience. This white paper explores the mechanisms behind audio-to-video synchronization in an AV-over-IP ecosystem, with a focus on Visionary's PacketAV Duet Endpoints and their integration with Dante audio networking.

### The Importance of Audio-to-Video Synchronization

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Audio-to-video synchronization, often referred to as "lip-sync," is the temporal alignment of audio and video streams. Misalignment can lead to perceptible delays, detracting from the viewing experience and, in professional settings, potentially causing significant issues.

The thresholds for detectable audio-to-video synchronization errors have been carefully studied.

According to the International Telecommunication Union (ITU) Recommendation BT.1359-1, audio can precede video by up to 45 milliseconds, or lag behind video by up to 125 milliseconds before becoming noticeably out of sync.

This standard highlights that the human brain can tolerate minor discrepancies between audio and video. However, AV-over-IP systems must aim to minimize these delays to ensure user satisfaction.

### AV-over-IP Ecosystem Overview

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An AV-over-IP ecosystem leverages network infrastructure to transmit audio and video data packets over standard IP networks. This approach offers scalability, flexibility, and cost-effectiveness compared to traditional point-to-point AV distribution methods. However, it introduces challenges in maintaining synchronization due to network-induced latencies and potential clock drift between audio and video streams.

### Synchronization Mechanisms / Clocking and Latency

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Synchronization in an AV-over-IP system relies on precise clocking mechanisms to ensure that audio and video streams are temporally aligned. Clock drift occurs when independent clocks used by audio and video devices deviate over time, leading to synchronization errors.

- **Audio Clocking** - Audio networks like Dante use Precision Time Protocol (PTP) for clock synchronization across devices, achieving low-latency audio transmission with standard latencies as low as 1 millisecond.
- **Video Clocking** - Video transmission over IP typically involves buffering frames to accommodate network variations, resulting in a fixed latency, commonly set to one frame (approximately 16.67 milliseconds at 60 Hz).

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### Visionary's PacketAV™ Duet Endpoints

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Visionary's PacketAV™ Duet Endpoints integrate both video and Dante audio streams within the same device, each locked to their respective clocks:

- **Video Stream** - The video component operates with a fixed latency of one frame, ensuring consistent timing regardless of network conditions.
- **Audio Stream** - The audio component utilizes Dante's standard latency settings, benefiting from PTP synchronization to maintain low-latency audio transmission.

By locking audio and video to their own stable clocks and ensuring they do not drift relative to each other, Visionary's solution achieves deterministic synchronization between audio and video streams.

### Deterministic Clock Locking

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Deterministic clock locking refers to the ability to predict and maintain a constant time relationship between audio and video clocks. In Visionary's PacketAV™ Duet Endpoints:

- **Independent Clocks** - Both audio and video clocks are stable and free-running, avoiding drift over time.
- **Consistent Latencies** - Fixed latencies for both audio and video streams mean that the temporal relationship remains constant.
- **Threshold Compliance** - The minimal and consistent delay falls well within the +45 / -125 milliseconds detectability threshold defined by ITU standards.

### Benefits of Visionary's Approach

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- **Predictable Performance** - Deterministic clock locking ensures that audio and video remain synchronized over time without the need for complex synchronization mechanisms.
- **Standards Compliance** - By adhering to ITU guidelines, Visionary's solution delivers a viewing experience free from perceptible synchronization errors.
- **Simplified Integration** - The integration of Dante audio and video within the same endpoint simplifies system design and reduces potential points of failure

## Dante™ Audio to Video Sync in Visionary’s AV-over-IP Ecosystem

### Real-World Application: Visionary’s Solution in Action

In practical applications, Visionary’s PacketAV™ Duet endpoints have been successfully deployed in environments such as corporate boardrooms, educational institutions, and large-scale entertainment venues.

The real-world performance consistently demonstrates seamless synchronization between Dante audio and video streams, even over complex IP networks with varying latency conditions.

In these deployments, the deterministic clock locking of audio and video streams allows Visionary’s system to maintain lip sync across a wide range of content types, from live video conferences to high-definition broadcasts.

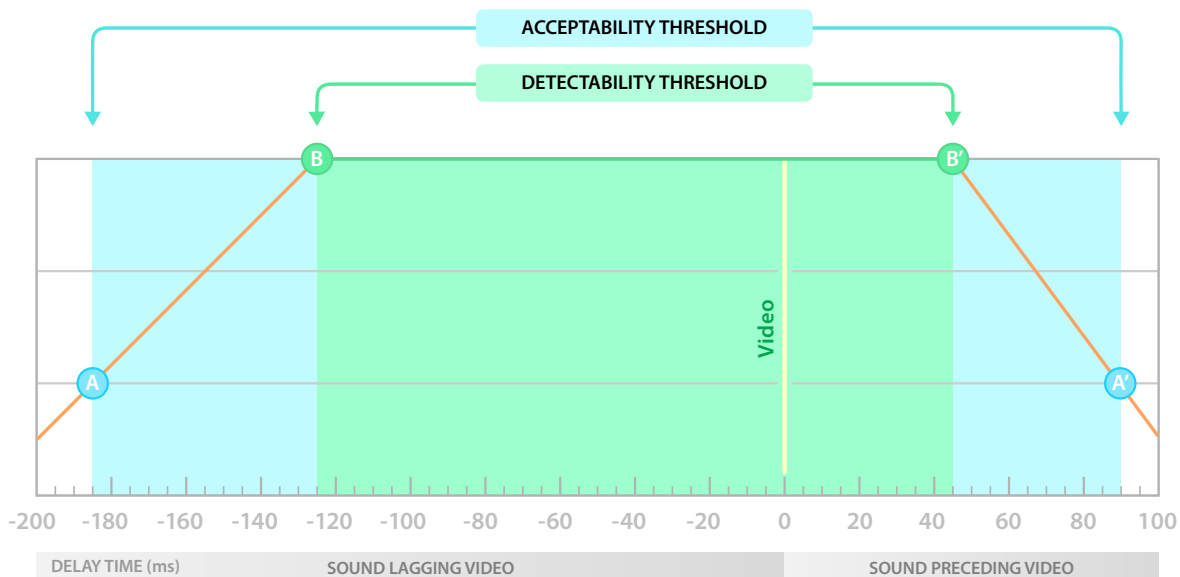
This capability is particularly important in professional AV settings, where the audience’s ability to engage with content depends on smooth, uninterrupted AV performance.

### Conclusion

Maintaining precise audio-to-video synchronization in an AV-over-IP ecosystem is critical for delivering high-quality audiovisual experiences. Visionary’s PacketAV™ Duet Endpoints leverage deterministic clock locking and consistent latencies to ensure that audio and video streams remain synchronized within the perceptual thresholds defined by industry standards.

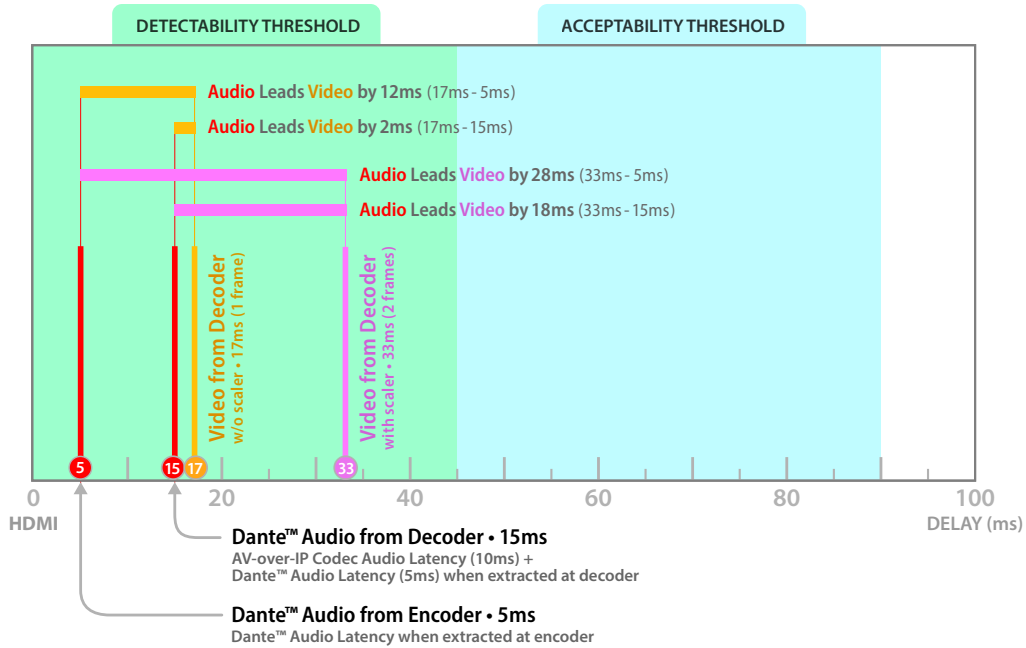
By understanding and implementing these synchronization mechanisms, AV professionals can design and deploy systems that meet the demanding requirements of modern audiovisual applications.

### ITU-R BT.1359-1 • Detectability and Acceptability Thresholds



## Dante™ Audio to Video Sync in Visionary's AV-over-IP Ecosystem

### Dante™ Audio to 60fps Video Synchronization



### Dante™ Audio to 30fps Video Synchronization

