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2: Key Digital Principles

2.1 **Standards**: It is integral to the preservation of audio that the formats, resolutions, carrier and technology systems selected adhere to internationally agreed standards appropriate to the intended archival purposes. Non-standard formats, resolutions and versions may not in the future be included in the preservation pathways that will enable long term access and future format migration.

2.2 **Sampling Rate**: The sampling rate fixes the maximum limit on frequency response.When producing digital copies of analogue material IASA recommends a minimum sampling rate of 48 kHz for any material. However, higher sampling rates are readily available and may be advantageous for many content types. Although the higher sampling rates encode audio outside of the human hearing range, the net effect of higher sampling rate and conversion technology improves the audio quality within the ideal range of human hearing. The unintended and undesirable artefacts in a recording are also part of the sound document, whether they were inherent in the manufacture of the recording or have been subsequently added to the original signal by wear, mishandling or poor storage. Both must be preserved with utmost accuracy. For certain signals and some types of noise, sampling rates in excess of 48 kHz may be advantageous. IASA recommends 96 kHz as a higher sampling rate, though this is intended only as a guide, not an upper limit; however, for most general audio materials the sampling rates described should be adequate. For audio digital-original items, the sampling rate of the storage technology should equal that of the original item.

2.3 **Bit Depth**: The bit depth fixes the dynamic range of an encoded audio event or item. 24 bit audio theoretically encodes a dynamic range that approaches physical limits of listening, though in reality the technical limits of the system is slightly less. 16 bit audio, the CD standard, may be inadequate to capture the dynamic range of many types of material, especially where high level transients are encoded such as the transfer of damaged discs. IASA recommends an encoding rate of at least 24 bit to capture all analogue materials. For audio digital-original items, the bit depth of the storage technology should at least equal that of the original item. It is important that care is taken in recording to ensure that the transfer process takes advantage of the full dynamic range.

2.4 **Analogue to Digital Converters (A/D)**

2.4.1 In converting analogue audio to a digital data stream, the A/D should not colour the audio or add any extra noise. It is the most critical component in the digital preservation pathway. In practice, the A/D converter incorporated in a computer's sound card can not meet the specifications required due to low cost circuitry and the inherent electrical noise in a computer. IASA recommends the use of discrete (stand alone) A/D converters connected via an AES/EBU or S/PDIF interface, IEEE1394 bus-connected (firewire) discrete A/D converters or USB serial interface-connected discrete A/D converters that will convert audio from analogue to digital in accordance with the following specification. All specifications are measured at the digital output of the A/D converter, and are in accordance with Audio Engineering Society standard AES 17-1998 (r2004), IEC 61606-3, and associated standards as identified.

2.4.1.1 **Total Harmonic Distortion + Noise (THD+N)**
With signal 997 Hz at -1 dB FS, the A/D converter THD+N will be less than -105 dB unweighted, -107 dB A-weighted, 20 Hz to 20 kHz bandwidth limited.
With signal 997 Hz at -20 dB FS, the A/D converter THD+N will be less than -95 dB unweighted, -97 dB A-weighted, 20 Hz to 20 kHz bandwidth limited.

2.4.1.2. **Dynamic Range (Signal to Noise)**
The A/D converter will have a dynamic range of not less than 115 dB unweighted, 117 dB A-weighted. (Measured as THD+N relative to 0 dB FS, bandwidth limited 20 Hz to 20 kHz, stimulus signal 997 Hz at -60 dB FS).