ATSC Recommended Practice: A/327:2024-04 Amendment No. 1, "SISO Operation of MIMO-Capable Transmitters"

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Revision History

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1. OVERVIEW

1.1 Definition

An Amendment is generated to document an enhancement, an addition or a deletion of functionality to previously agreed technical provisions in an existing ATSC document. Amendments shall be published as attachments to the original ATSC document. Distribution by ATSC of existing documents shall include any approved Amendments.

1.2 Scope

This Amendment of ATSC A/327 Guidelines for the Physical Layer Protocol is for the purpose of adding description of MIMO / SISO combo operations. Latest changes in A/322 and A/324 for joint MIMO, LDM and Channel Bonding allow for SISO operation to be mixed with MIMO operations. This amendment clarifies that operation.

1.3 Rationale for Changes

Support the modifications being made in A/322 and A/324 to enable joint use of MIMO and SISO that hitherto was proscribed. To clarify such joint use, examples and further description of transmitter connections are provided.

1.4 Compatibility Considerations

The changes described in this document are backwardly compatible relative to the currently published version of the standard to which this Amendment pertains.

2. LIST OF CHANGES

Change instructions are given below in *italics*. Unless otherwise noted, inserted text, tables, and drawings are shown in blue; deletions of existing text are shown in ~~red strikeout~~. The text "[ref]" indicates that a cross reference to a cited referenced document should be inserted. Yellow highlighted references indicate the document editor should insert the appropriate internal document references.

2.1 Change Instructions

Add Section 4.2.22 as follows:

4.2.22 SISO Operation of MIMO-Capable Transmission System

When it is possible to include both SISO and MIMO operation alternately in a single transmitted emission, as provided by A/322 and A/324, it is important to establish the correct signal phasing between the two outputs of a MIMO-capable transmitter and through the following portions of the RF system, including the antenna, during SISO portions of the transmission.

Given the two outputs of a MIMO-capable transmitter, when in SISO operation, either one output (Polarization #2) will be muted, or the two outputs will have identical signals on each. (What follows presumes that the Polarization #2 output is not muted during SISO operation but remains active to enable taking advantage of the power available from the combination of the two

high-power outputs.) It is assumed in the ATSC 3.0 MIMO system design described that the two outputs will feed a pair of passive RF systems (e.g., mask filters and transmission lines) that connect to a pair of antenna inputs that, in turn, produce a pair of cross-polarized radiated signals.

To obtain optimum performance from the MIMO transmitting antenna with its pair of inputs, when operated in SISO mode, the emitted signals must be both time-coincident and in-phase with one another. In such an arrangement, the two radiated signals will add to create a stronger signal for SISO reception, while, if they are out of time or phase, they will subtract one from the other, resulting in effectively weaker signals at receiver inputs.

For maximum benefit from the addition of power from the two transmitted signals, they should be offset in phase from one another by 90 degrees. This will produce a signal rotating in polarization with one rotation for each cycle of the carrier frequency. Depending on which part of the antenna leads in phase and which one lags, the result will be either left-hand or right-hand circular or elliptical polarization. Either can work, but which should be used may be specified in regulations by a national or regional communications authority. If the power in both polarizations is equal, circular polarization will result upon radiation; if they are unequal, elliptical polarization will result. Most important with respect to the direction of rotation is that, if receivers have only single inputs (i.e., they are not capable of MIMO), they can use circular-polarized receiving antennas to improve reception, but the transmitting and receiving antennas must be designed for the same direction of polarization rotation.

It is worth noting that, in MIMO signal delivery, because different data is being sent in the two polarizations, there will be no signal coherence between the two polarizations of the transmission, thus no power gain as in the circularly polarized SISO case. But the benefit of the additional transmitter capacity nevertheless is obtained in MIMO operation either through sending the same data in both polarizations but coded independently, or through sending up to twice as much data as would be sent in a SISO signal.

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