MONARCH
Antenna. Inc.
Reshaping Wireless

Self-Structuring Antenna for Handsets

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Tayfun Özdemir, Ph.D.

Chief Technology Officer

2008 RWS

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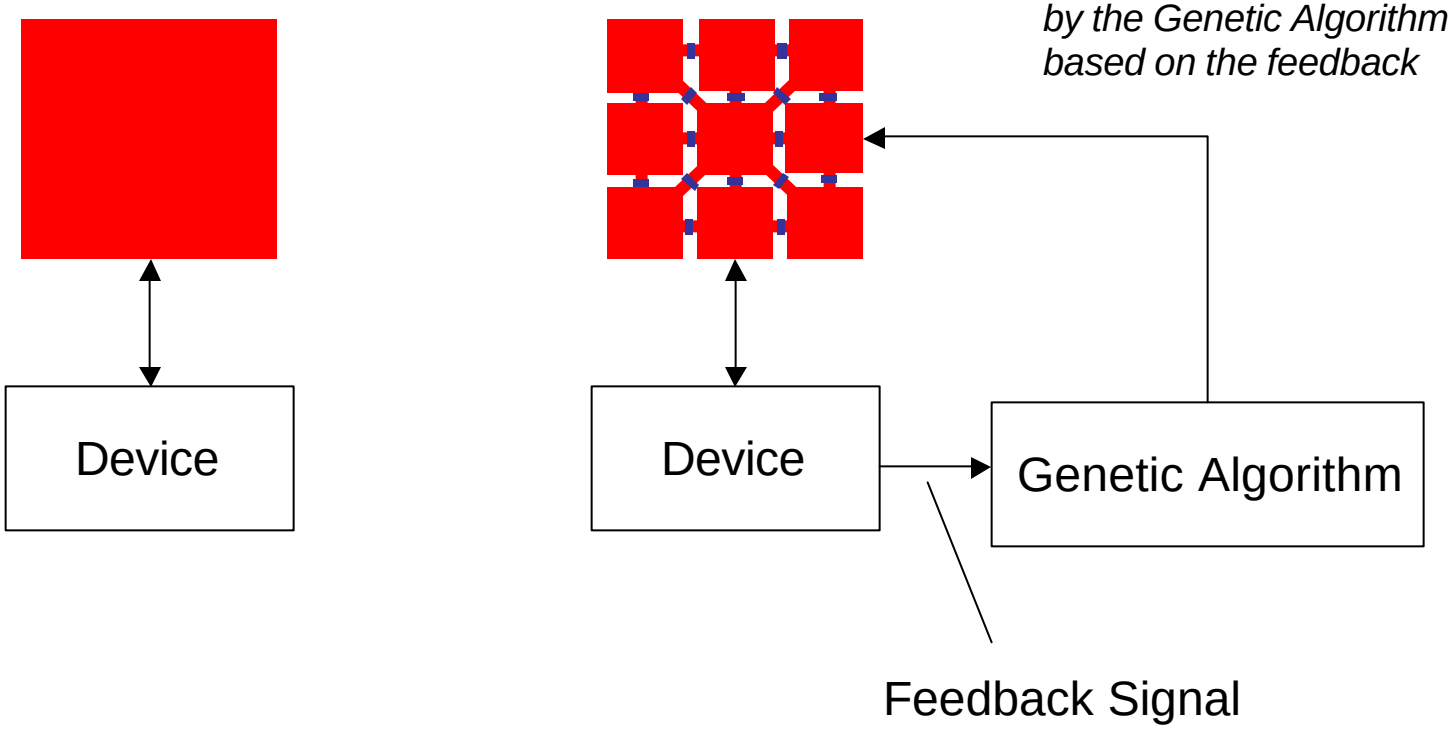
Self-Structuring Antenna (SSA)

Conventional Antenna
(Fixed Aperture)

SSA
(Adaptive Aperture)

Antenna aperture altered by the Genetic Algorithm based on the feedback



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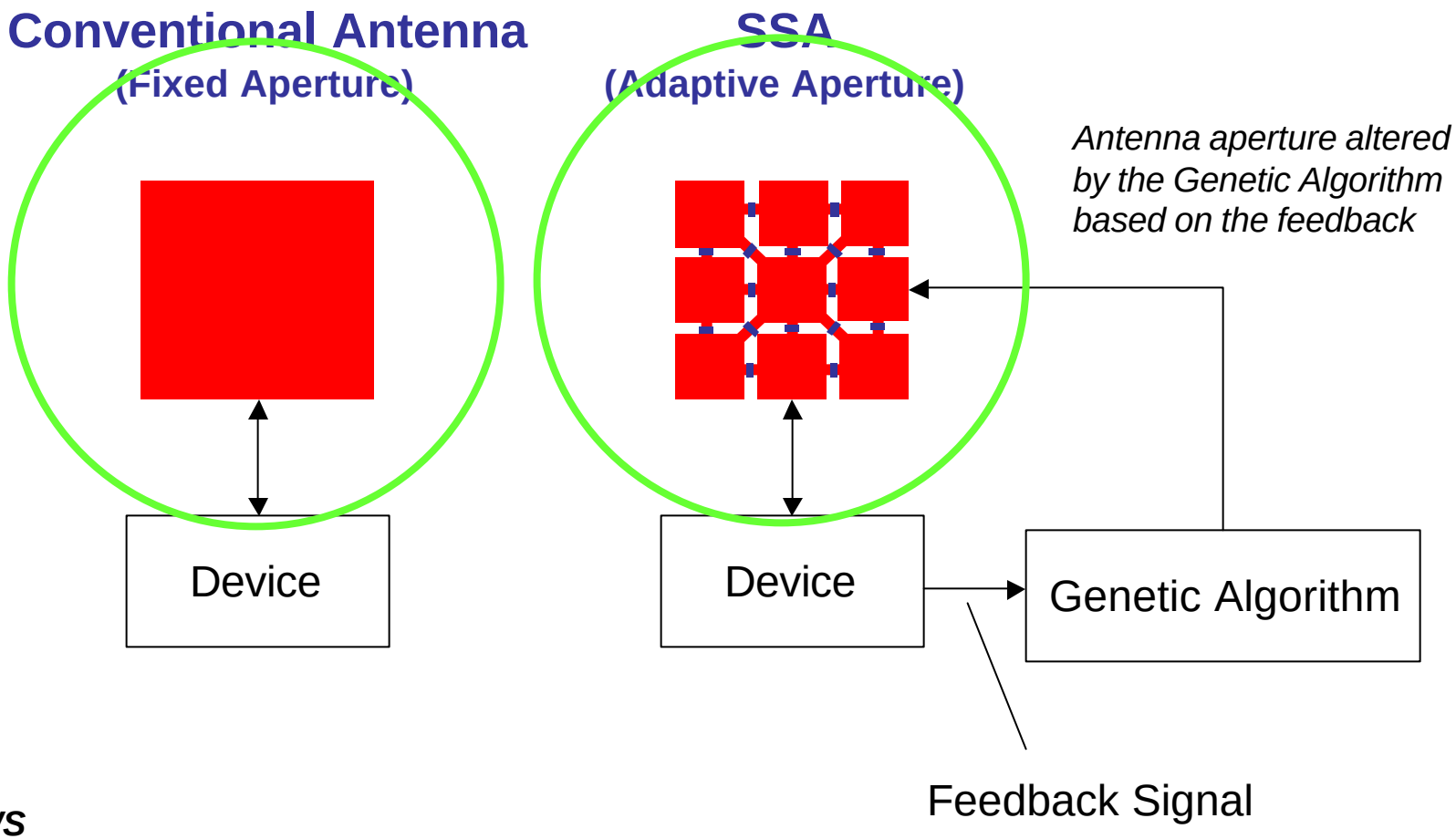
Self-Structuring Antenna (SSA)



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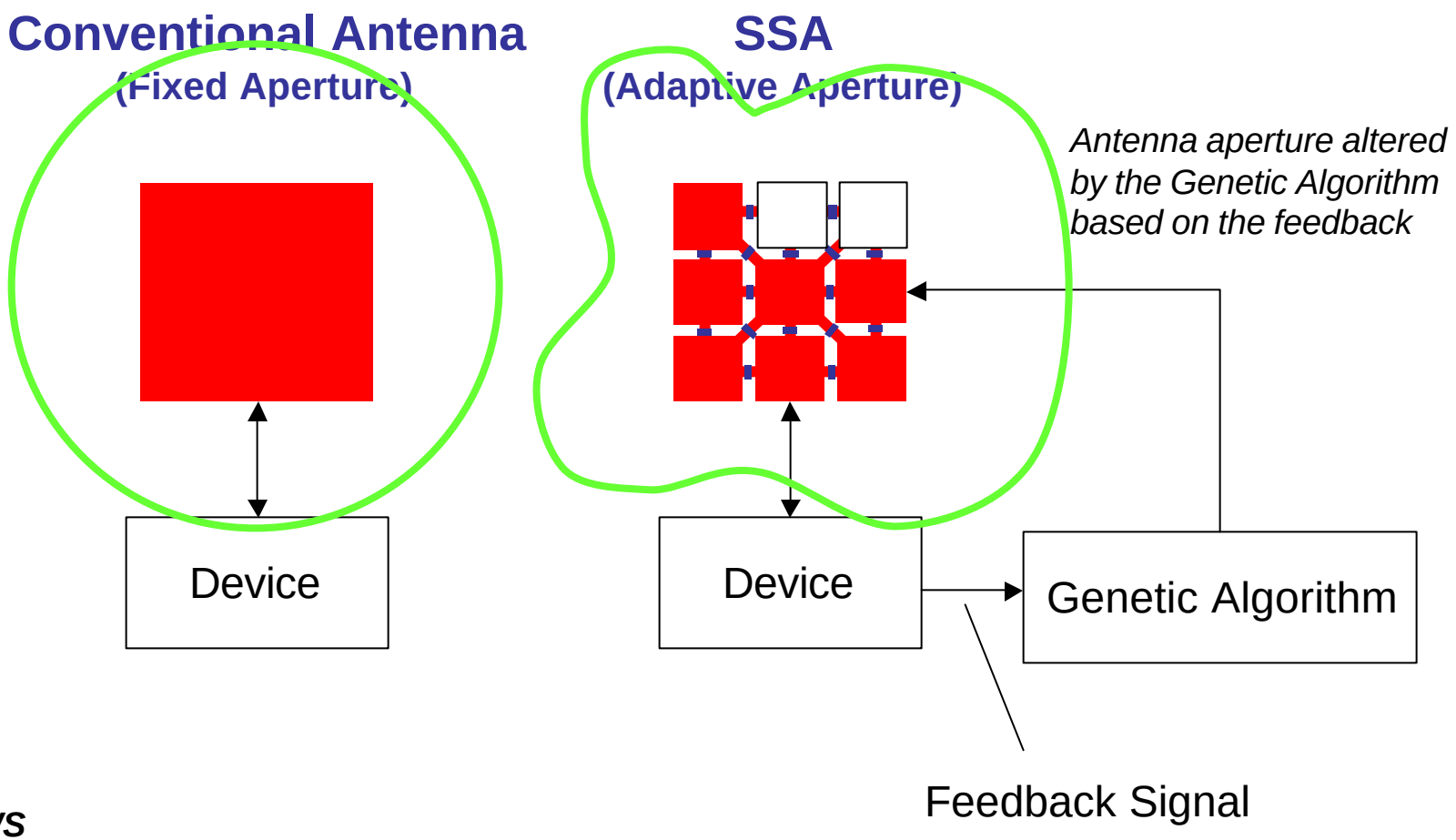
Self-Structuring Antenna (SSA)



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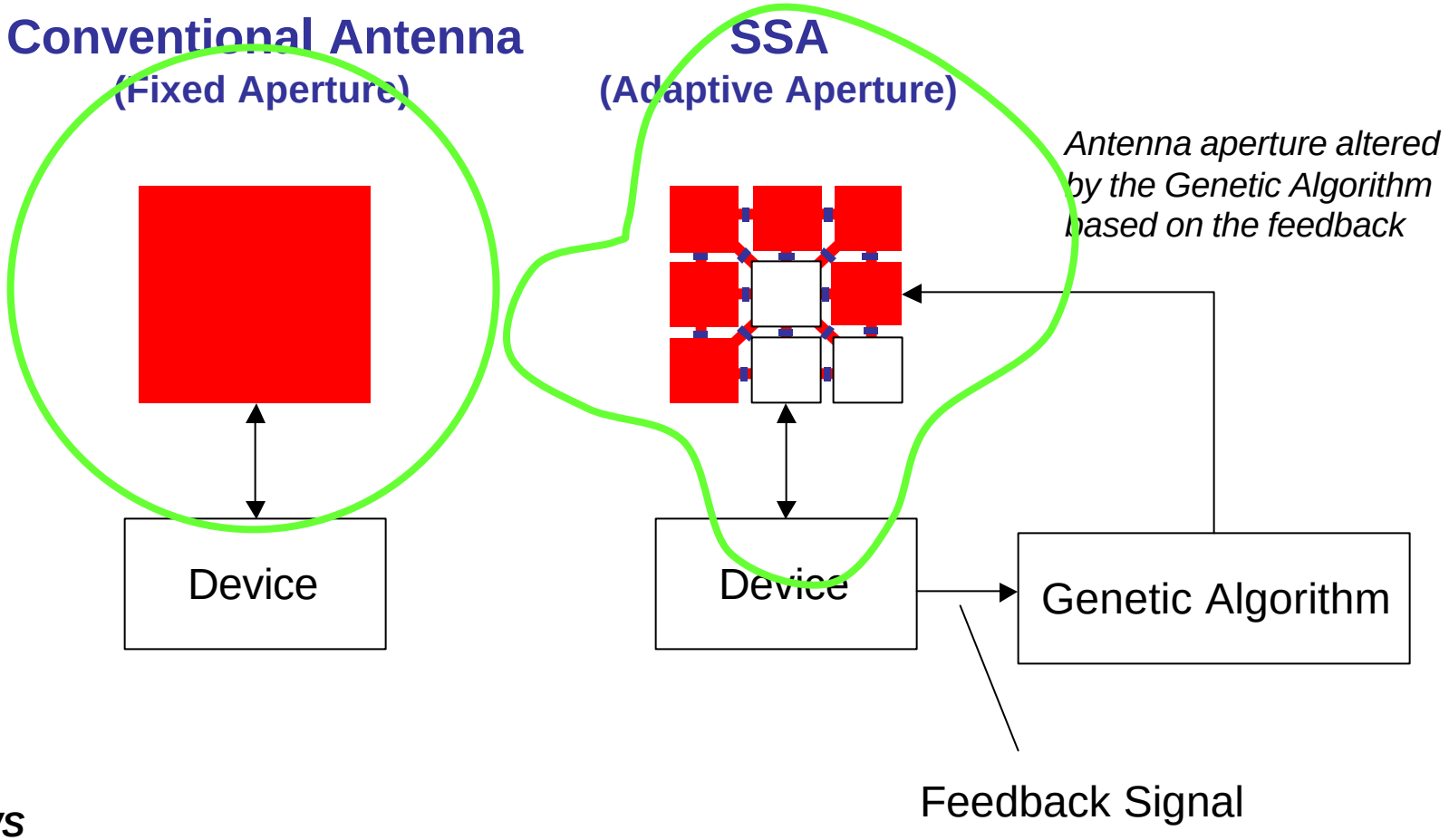

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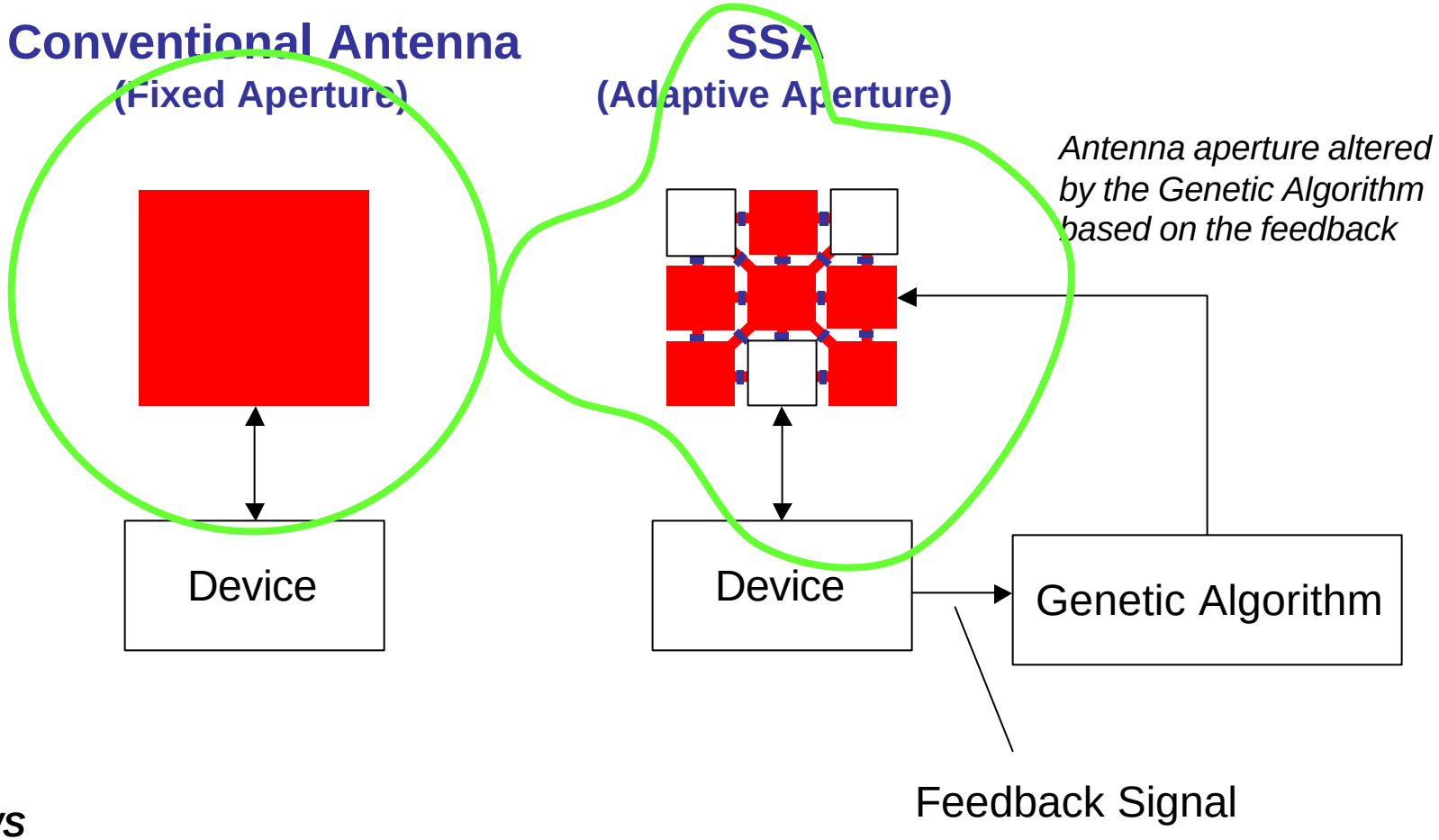
Self-Structuring Antenna (SSA)



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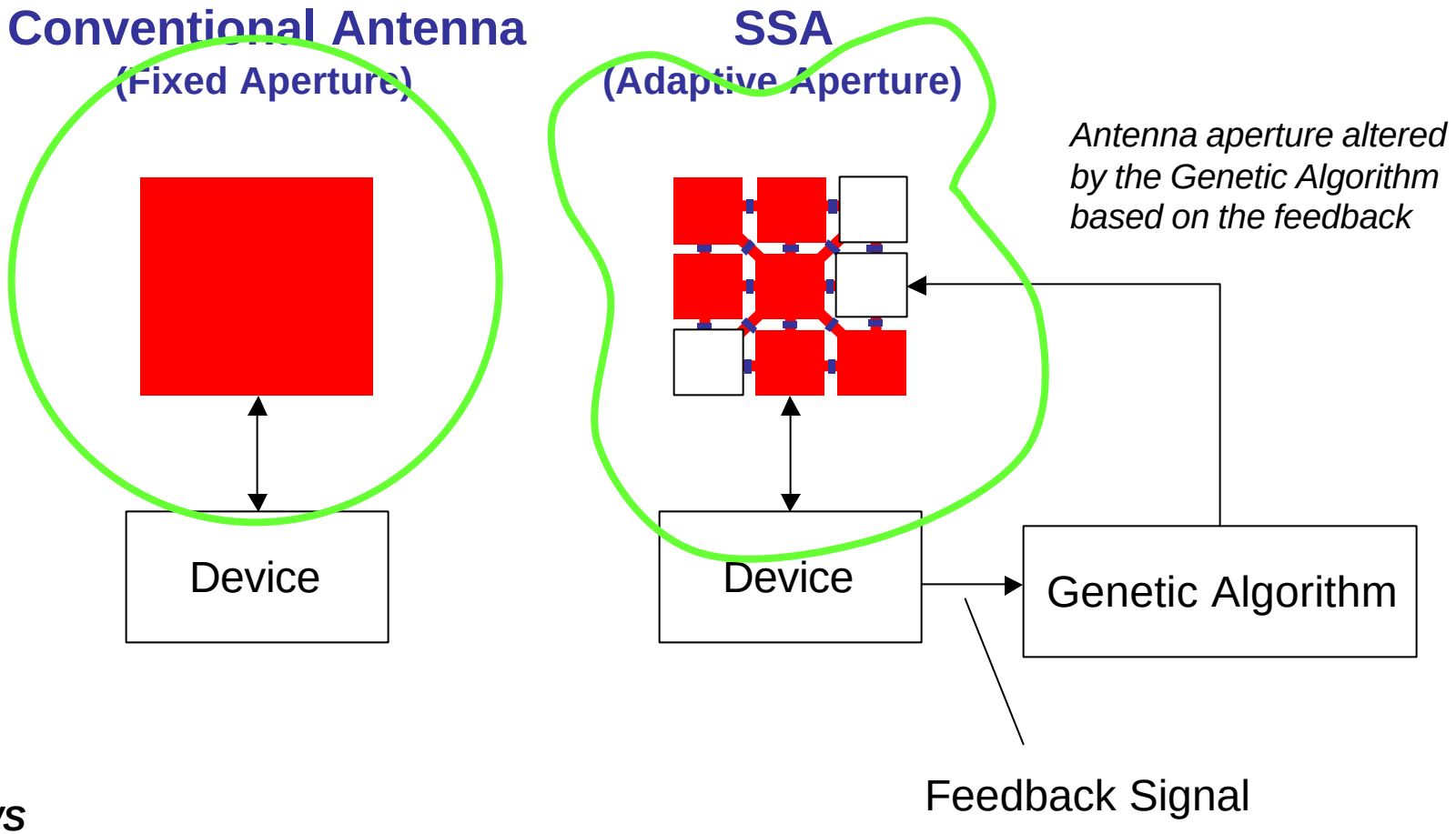

Technology

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- The SSA automatically configures itself to accommodate changes in signal strength, orientation, and atmospheric conditions through the control of simple on/off switches

- Changes in switch states cause the electrical shape of the antenna to be altered, allowing it to adjust to changes in its electromagnetic environment

- The effect of different antenna configurations is unknown to the designer, only a statistical approach is utilized in testing

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Benefits

- Pattern Shaping
- Beam Sharpening (Increased Gain)
- Insensitive to Frequency Detuning
- Compensates for Packaging Effects
- Self-healing/Graceful Degradation

Technology – *Applications*

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Wide-Band:

- Quad-band Phones
- Media-capable Phones (iPhone)

Narrow Band:

- 802.11 (WLAN)
  - Wi-Fi
- 802.15 (PAN)
  - Bluetooth
  - Zigbee
- 802.16 (WMAN)
  - Wi-Max
- Cellular Broadband
  - GPRS / EVDO / UMTS / IDEN
- Cellular Voice
  - GSM, CDMA, TDMA

Prototype - Current

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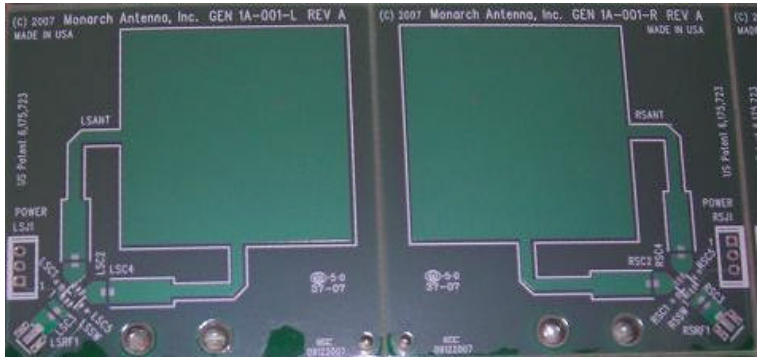
Laptop Wi-Fi
(2.4 GHz)



2007

GEN 1:

Selection Diversity
+
Polarization Diversity

Prototype - Current

MONARCH Antenna. Inc.
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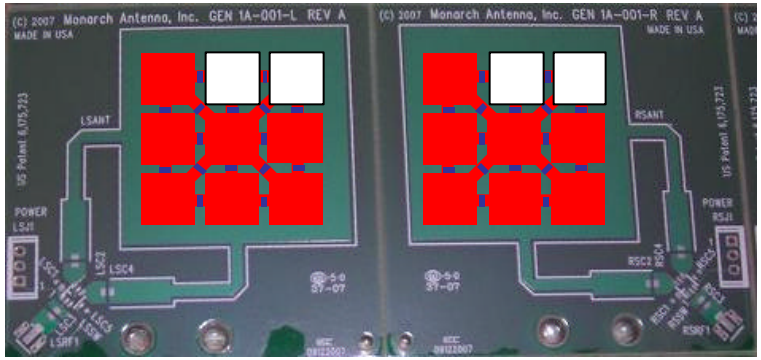
Laptop Wi-Fi
(2.4 GHz)



2007

GEN 2:

Selection Diversity
+
Polarization Diversity
+
Pattern Shaping (Higher Gain)

Laptop Wi-Fi Antenna

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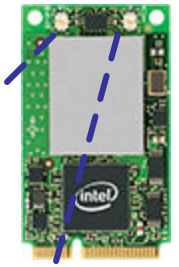
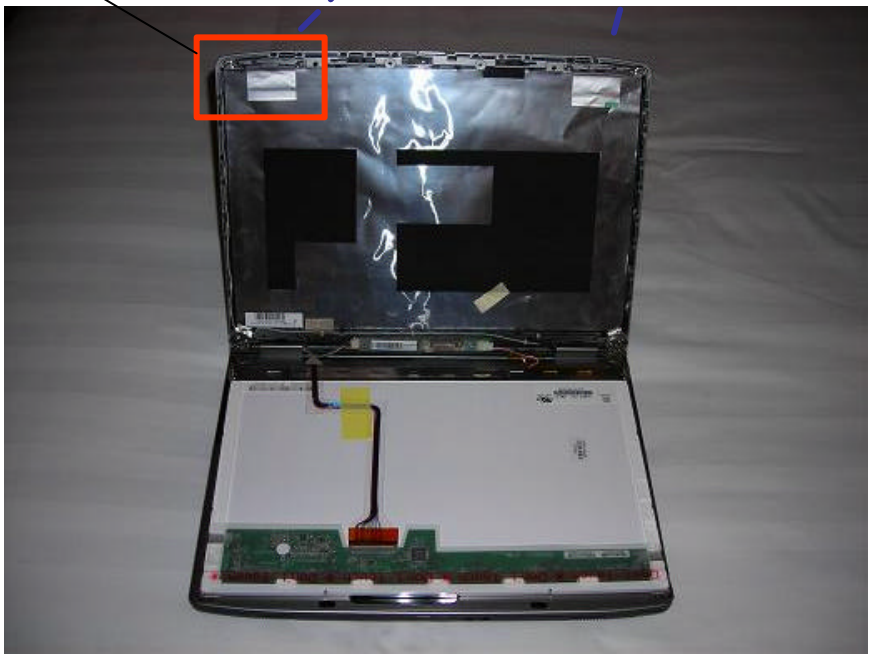
Inverted F
(Omni-directional)

Intel® PRO/Wireless 3945ABG

Selection Diversity





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Laptop Wi-Fi Antenna – GEN 1

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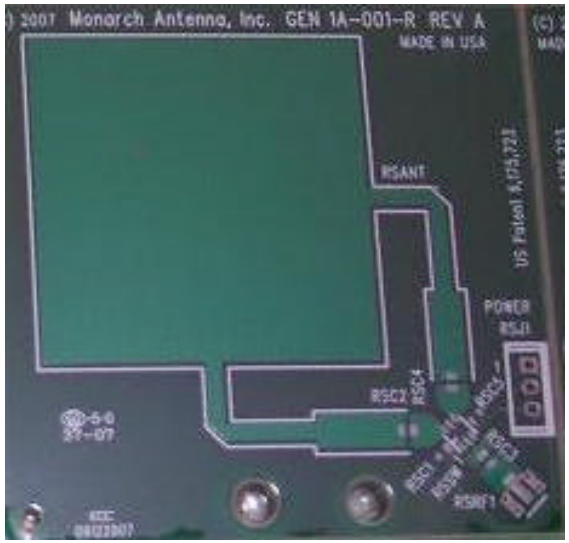
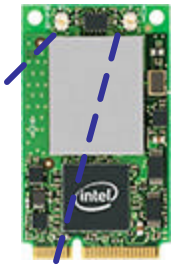
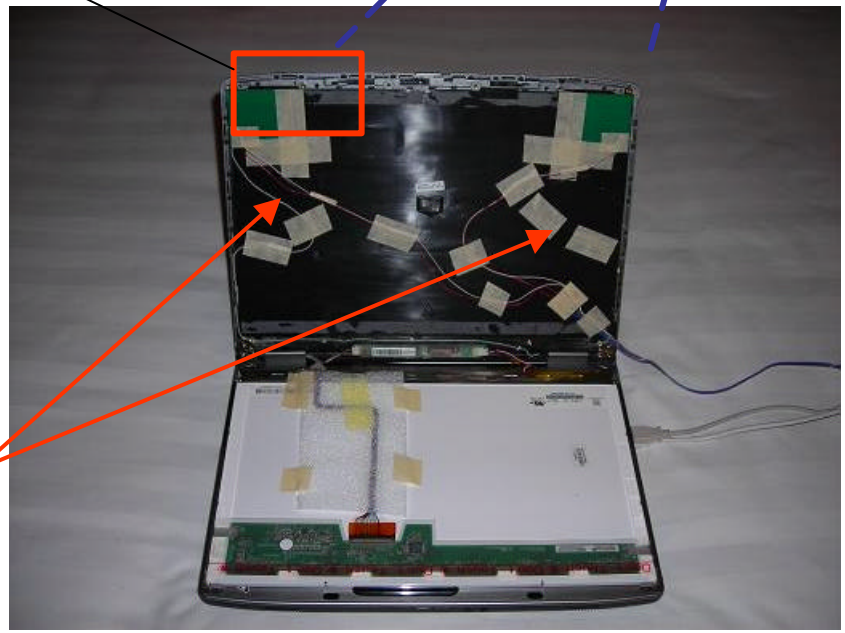
GEN 1



Intel® PRO/Wireless 3945ABG

Selection Diversity





Square Patch
(Uni-directional)
+
Polarization Diversity

Used Native Cabling

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Laptop Wi-Fi Antenna – GEN 1

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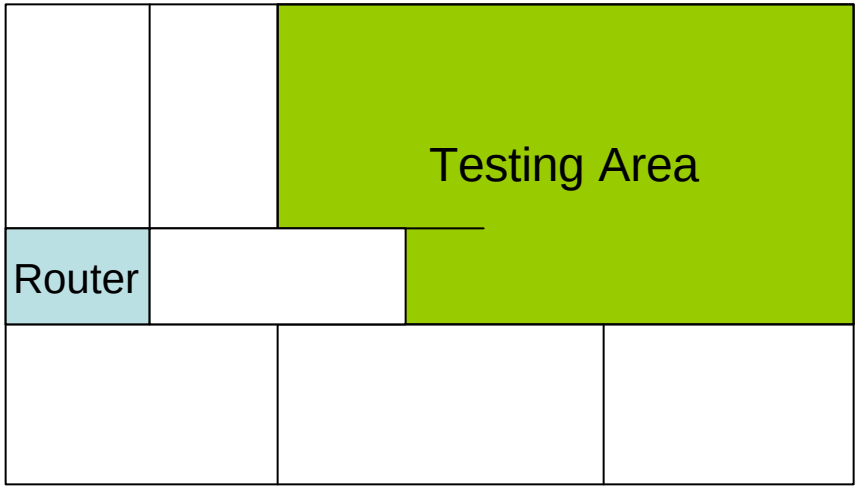
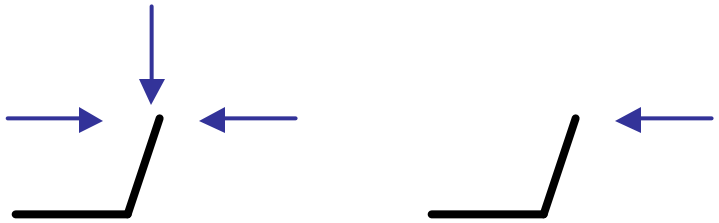


Proof-Of-Concept:

Compared RSSI for different locations and orientations

-> **13%** better performance (linear scale) on average

WHY BETTER?



OEM
Omni-Directional
+
Fixed

Monarch
Unidirectional
+
Polarization Diversity!

40-60% with GEN 2

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Laptop Wi-Fi Antenna – GEN 2

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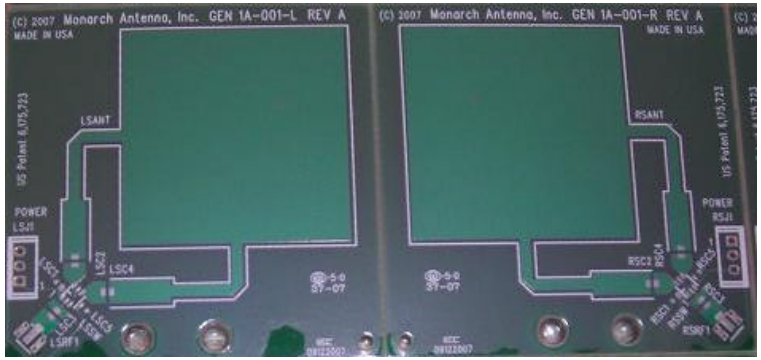
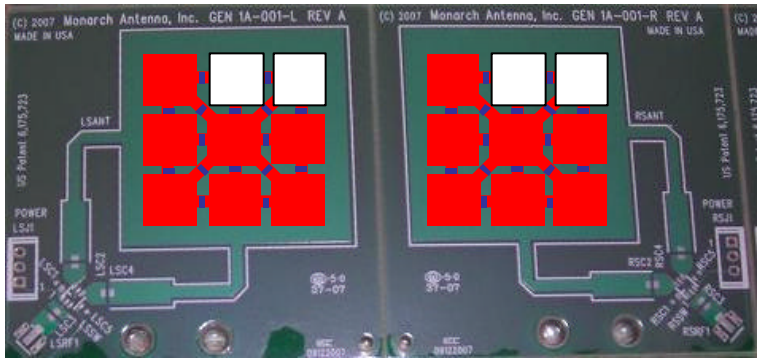
GEN 1



Selection Diversity (802.11 b/g)
MIMO (802.11 n)
+
Polarization Diversity

GEN 2



Selection Diversity (802.11 b/g)
MIMO (802.11 n)
+
Polarization Diversity
+
Pattern Shaping -> *Higher Gain!*

Handset Antenna

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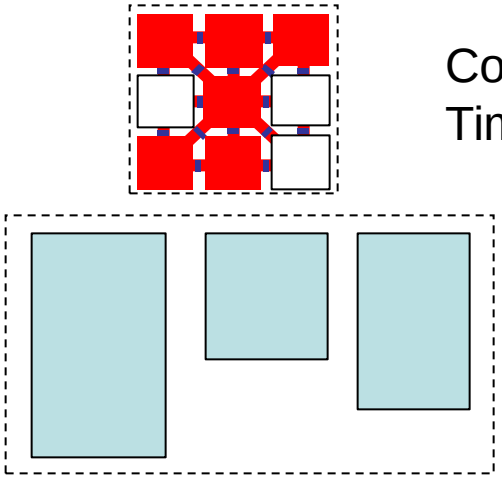
Why is SSA small?

Multi-Frequency Case



Common aperture shared through Time-Division Multiplexing

Separate/dedicated antenna for each frequency/radio.
-> Occupies more space

Company

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Equity Partners

1. Delphi Technologies, Inc.
2. Michigan State University
3. Automation Alley

DELPHI

MICHIGAN STATE UNIVERSITY

AUTOMATION ALLEY

HQ: SPARK

Ann Arbor, Michigan

Company - Strategy

MONARCH Antenna, Inc.
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- **Fabless technology company**
- **Maintain dominant SSA patent position**
- **Develop dual-use from Military to consumer**
- **Enabler: *"Monarch Inside"* like *"Intel Inside"* branding**

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