

6G: A New Approach to Increasing Data Throughput

Exploiting Dual-Polarization to go Beyond 100 Gbps to 1 Tbps

6G: A New Approach to Increasing Data Throughput by a Factor of Two

6G aims to be the first generation of wireless technology to improve the quality of human life by bridging the physical, digital, and human worlds. Accomplishing this will mean adding artificial intelligence to networks to make them more efficient and building high-fidelity digital twins. It will also require building upon network architectures like non-terrestrial networks and highly virtualized disaggregated networks that began in 5G and expanding spectrum use.

For 6G to meet these goals, the spectrum allotted for wireless communications must be used more efficiently, and new spectrum must be studied. Without expanding into new spectrum bands, it will be impossible to meet the high data throughput and volume needs of applications like immersive telepresence, virtual reality, and extended reality.

Keysight has previously demonstrated two case studies on achieving high data throughput for 6G: Single-Input Single-Output (SISO) at 285 GHz using a single-carrier waveform with an extreme bandwidth of 30 GHz ¹, and simultaneous 2X2 Multiple-Input Multiple Output (MIMO) with 12.5 GHz bandwidth OFDM waveforms at 142 GHz and 285 GHz ². The SISO Over-the-Air (OTA) transmission achieved approximately 100 Gbps, while the simultaneous 2X2 MIMO OTA transmission achieved approximately 127 Gbps. The SISO case study was transmitted across a room for an over-the-air point-to-point transmission approximately 8 meters (26.5 feet) at 285 GHz using quasi-optic techniques.

This whitepaper reviews existing SISO and MIMO case studies as a baseline in order to present a new approach which builds upon them to double the data throughput per sub-THz link. Orthomode Transducers (OMTs) are used in this new approach to combine two independent vertical and horizontal polarized signals into one dual-polarized signal to double the data throughput relative to a single-polarized transmission. This exploits orthogonal horizontal and vertical polarizations to transmit two independent signals simultaneously on one sub-THz link.

The dual-polarized links are transmitted across a room approximately 8 meters (26.5 feet) using lenses to achieve ~200 Gbps at 285 GHz with two independent single-carrier signals occupying 30 GHz of bandwidth. In addition, the equivalent data throughput of 2X2 MIMO at 142 GHz and 285 GHz is achieved using only one transmit and receive antenna with dual-polarization, doubling the data throughput per sub-THz link.

¹ Early Insights into the 220 to 330 GHz Sub-Terahertz Band. Keysight, 2024

² 6G Sub Terahertz MIMO, Go Beyond 100 Gbps to 1 Tbps. Keysight, 2024

Lenses: Quasi-Optic OTA Transmission

Using Lenses to Collimate the Beam

Both the SISO case study and the dual-polarized beam case studies use lenses to collimate the beam to extend the OTA transmission distances. A brief review of quasi-optic transmission with lenses is presented.

The concept of using lenses for quasi-optic transmission is shown in figure 1. The transmitting source is spaced at a distance Z_0 between the radiating element (feed horn antenna) and the quasi-optical focusing element (lens). A beam waist will occur at distance Z_1 with a narrow beam radius. The receive quasi-optical focusing element (lens) can be spaced up to a distance up to $2 \times Z_1$, where the beam waist is located halfway between the lenses; distances beyond $2 \times Z_1$ will incur increasing loss. A more rigorous description of quasi-optic systems can be found in ¹.

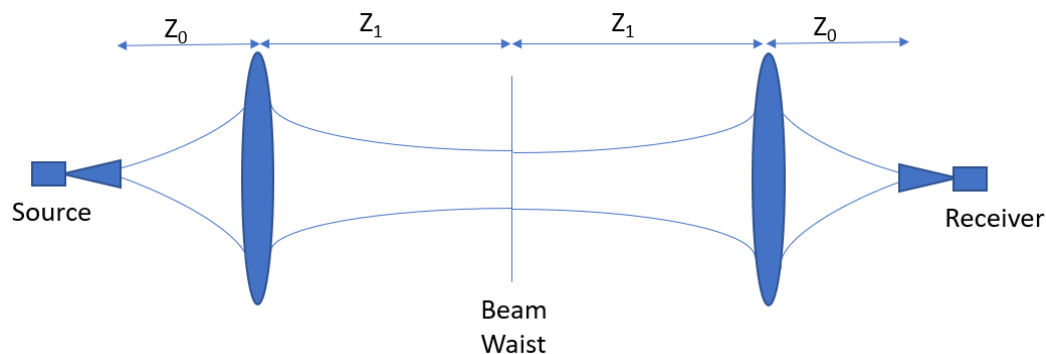


Figure 1. Quasi-optic transmission, assuming the same lenses and feed horns for the source and receiver.

To illustrate the impact of the lens collimating the beam, a simulation was performed using TICRA GRASP. A source antenna with a Gaussian pattern was simulated with and without a lens, and the boresight electric field was evaluated in a planar XY grid at different propagation distances along the Z-axis.

¹ Goldsmith, Paul F. Quasioptical Systems: Gaussian Beam Quasioptical Propagation and Applications. Wiley-IEEE Press, 1998. Paper.

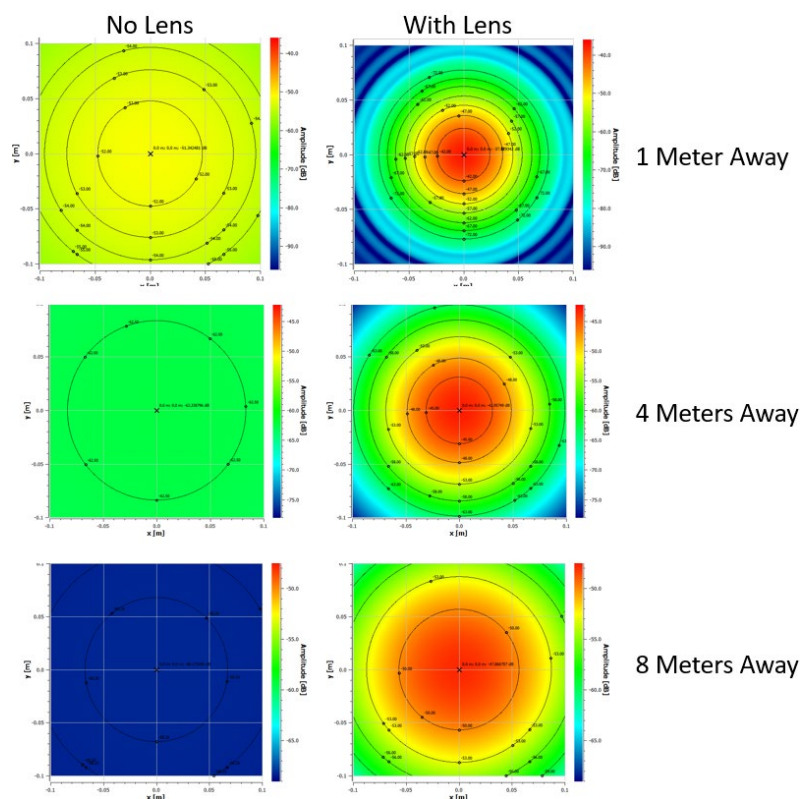


Figure 2. Lens simulation

Figure 2 shows the simulation results without a lens on the left and with a lens on the right at distances of 1, 4, and 8 meters. The signal strength is indicated by the color with red being the highest peak power and blue being the lowest power. The simulation with the lens (right) shows that the highest peak power is contained within a collimated beam radius, whereas the simulation without the lens (left) shows the rapid decrease in power at higher propagation distances due to spherical spreading of the fields from the source antenna.

Baseline Case Study: 285 GHz SISO with 30 GHz Bandwidth OTA 8 meters (26.5 feet), ~100 Gbps

This Single-Input Single-Output (SISO) baseline case study shows a 285 GHz signal being transmitted across a room for an Over-the-Air (OTA) point-to-point transmission approximately 8 meters (26.5 feet) using quasi-optics ¹. The SISO OTA link transmission uses an extreme bandwidth of 30 GHz to achieve approximately 100 Gbps data throughput with a single-polarization.



Figure 3. OTA quasi-optic transmission at 285 GHz with 30 GHz bandwidth, transmit side.

For this experiment, the testbed shown in figure 3 is split between a transmit section and a receive section. The transmit side of the test setup consists of the M8199A AWG to generate a wideband IF signal.

An E8267D PSG signal generator provides a low-phase-noise LO for the [Virginia Diodes Inc. \(VDI\)](#) upconverter. A VDI compact WR3.4 upconverter converts the IF signal from the M8199A AWG to 285 GHz. A 270 GHz high-pass filter rejects the lower undesired image while passing the desired image. The 285 GHz signal is passed through an amplifier then transmitted over-the-air with a diagonal horn antenna.

Fixtures were designed and 3D printed to mount six-inch lenses to a track. A fixture was also designed and 3D printed to mount the VDI converters, with careful consideration to align the center of the diagonal horn antenna with the center of the lens. Horizontal track mounts allow the focal distance to be adjusted between diagonal horn antenna and the lens both on the transmit side as well as the receive side of the test setup.

¹ Early Insights into the 220 to 330 GHz Sub-Terahertz Band. Keysight, 2024

The receive side of the test setup shows the receive lens, followed by a diagonal horn antenna attached to the VDI compact WR3.4 downconverter. The final spacing achieved between the transmit lens and the receive lens was 26.5 feet, or an 8-meter lens-to-lens spacing.

An E8257D PSG analog signal generator provides a low-phase-noise LO for the VDI downconverter. The 285 GHz signal is downconverted to an IF signal, which is amplified by an external IF amplifier. The IF signal is digitized with UXR four channel 110 GHz oscilloscope and demodulated using VSA Flex Frame software.

A laser source is mounted on the receive track, and used for initial alignment of the receive lens with the transmit lens. Power measurements were performed using an N1913PM5B VDI Erickson power meter with the diagonal horn antenna connected to the sensor head.

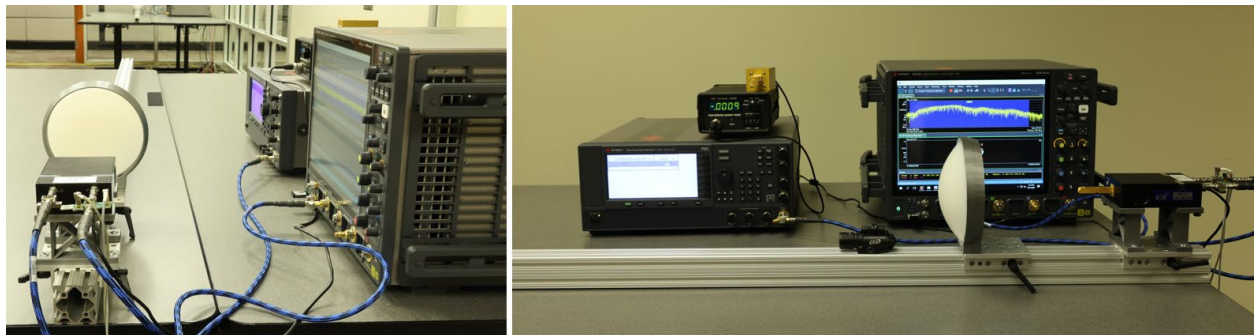


Figure 4. OTA quasi-optic transmission at 285 GHz with 30 GHz bandwidth, receive side.

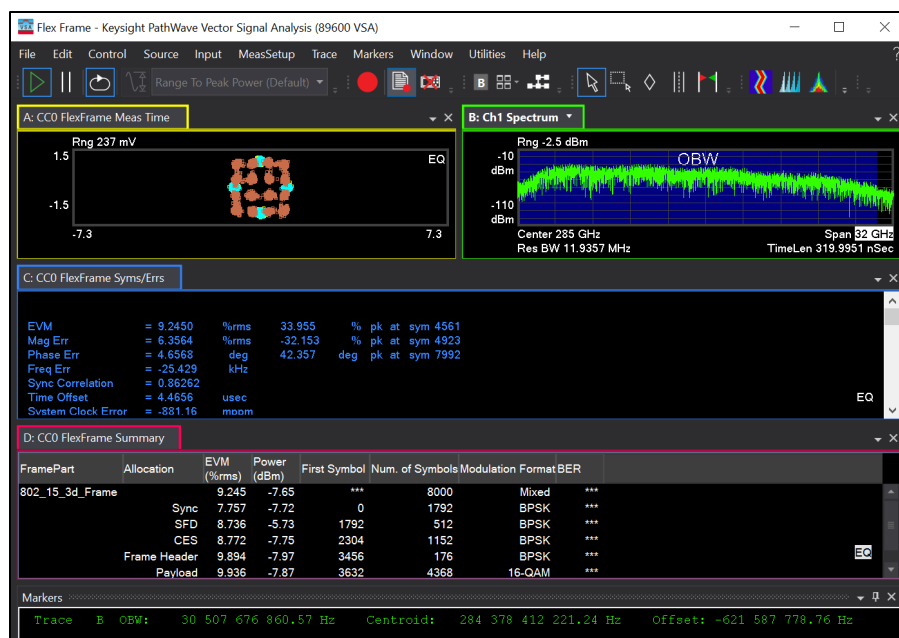


Figure 5. VSA flex frame demodulation results for quasi-optic transmission at 285 GHz with 30 GHz bandwidth across 26.5 feet (8 meters).

The OTA demodulation results using VSA Flex Frame show the measured 16QAM constellation and measured spectrum at 285 GHz on the upper traces. The blue shaded region in the spectrum measures the occupied bandwidth of 30.5 GHz. The middle trace shows the composite EVM measurement of 9.2 %. The lower trace shows the VSA Flex Frame summary for the Sync, SFD, CES, Frame Header, and Data Payload frame part allocations.

VSA Flex Frame software was enhanced to perform a two-pass channel estimation to address these challenging channel scenarios in low SNR environments. The first pass uses pilots and preamble to perform synchronization and an initial estimation of the channel. The second pass adds data payload to perform channel estimation with pilots, preamble, and data payload symbols, minimizing EVM over the specified number of symbols in the result length field.

Changing the number of data payload symbols included in the EVM measurement will impact composite EVM. The Least Means Square (LMS) equalizer attempts to minimize the EVM over the number of symbols specified (8000 symbols for this measurement). Symbols are noisy due to low SNR over the 30 GHz bandwidth, so the LMS equalizer algorithm has an increasingly more difficult estimation process as the number of symbols are increased.

The calculated data throughput for the 285 GHz SISO OTA transmission is shown below.

SISO baseline case study data throughput calculation

- Waveform type: Single-Carrier
- Symbol rate: 25 Gsps
- Bits per symbol: 4 (16QAM)
- Total number of symbols: 127744
- Total number of non-data payload symbols: 3760
 - 1792 Sync
 - 512 SFD
 - 1152 CES
 - 176 Frame Header
 - 128 Idol
- Number of payload symbols: 123984
- Frame length: 5.11 uSec

Throughput = Number of Payload Symbols * Bits/Symbol/Frame Length

Throughput = $123984 * 4 / 5.11 \text{ uSec} = \sim 97.1 \text{ Gbps for 16QAM}$

Additional information and details about the case study can be found at [Early Insights into the 220 to 330 GHz Sub-Terahertz Band](#).

MIMO Baseline Case Study: Simultaneous 2X2 MIMO at 142 GHz and 285 GHz with 12.5 GHz Bandwidth, ~127 Gbps

This second baseline case study shows simultaneous 2X2 Multiple-Input Multiple Output (MIMO) transmission at both 142 GHz and 285 GHz ¹. The simultaneous 2X2 MIMO OTA transmission achieved approximately 127 Gbps.

Figure 6 shows a simultaneous 2X2 MIMO OTA transmission at 142 GHz and 285 GHz with 12.5 GHz bandwidth OFDM signals.

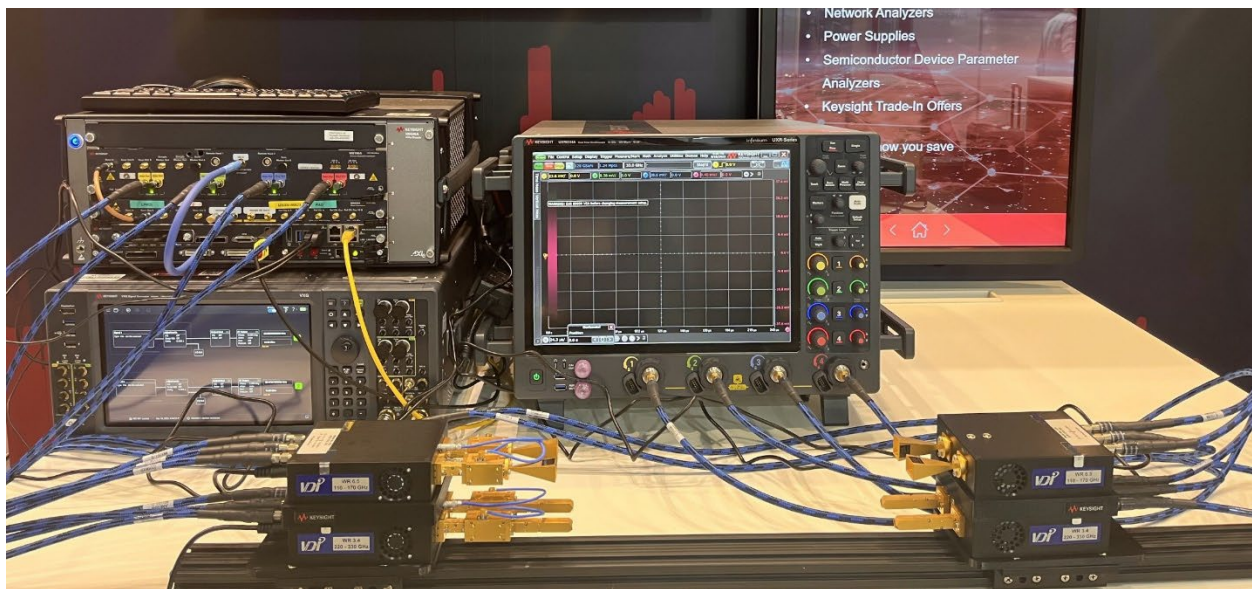


Figure 6. Sub-THz MIMO testbed for 6G research

An M8199A four-channel AWG generates wide-bandwidth modulated IF signals. The four IF signals are input into the VDI WR6.5 dual upconverter inputs (top left) and WR3.4 dual upconverter inputs (bottom left) to upconvert the two 2X2 MIMO signals to 142 GHz and 285 GHz. The 142 GHz and 285 GHz MIMO signals are filtered then amplified with VDI waveguide amplifiers and transmitted Over-the-Air (OTA) with horn antennas.

An M9384B VXG dual-channel microwave signal generator generates two different Local Oscillator (LO) signals for the VDI compact dual upconverters and dual downconverters.

On the receive side the 142 GHz and 285 GHz MIMO signals from the two receive horn antennas are downconverted to four IF signals with the WR6.5 dual downconverter (top right) and WR3.4 dual downconverter (bottom right) and digitized with the 33 GHz UXR four-channel real-time oscilloscope to demodulate and analyze with VSA software.

¹ 6G Sub Terahertz MIMO, Go Beyond 100 Gbps to 1 Tbps. Keysight, 2024

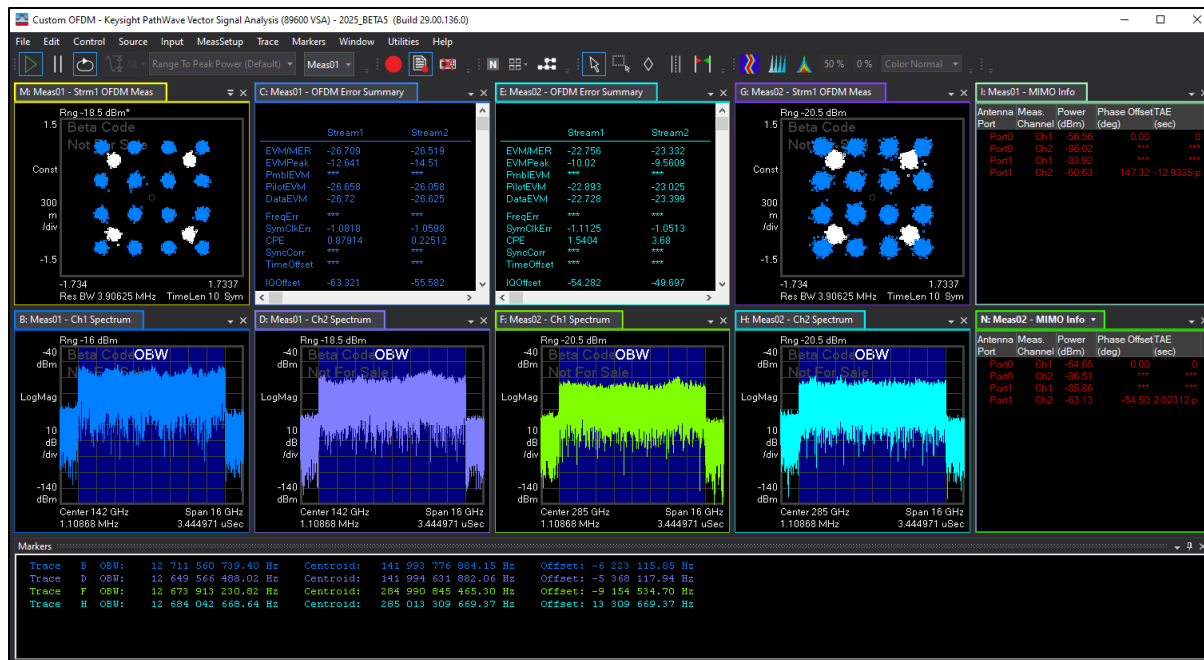


Figure 7. VSA demodulation of custom OFDM MIMO signals

The 142 GHz MIMO demodulation results are shown on the left and the 285 GHz MIMO demodulation results are shown on the right. The 16 QAM constellation and OFDM Error Summary tables are shown on the top row for 142 GHz (left) and 285 GHz (right). The EVM measurements for the OTA transmission of the 2X2 MIMO signals are approximately -26 dB at 142 GHz and -23 dB at 285 GHz. The four spectrum measurements are shown in the middle row for 142 GHz channel 1 and channel 2 (left two spectrums) and 285 GHz channel 1 and channel 2 (right two spectrums). The measured occupied bandwidths of each four spectrum measurements are shown at the bottom of the VSA display. The occupied bandwidths are measured to be approximately 12.5 GHz for each of the four sub-THz signals.

The calculated data throughput for the simultaneous 2X2 MIMO OTA transmission at 142 GHz and 285 GHz are shown below.

MIMO baseline case study data throughput calculation

- Waveform type: Custom OFDM
- Used subcarriers in one OFDM symbol: 3276 (FFT size- lower/upper guard subcarriers)
- 4 bits per subcarrier (16QAM)
- Total data OFDM symbols: 2 (one OFDM symbol for DMRS)
- Data payloads: PN23 and PN15
- Total time length: 826 ns

Throughput = Used Subcarriers/OFDM Symbol * Bits/Subcarrier* Total Data OFDM Symbols/Total Time Length

Throughput = $3276 * 4 * 2 / 826 \text{ ns} = 31.728 \text{ Gbps}$

This is 2-layer MIMO signal, so the total throughput would be ~63.457 Gbps

For simultaneous D-band and H-band the total data throughput across all four channels twice this ~126.915 Gbps

Additional information and details about the case study can be found at [6G Sub Terahertz MIMO: Go Beyond 100 Gbps to 1 Tbps.](#)

New Approach: Double the Data Throughput Per Sub-THz Link with Dual-Polarization

This new case study builds upon the SISO and MIMO baseline case studies and uses dual-polarized links to double the data throughput per sub-THz link. This exploits orthogonal horizontal and vertical polarizations to transmit two independent signals simultaneously on one sub-THz link.

For the SISO baseline case study, the data throughput is doubled to ~200 Gbps using this new approach with two independent single-carrier waveforms and 30 GHz bandwidth.

For the MIMO baseline case study, the equivalent data throughput of 2X2 MIMO at 142 GHz and 285 GHz is achieved with only one transmit and receive antenna using this new approach. This doubles the data throughput per sub-THz link to ~63.5 Gbps with two independent custom-OFDM waveforms and 12.5 GHz bandwidth.

The single-carrier and custom OFDM dual-polarized beams are transmitted across a room approximately 8 meters (26.5 feet) using quasi-optics lens transmission.

Dual-polarized signals are achieved by combining the horizontal and vertical polarized outputs of dual WR6.5 (110-170 GHz) or dual WR3.4 (220-330 GHz) upconverters into a common mode output using Orthomode Transducers (OMTs) and transmitting the dual-polarized beam across the room using a horn antennas and lenses which can support dual-polarized signals. On the receive side, the dual-polarized beams are received by lenses and horn antennas, then split back out into horizontal and vertical polarized signals with OMTs into dual WR6.5 (110-170 GHz) or dual WR3.4 (220-330 GHz) downconverter inputs.

WR6.5 and WR3.4 OMTs developed by [Micro Harmonics Corporation](#) are used to combine the vertical and horizontal polarized signals into a single dual-polarized signal.

[Orthomode Transducers](#) (OMTs), also known as polarization duplexers, are waveguide components that combine or separate two orthogonally polarized signals. OMTs have three waveguide ports. Two of the ports support a single propagating mode, typically the TE₁₀ mode in rectangular waveguide. The third port, often referred to as the common mode port or antenna port, supports two orthogonal propagating modes. The common mode waveguide can have a square cross-section or a circular cross-section.

There are several important characteristics to consider when evaluating OMTs. Low insertion loss is important since the common port of the OMT is often attached directly to an antenna, placing the OMT in front of the first low noise amplifier. Another important OMT parameter is high isolation. In an OMT, isolation refers to the amount of signal that is coupled from one of the single mode ports to the other single mode port. The Micro Harmonics WR3.4 millimeter-wave OMT exhibits insertion loss less than 0.8 dB and isolation greater than 45 dB.

Low cross-polarization coupling is another important OMT characteristic. The purpose of the OMT is to direct one of the polarizations in the common mode port to one of the single mode ports and direct the other polarization in the common port to the other single mode port. Cross-polarization coupling refers to the amount of signal that gets coupled to the wrong port. The Micro Harmonics WR3.4 OMT exhibits cross-polarization coupling of less than -35 dB.

The WR6.5 and WR3.4 setups are modified as shown in figure 8 to connect the dual-polarized outputs and inputs of the VDI dual converters to Micro Harmonics OMTs. The WR3.4 setup is shown on top, and the WR6.5 setup is shown on the bottom.

For the WR3.4 transmit (Tx) setup, the vertical polarized OMT input (rectangular port) is directly connected to the RF 1 waveguide output path from the VDI converter, filter, and amplifier. The horizontal polarized OMT input port is connected to the RF2 waveguide path from the VDI converter, filter, and amplifier using a custom waveguide bend.

For the WR6.5 transmit (Tx) setup, the vertical polarized OMT input (rectangular port) is directly connected to the RF 1 waveguide output path from the VDI converter, filter, and amplifier. The horizontal polarized OMT input port is connected to the RF2 waveguide path from the VDI converter, filter, and amplifier using flexible waveguide (which resembles a black coaxial cable).

Horn antennas which can support both horizontal and vertical polarization are connected to the OMT common mode output ports on the Tx side to transmit the dual-polarized beams.

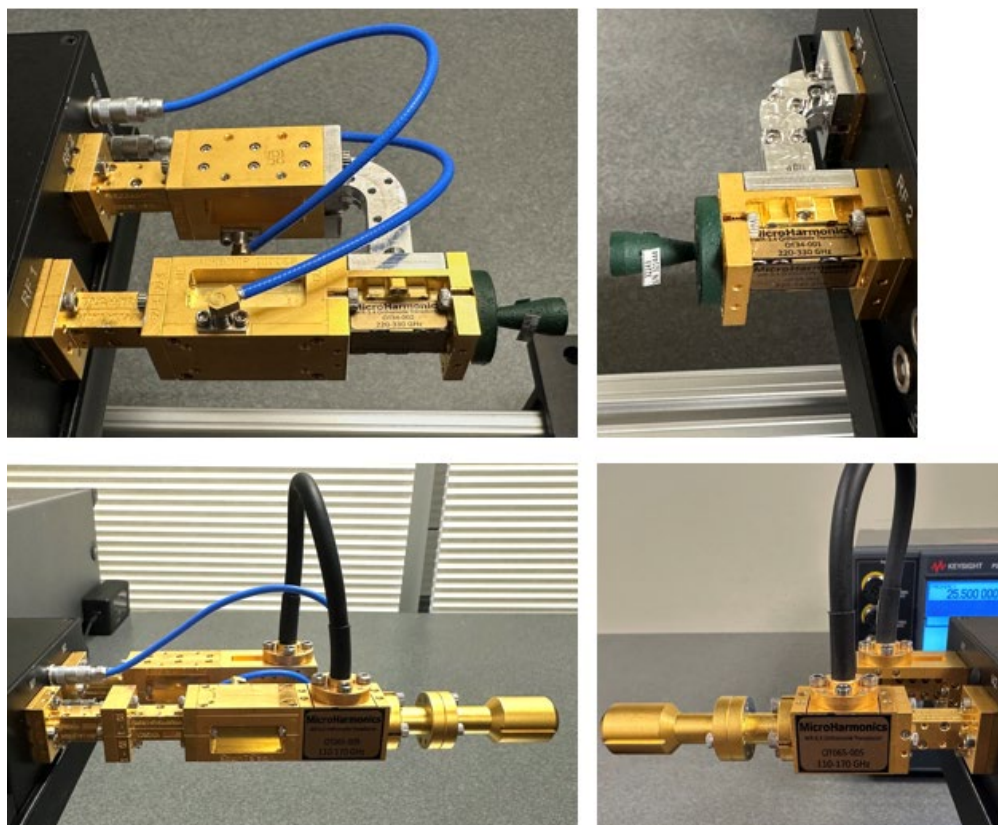


Figure 8. Close-ups of WR3.4 (top) and WR6.5 (bottom) VDI dual converters, filters, amps, and Micro Harmonics OMTs.

On the receive (Rx) side, horn antennas which can support both horizontal and vertical polarization are connected to the WR6.5 and WR3.4 OMT common mode input ports to receive the dual-polarized beam. The OMT horizontal and vertical output ports (rectangular ports) are connected to the RF 1 and RF 2 waveguide horizontal and vertical inputs for the dual WR6.5 and WR3.4 VDI converters.

The lenses from the SISO setup in figures 3 and 4 were re-used for these experiments. Fixtures were designed and 3D printed to mount the lenses to a track, with careful consideration to align the center of the WR6.5 and WR3.4 horn antennas concentrically with the center of the lenses. Horizontal track mounts allow the focal distance to be adjusted between the horn antenna and the lens both on the transmit side as well as the receive side of the test setup.

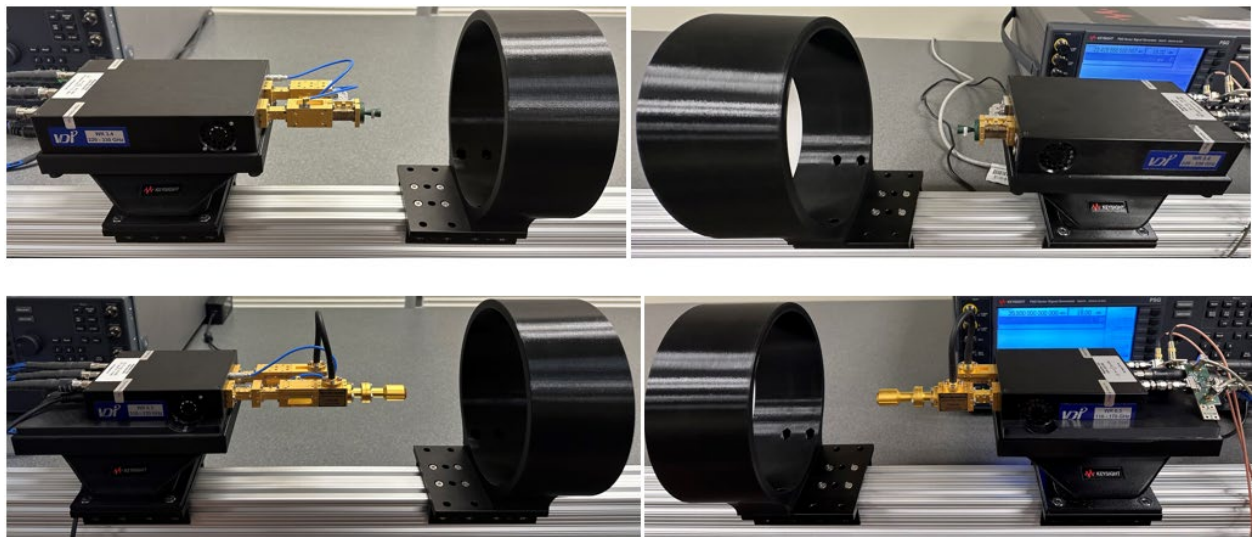


Figure 9. WR3.4 (top) and WR6.5 (bottom) VDI dual converters, Micro Harmonics OMTs, and lenses.

Experiments were performed both at 142 GHz using the WR6.5 setup and 285 GHz using the WR3.4 setup, but only pictures of the 285 GHz WR3.4 setup are shown in figures 10 and 11 for brevity.

On the Tx side, an M8198A two-channel AWG generates wide-bandwidth modulated IF signals. The M8198A AWG offers enhanced playback memory depth over the M8199A AWG used in the previous case studies. A PSG is used to provide the low-phase-noise LO for the VDI dual upconverter. The IF signals are upconverted to either 142 GHz or 285 GHz, and the two outputs of the dual VDI converters are combined into one single dual-polarized signal with the Micro Harmonics OMT. The OMT's common mode output signals are transmitted with the horn antennas, then the dual-polarized beams (either 142 GHz or 285 GHz) are collimated with the Tx lens.

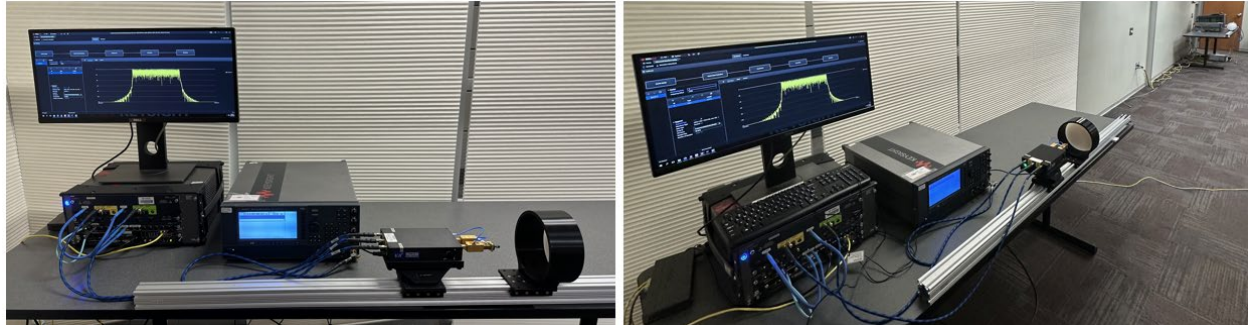


Figure 10. Quasi-optic OTA transmission of a dual-polarized links at 142 GHz or 285 GHz (shown here), transmit side.

The Tx and Rx lenses are separated by 8 meters (26.5 feet) lens-to-lens spacing. The lenses were initially aligned with a laser, then by measuring a CW signal and maximizing the signal peak. Additional lens alignments were performed during demodulation process to achieve optimal EVM.

On the Rx side, the dual-polarized beams (either 142 GHz or 285 GHz) are received by the Rx lens and horn antennas which are connected to the Micro Harmonics OMT common mode input port. The OMT horizontal and vertical rectangular waveguide outputs are fed into the VDI dual downconverter inputs. The VDI IF output signals are amplified with external IF amplifiers then input into two channels of a four channel 110 GHz UXR oscilloscope to digitize and demodulate the signal with VSA software.

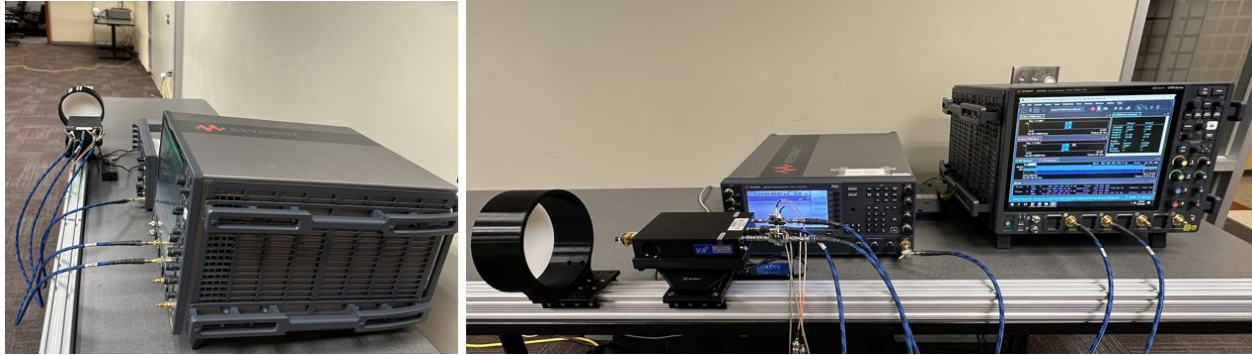


Figure 11. Quasi-optic OTA transmission of a dual-polarized links at 142 GHz or 285 GHz (shown here), receive side.

New Case Study- Double the Data Throughput Per Sub-THz Link Using 12.5 GHz Bandwidth OFDM, ~63.5 Gbps per Link

Instead of transmitting and receiving multiple independent streams of data with multiple transmit/receive antennas as shown in the MIMO baseline case study, OMTs are used to transmit two independent dual-polarized signals simultaneously with one transmit and receive antenna to double the data throughput per sub-THz link.

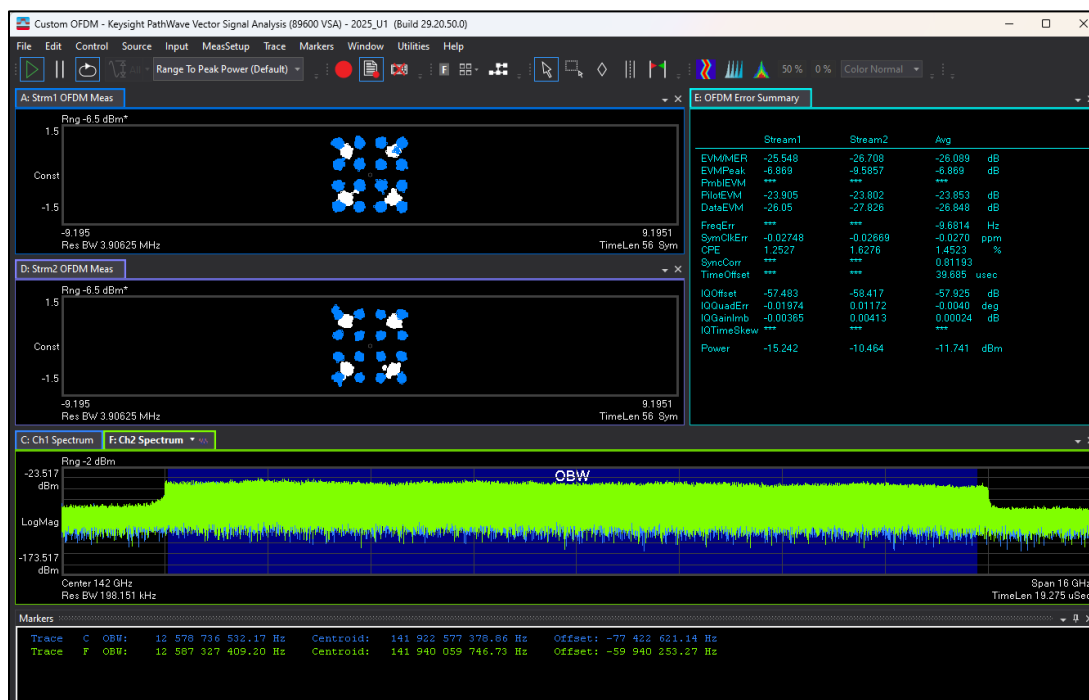


Figure 12. VSA demodulation of quasi-optic OTA transmission of a dual-polarized link at 142 GHz.

The demodulation results are shown for the quasi-optic OTA transmissions of the dual-polarized link at 142 GHz. Stream 1 is the vertical polarized signal and stream 2 is the horizontal polarized signal. The two 16 QAM constellations and OFDM Error Summary table are shown on the top rows. The EVM measurements for the OTA transmission of the 142 GHz dual-polarized link across 8 meters (26.5 feet) is approximately -26 dB. The two spectrum measurements are shown in the middle row. The occupied bandwidths are measured at the bottom of the VSA display to be approximately 12.5 GHz for each of the sub-THz signals.

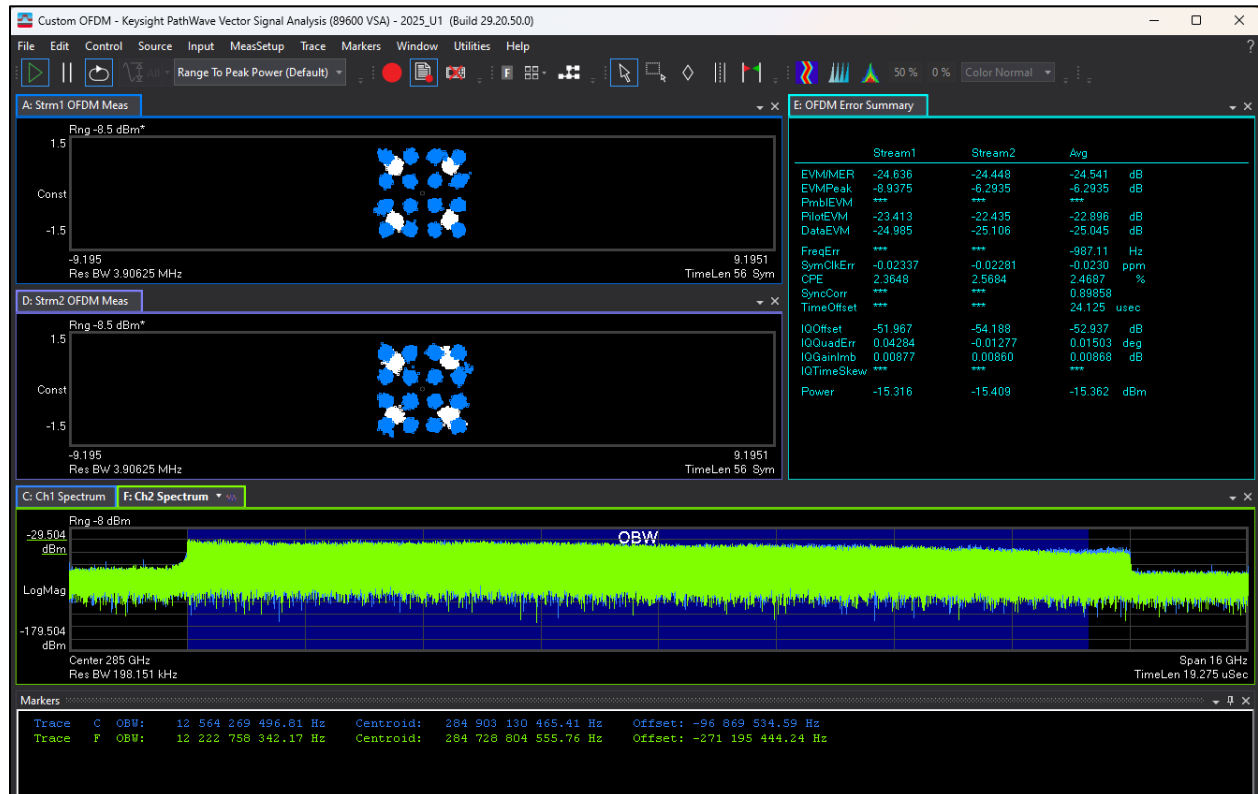


Figure 13. VSA demodulation of quasi-optic OTA transmission of a dual-polarized link at 285 GHz with two custom OFDM 12.5 GHz bandwidth waveforms.

The demodulation results are shown for the quasi-optic OTA transmissions of the dual-polarized link at 285 GHz. Stream 1 is the vertical polarized signal and stream 2 is the horizontal polarized signal. The two 16 QAM constellations and OFDM Error Summary table are shown on the top rows. The EVM measurement for the OTA transmission of the 285 GHz dual-polarized link across 8 meters (26.5 feet) is approximately -24 dB. The two spectrum measurements are shown in the middle row. The occupied bandwidths are measured at the bottom of the VSA display to be approximately 12.5 GHz for each of the sub-THz signals.

The calculated data throughput for the 142 GHz or 285 GHz dual-polarized OTA transmissions with two custom OFDM Waveforms are shown below.

Dual polarized 142 GHz or 285 GHz link throughput calculation with two custom OFDM 12.5 GHz bandwidth waveforms

- Waveform type: Custom OFDM
- Used subcarriers in one OFDM symbol: 3276 (FFT size- lower/upper guard subcarriers)
- 4 bits per subcarrier (16QAM)
- Total data OFDM symbols: 2 (one OFDM symbol for DMRS)
- Data payloads: PN23 and PN15
- Total time length: 826 ns

Throughput = Used Subcarriers/OFDM Symbol * Bits/Subcarrier* Total Data OFDM Symbols/Total Time Length

Previous Baseline Single-Polarization Throughput per Sub-THz Link = $3276 * 4 * 2 / 826 \text{ ns}$
= 31.728 Gbps.

**New Dual-Polarization Throughput per Sub-THz Link = $2 * 31.728 \text{ Gbps} = 63.457 \text{ Gbps}$,
or 126.915 Gbps Total for Two Sub-THz Links if Transmitting D-Band and H-Band
simultaneously**

New Case Study- Double the Data Throughput for the 285 GHz Link Using 30 GHz Bandwidth Single-Carrier, ~200 Gbps

Instead of transmitting a single-polarized signal for the SISO baseline case study, OMTs are used to transmit two independent dual-polarized signals simultaneously with one transmit and receive antenna to double the data throughput from 100 Gbps to 200 Gbps.

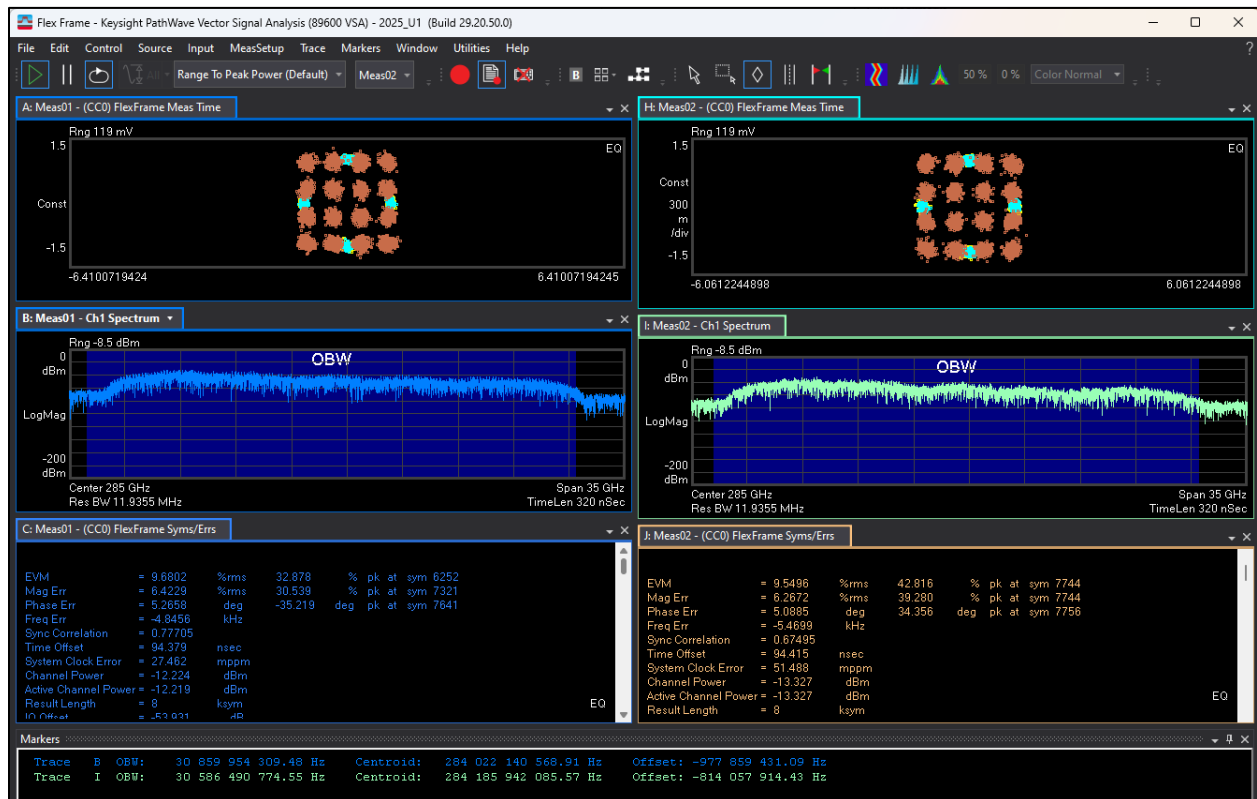


Figure 14. VSA demodulation of quasi-optic OTA transmission of a dual-polarized link at 285 GHz using two independent single-carrier 30 GHz bandwidth waveforms.

The OTA demodulation results using VSA Flex Frame show the two polarized signals- the vertical polarized signal is on the left and the horizontal polarized signal is on the right. The measured 16QAM constellations are shown on the upper traces. The measured spectrums at 285 GHz are shown on the middle traces. The blue shaded region in the spectrum measures the occupied bandwidths of approximately 30.5 GHz shown at the bottom. The tables below the spectrums show the composite EVM measurements of approximately 9.6%.

The calculated data throughput for the 285 GHz dual-polarized OTA transmission with two independent single-carrier waveforms are shown below.

Dual polarized 285 GHz link throughput calculation with two 30 GHz bandwidth single-carrier waveforms

- Waveform type: Single-Carrier
- Symbol rate: 25 Gsps
- Bits per symbol: 4 (16QAM)
- Total number of symbols: 127744
- Total number of non-data payload symbols: 3760
 - 1792 Sync
 - 512 SFD
 - 1152 CES
 - 176 Frame Header
 - 128 Idol
- Data payloads: PN9 and PN23
- Number of payload symbols: 123984
- Frame length: 5.11 uSec

Previous Baseline Single Polarization Throughput = Number of Payload Symbols *
Bits/Symbol/Frame Length = $123984 * 4 / 5.11 \text{ uSec} = \sim 97.1 \text{ Gbps}$ for 16QAM

New Dual-Polarization Throughput = $2 * 97.1 \text{ Gbps} = 194.2 \text{ Gbps}$

Key Findings

For the dual-polarized link at 142 GHz and 285 GHz using two 12.5 GHz bandwidth custom OFDM waveforms (previously 2X2 MIMO), the isolation between the OMT horizontal and vertical polarizations and horn antennas exceeded the requirements to maintain the EVM performance as previously measured for the 2X2 MIMO approach without an OMT and using separate horn antennas. EVM was improved at 285 GHz for this new case study due to enhancements made to the VDI WR3.4 amplifiers.

Furthermore, the EVM measurements for the quasi-optic transmission with the horn antennas and lenses across 8 meters (26.5 feet) were not significantly different than the 2X2 MIMO transmission over a short distance with separate horn antennas, indicating that the lenses maintain the dual-polarization characteristics.

For the dual-polarized link at 285 GHz using two 30 GHz bandwidth single-carrier waveforms (previously SISO with a single-polarization), the isolation between the OMT horizontal and vertical polarizations exceeded the requirements to double the data throughput from ~100 Gbps to ~200 Gbps. However, a slight amount of crosstalk between the two polarizations was observed. Crosstalk can be caused by OMTs, horn antennas, and possibly mis-alignment.

Conclusion

This whitepaper reviewed existing SISO and MIMO case studies as a baseline in order to present a new approach which builds upon them to double the data throughput per sub-THz link. The previous baseline approaches were (1) 285 GHz SISO using 30 GHz single-carrier waveforms to achieve approximately 100 Gbps, and (2) Simultaneous MIMO at 142 GHz and 285 GHz using 12.5 GHz custom OFDM waveforms to achieve approximately 127 Gbps.

A new approach was introduced to double the data throughput per sub-THz link by transmitting two independent signals simultaneously on one dual-polarized sub-THz link using OMTs.

For the new 285 GHz SISO single-carrier case study, the data throughput was doubled from ~100 Gbps to ~200 Gbps. For the new OFDM case studies at 142 GHz and 285 GHz, the equivalent data throughput of 2X2 MIMO is achieved using only one transmit and receive antenna with dual-polarization, doubling the data throughput per sub-THz link.

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