ANTENNA COMPANY

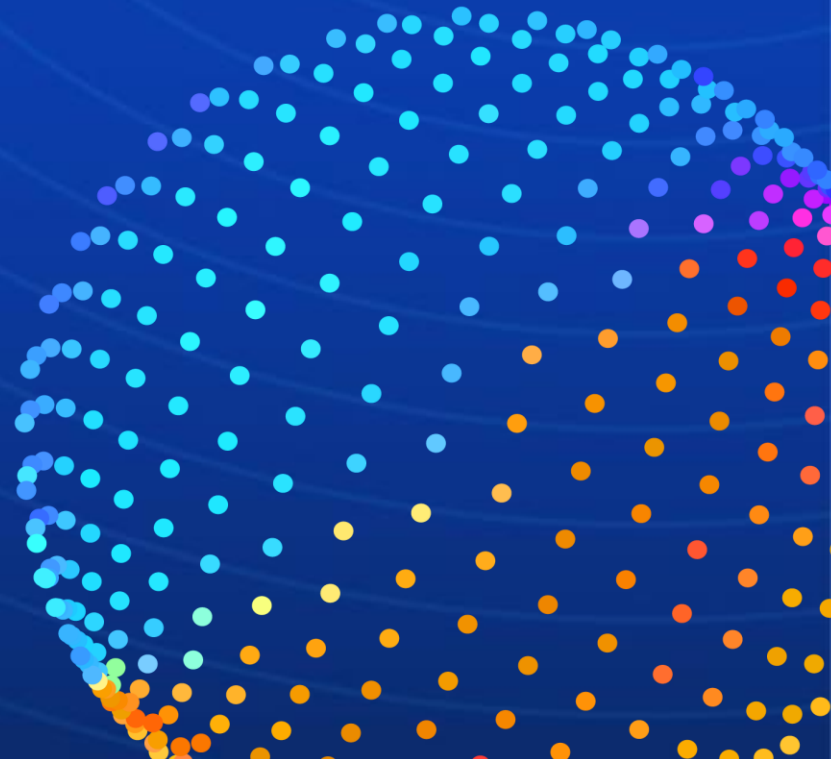
SHAPING CONNECTIVITY

CWTe 2016 Research Retreat

Eindhoven University of Technology

The Antenna Company

12 October 2016



Topics

- Introduction and Company Overview
- Technology Background
- Outdoor Wi-Fi Infrastructure
- Antennas for Telematics
- Antennas and Sensors for mmWave Applications

Antenna Company Overview and Leadership Team

- Company founded in 2013
- Office locations in the Netherlands, Germany, US, and China (Suzhou)
- *Supervisory board*: R. Pieper, J. van Beurden, E. Krubasik, P. van Wijngaarden

CEO
David Favreau

Ex-VP Qualcomm
20 yrs wireless experience

Chairman
Roland Pieper
Co-Founder

Ex-Board Member Philips
Multiple Executive Positions

CTO, Director R&D
Dr Diego Caratelli
Co-Founder

Award-winning
Antenna Researcher

SVP Operations
Andre van Hees

EVP AirTies Wireless,
Proxim, Agere Systems

VP Research/Materials
Dr Johan Gielis
Co-Founder

Inventor, Gielis Formula

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Antenna Company “In the News”

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Our Target Markets

Our products integrate advanced materials, novel antenna design and RF system know-how to provide optimal wireless system performance

Wi-Fi Networking

- Wi-Fi APs/Routers
- Outdoor APs
- Small Cells

Connected Home

- Set top box
- Home Gateway
- Smart TV

Telematics and IOT

- GPS and Cellular
- Automotive (V2V)
- M2M/IOT

Mobile Computing

- Notebooks

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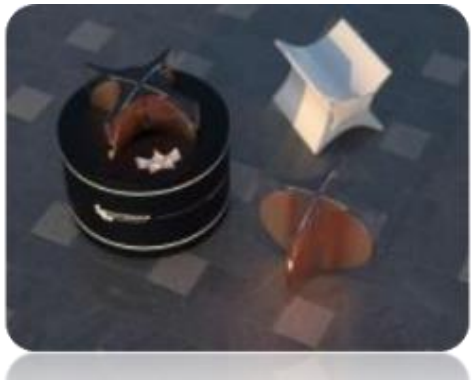
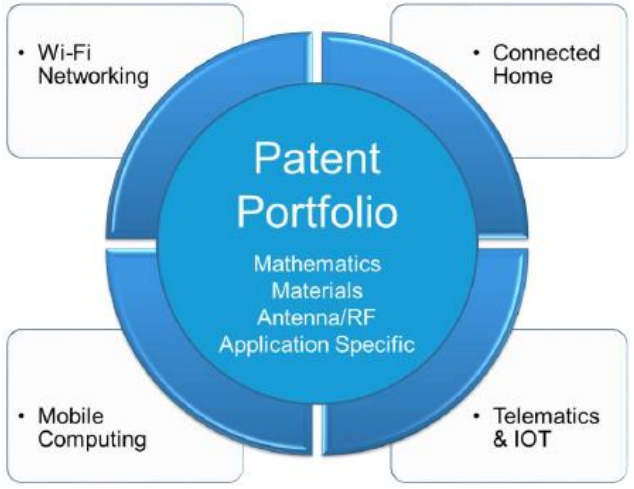
Key Innovations

- Reinventing the Dielectric Resonator Antenna (DRA)
- Applying unique polymer materials - new class of materials for antenna manufacturing, utilizing dielectrically loaded polymers
- Application of SuperShape® formula for antenna design
- Technology is protected by multiple granted and pending patents





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Advanced R&D activities

- Awarded a two-year contract by the European Space Agency for development of next-generation antenna array architectures for low/medium Earth orbit satellite applications

- NPI research program with European Space Agency and Eindhoven University of Technology on development of antenna systems based on overlapped sub-arrays

- Advanced materials

- SDRA antennas for mmWave applications to increase gain and selectivity of beam-steering in phased arrays

SDRA Motivation and Benefits

Ultra-wideband and **multi-band** communication systems

- Wide bandwidths
- Stable radiation patterns
- Reduced manufacturing costs

Enhanced design flexibility

DR antennas

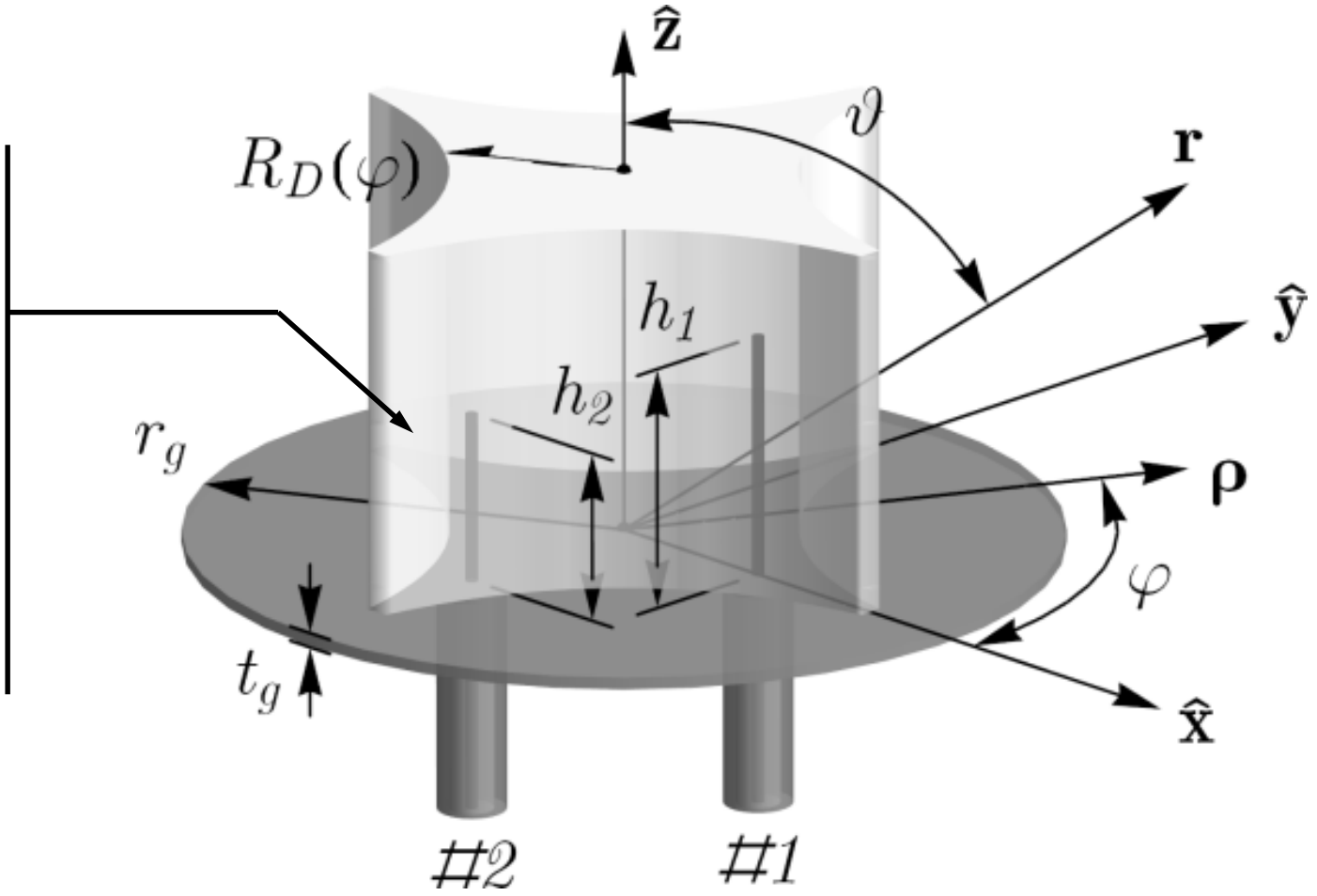
Supershaped DRAs

- One antenna can replace multiple antennas/frequencies
- Increase in efficiency and throughput/coverage
- Absence of antenna interaction/interference
- Uniformity of coverage, pattern control
- Industrial design freedom

SuperShape DRA

- Geometry of the radiating element:

The polymer dielectric resonator (DR) having base profile described by the polar equation $R_D(\varphi)$ is mounted on a metallic ground plane and fed by surface-mounted probes.



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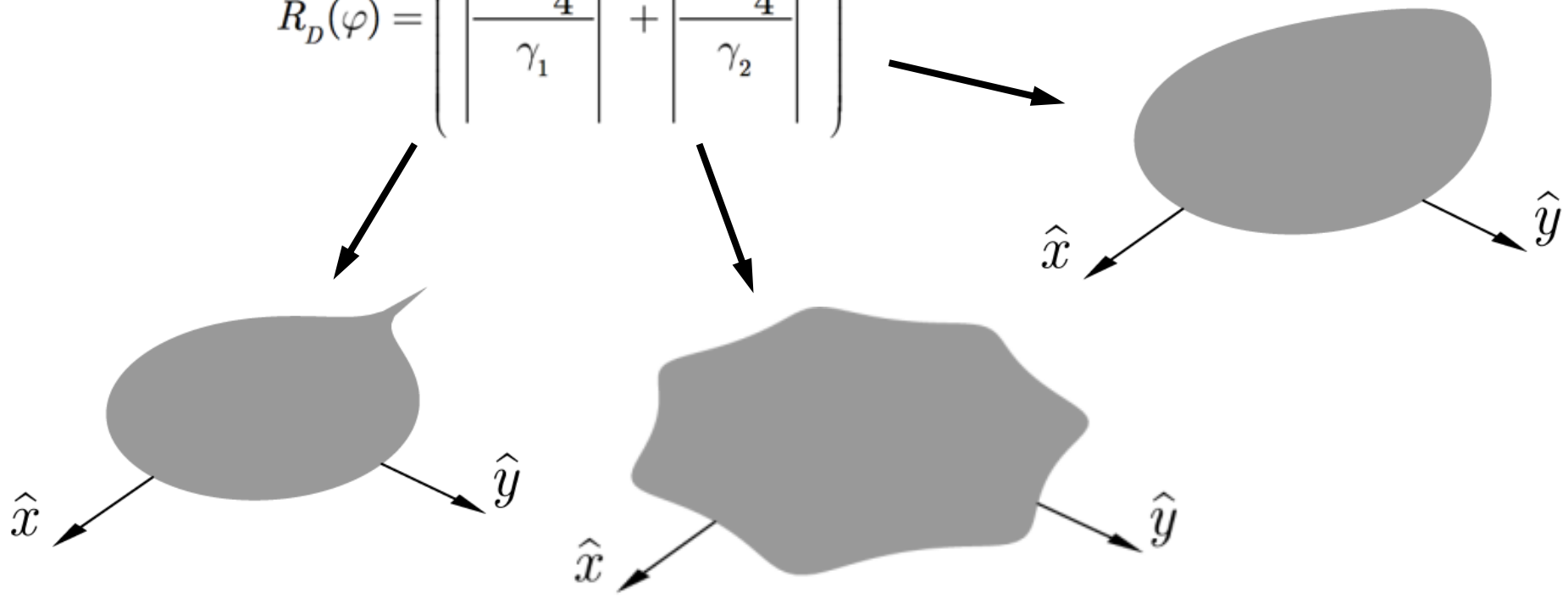
Gielis Formula

- Unified description of natural and abstract shapes in a general way:

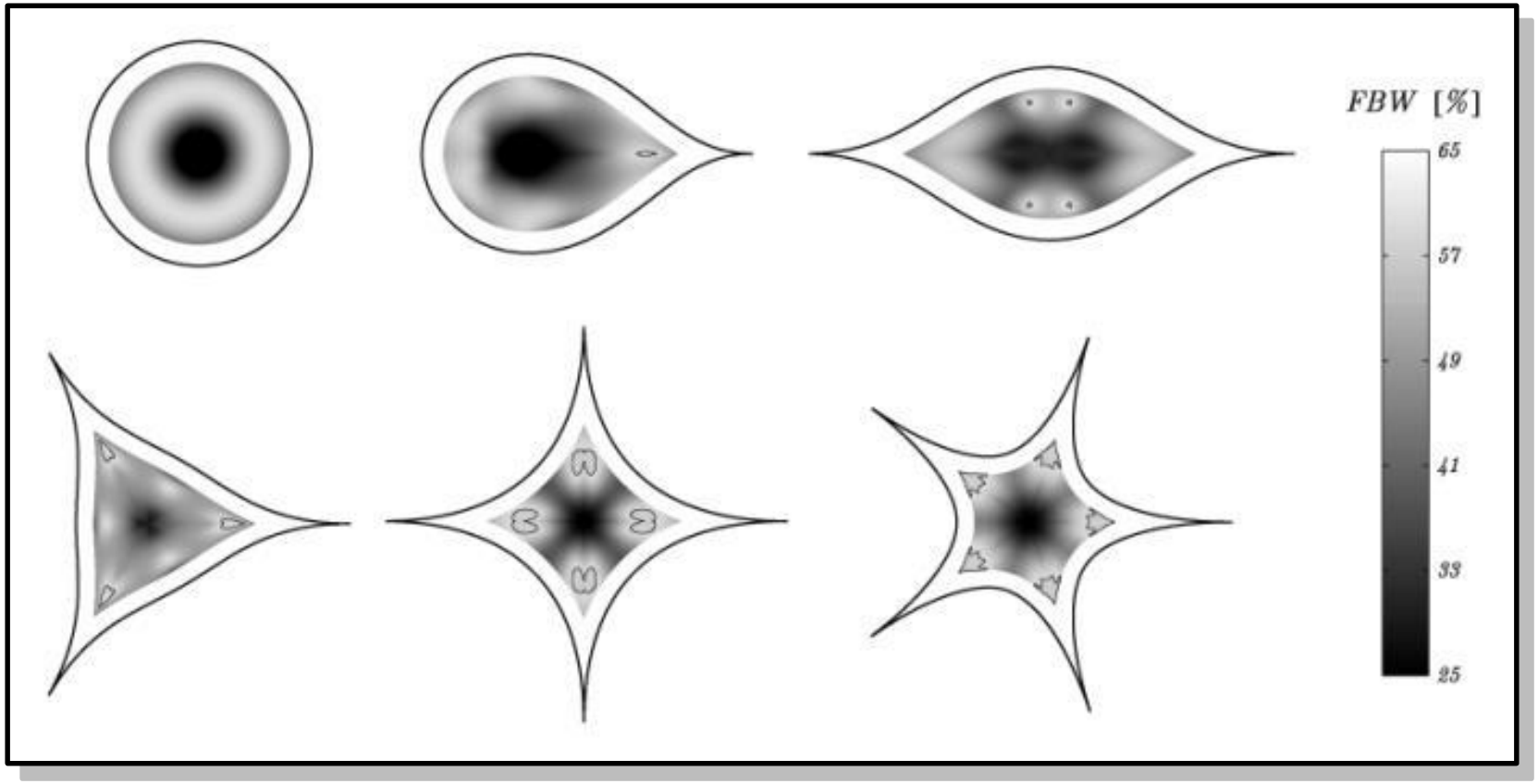
$$R_D(\varphi) = \left(\left| \frac{\cos\frac{p\varphi}{4}}{\gamma_1} \right|^{\nu_1} + \left| \frac{\sin\frac{q\varphi}{4}}{\gamma_2} \right|^{\nu_2} \right)^{-1/\nu_0}$$



- Optimal DR profiles are obtained by properly setting p, q, n_i, γ_i

Optimal Design Process

- Fractional bandwidth as a function of the DRA geometry:



- Gielis shaping provides competitive leverage in boosting performance

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Outdoor Wi-Fi Infrastructure

Proof Point: Aruba Networks AP 277 Outdoor Wi-Fi AP

Problem Statement :

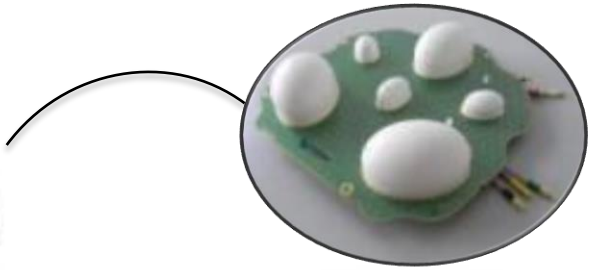
- High performance embedded antenna system for outdoor 3x3 access point
- Outperform existing integrated antenna solutions
- Outperform existing external antenna solutions
- Achieve industry leading compact form factor

23(W)x24(D)x27(H)

Existing AP 275 : Internal 5dBi 3x3 Antenna

45% Increase in Gain

23(W)x22(D)x13(H)

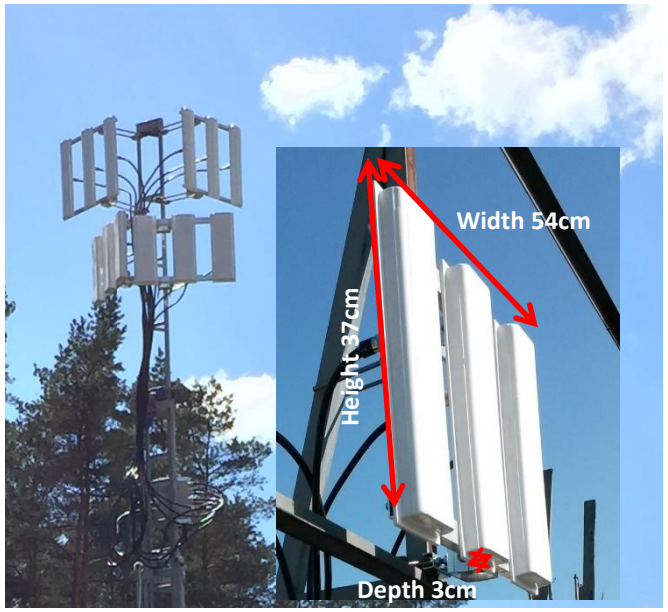


New AP 277 with Internal Antenna Company 5/8dBi 3x3 Dual band Antenna

Proof Point: Outdoor 5GHz Directional Antenna

Customer challenge:

- Existing Antenna prohibited from Installation on many building roof tops due to size. Performance limitation.

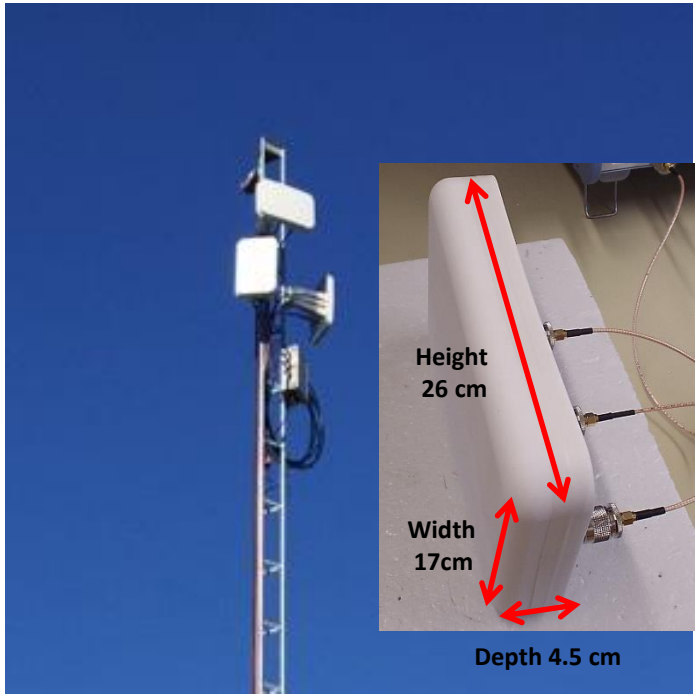


Traditional 13dBi 3x3 MIMO Sector Antenna
Utilizing Microstrip Technology

67% Reduction in Size

200% Increase in Gain

~2x range increase



Antenna Company 16dBi 3x3 MIMO Sector Antenna
Utilizing SuperShape SDRA Technology

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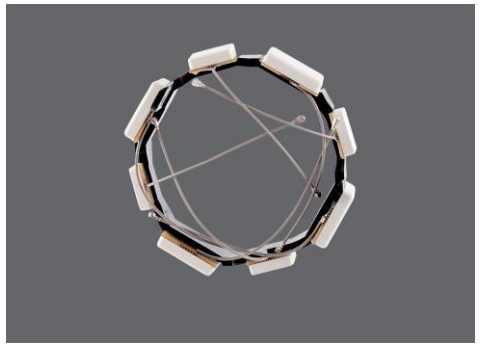
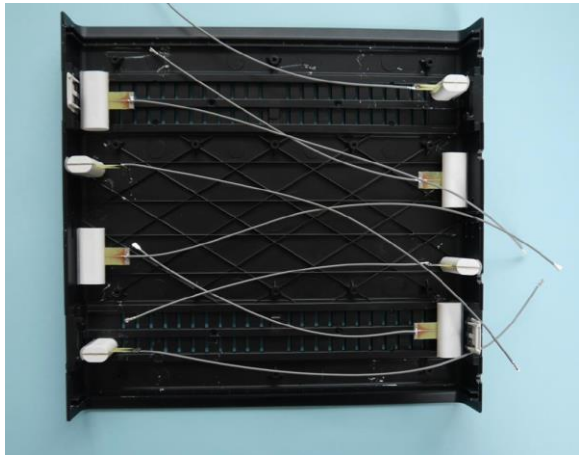
Embedded Wi-Fi Products

MIMO Wi-Fi Networking Antenna Systems



4x4 11ac

Connected Home Gateway

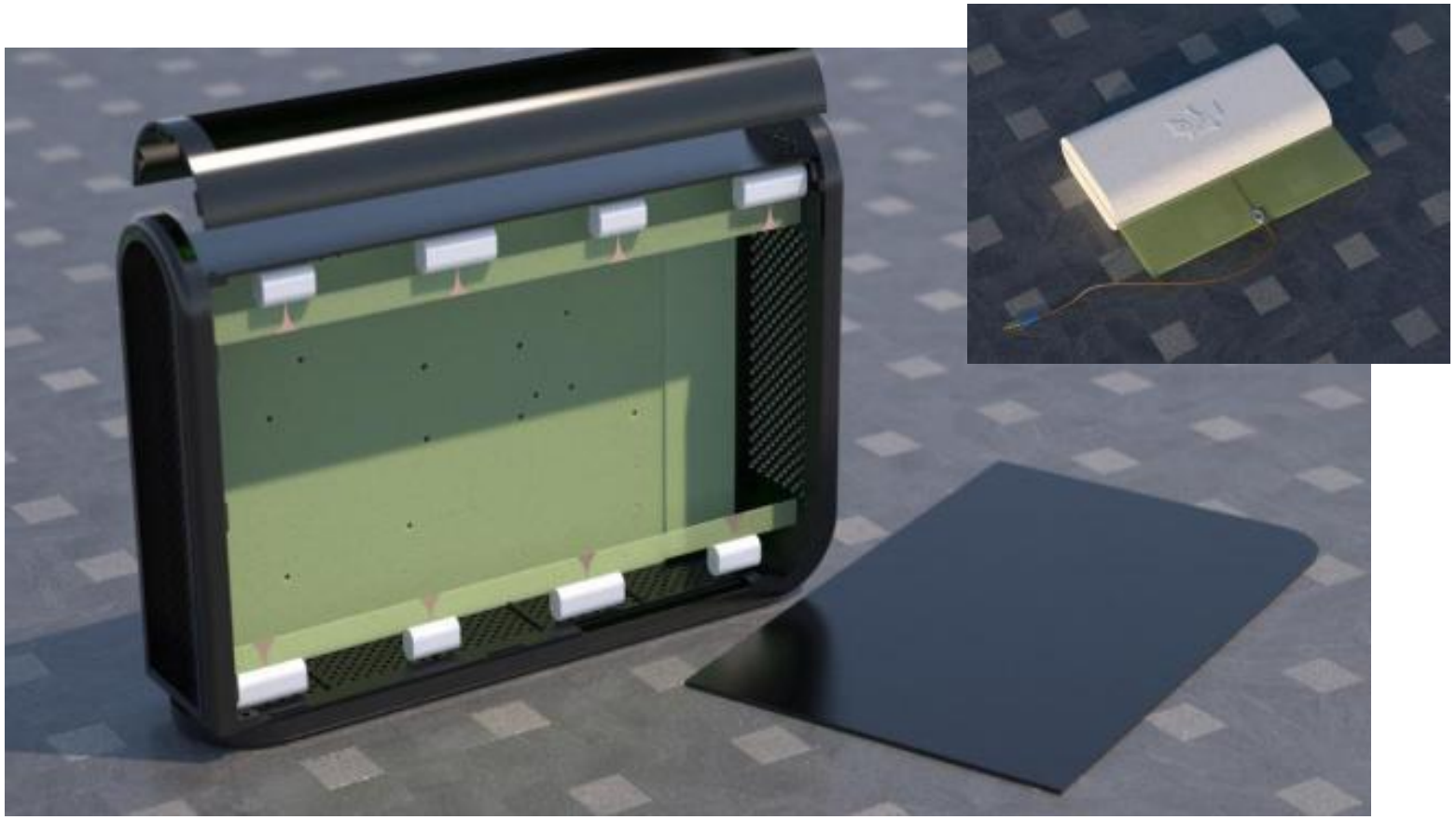


8x8 11ac

Residential Gateway

System Integration – Eliminating external antennas

Polymer-embedded antennas for replacement of external dipoles:



Integration in a reduced volume without compromising throughput

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Antennas for Telematics

Telematics Antenna Solution

Benefits for OBD-II Antenna Design:

- Solves Faraday cage issue
- Provides omni-directional antenna radiation
- Increased antenna efficiency
- Easy integration in the Plug-In Unit
- Excellent co-existence with cellular antenna
- Cost effective to manufacture

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Thank You