IEEE802.11n – Next Generation Wireless LAN

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Agenda

- Wireless Evolution
- 802.11n Highlights, Interoperability, Timeline
- 802.11n in the real World
- Deployment Considerations

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Wireless Evolution

- Business applications have gone mobile
- Wireless now meets the needs for high performance, pervasive connectivity

Point Applications
- Inventory Management
- Barcode Scanning

Mobile Data
- Email
- Web browsing

Business Ready
- Voice, Video, Data

Next Gen Wireless
- Ubiquitous mobile computing

802.11
2Mbps

802.11b
11Mbps

802.11ag
54Mbps

802.11n
300Mbps

Wi-Fi Device Proliferation

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802.11n Highlights

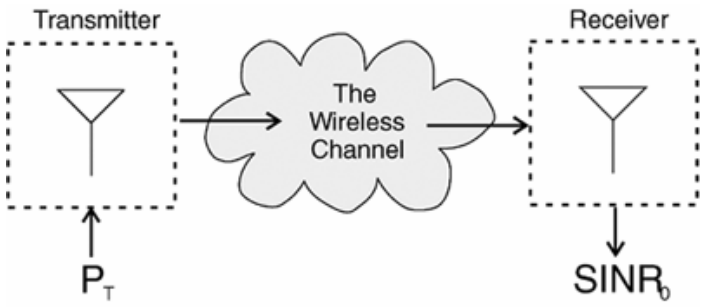
- Better overall end-user experience for high bandwidth data, voice and video applications
  - 5x higher throughput
  - More reliable and predictable coverage
- Backwards compatibility with 802.11a/b/g clients
  - Clients will co-exist for a long time

Primary 802.11n Components

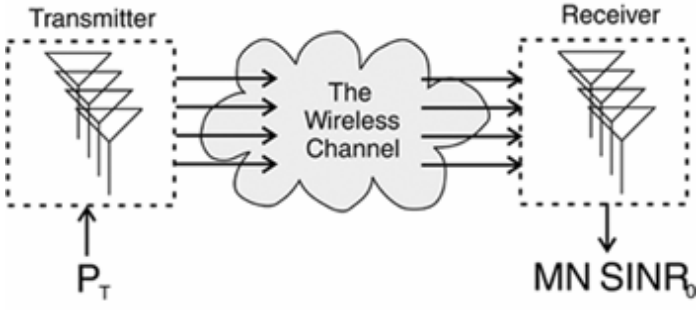
- **Multiple Input Multiple Output (MIMO)**
  - **Maximal Ratio Combining (MRC)**
  - **Beam forming**
  - **Spatial multiplexing**
- **40 MHz Channels**
  - **Two adjacent 20 MHz channels are combined to create a single 40 MHz channel**
- **Improved MAC Efficiency**
  - **Packet aggregation – multiple packets aggregated in a single transmission**
  - **Block Acknowledgements**

Evolution to New MIMO Technology

Single Input Single Output (SISO)

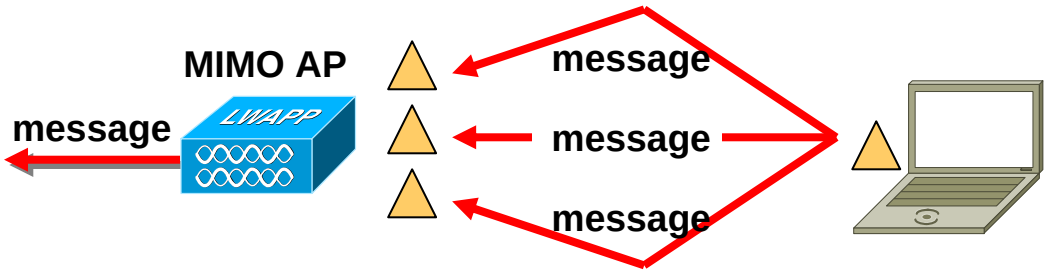


Multiple Input Multiple Output (MIMO)

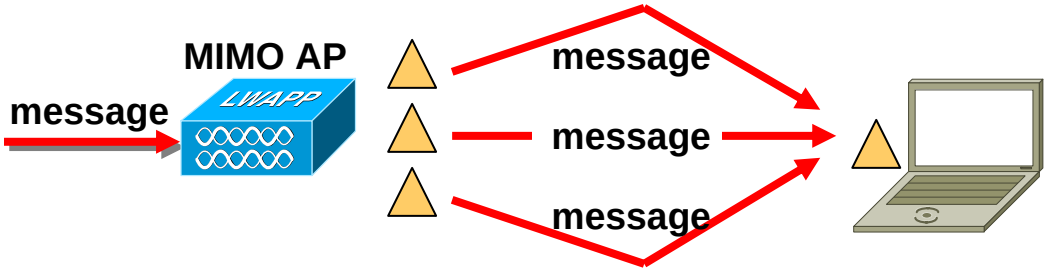


MIMO Overview

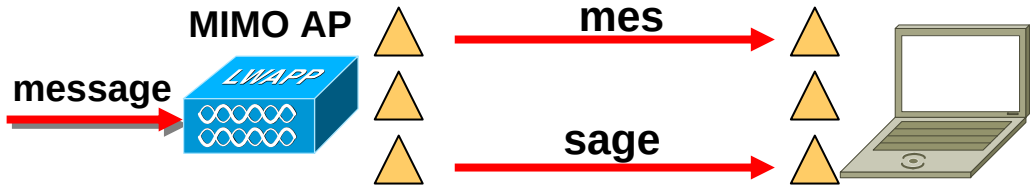
Maximal Ratio Combining
- Performed by receiver
- Combines multiple received signals
- **Increases receive sensitivity**
- Works with non-MIMO and MIMO clients



Transmit beam forming
- Performed by transmitter
- Ensures signal received in phase
- **Increases receive sensitivity**
- Works with non-MIMO and MIMO clients



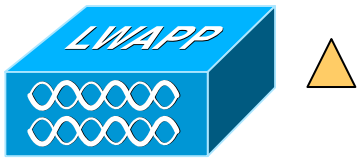
Spatial Multiplexing
- Transmitter and receiver participate
- Multiple antennas txmt concurrently on same channel
- **Increases bandwidth**
- Requires MIMO client

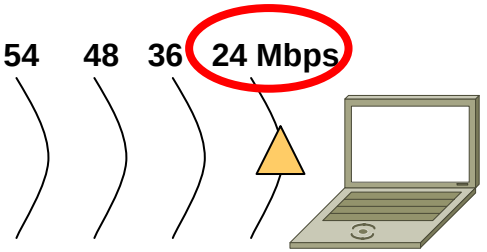


MIMO Increases PHY Data Rates for All Clients

- ☒ Maximal Ratio Combining (MRC)
- ☒ Beam forming
- ☒ Spatial Multiplexing

802.11a/g AP (non-MIMO)

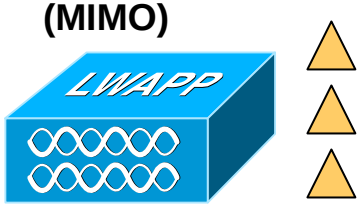


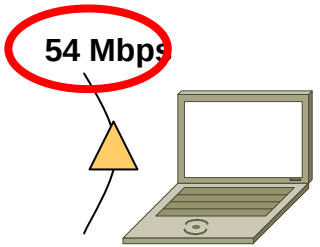


802.11a/g client (non-MIMO)

- ☑ Maximal Ratio Combining (MRC)
- ☑ Beam forming
- ☒ Spatial Multiplexing

802.11n AP (MIMO)

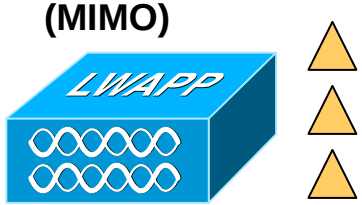


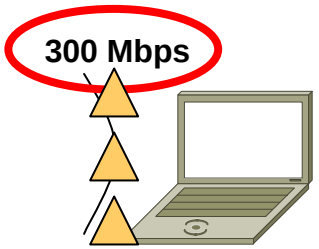


802.11a/g client (non-MIMO)

- ☑ Maximal Ratio Combining (MRC)
- ☑ Beam forming
- ☑ Spatial Multiplexing

802.11n AP (MIMO)



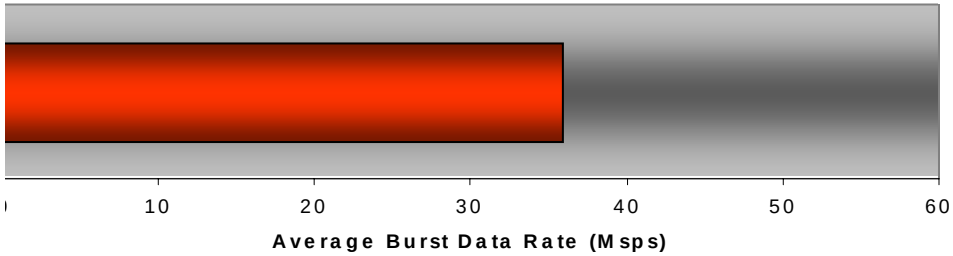


802.11n client (MIMO)

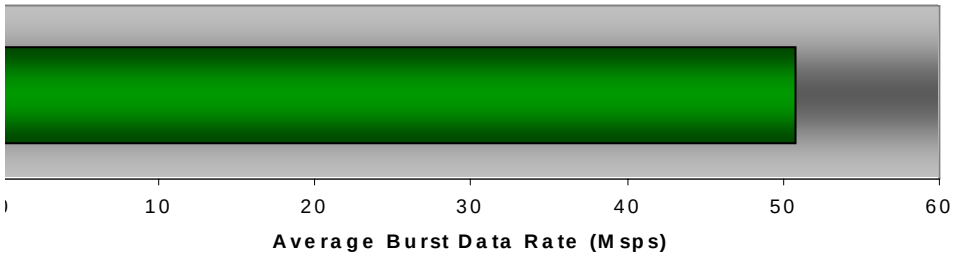
More Reliable, Predictable Connectivity for all clients

- Higher mean throughput, more reliable connections for each client
  - Better reliability, better user experience
  - Predictable throughput and coverage
  - Fewer help desk calls

Traditional AP



MIMO AP



40-MHz Channels

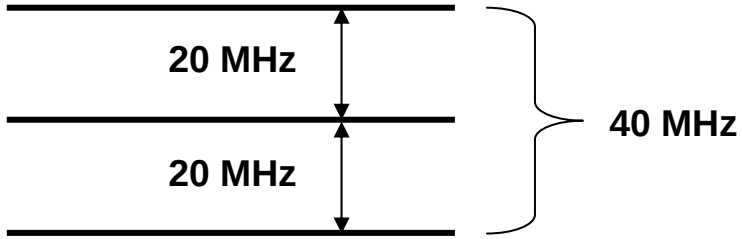
40-MHz Channels:

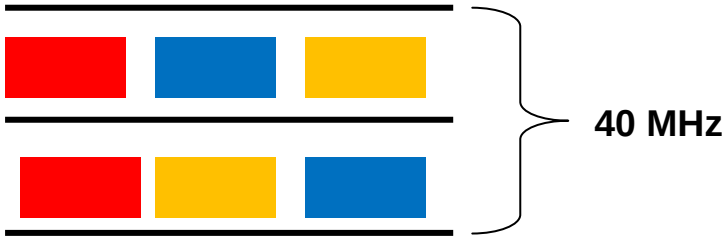
802.11n supports both 20- and 40-MHz wide channels

Wider channels means more BW per AP (not per physical location)

Auto Analogy:

Twice the traffic lanes, twice the cars





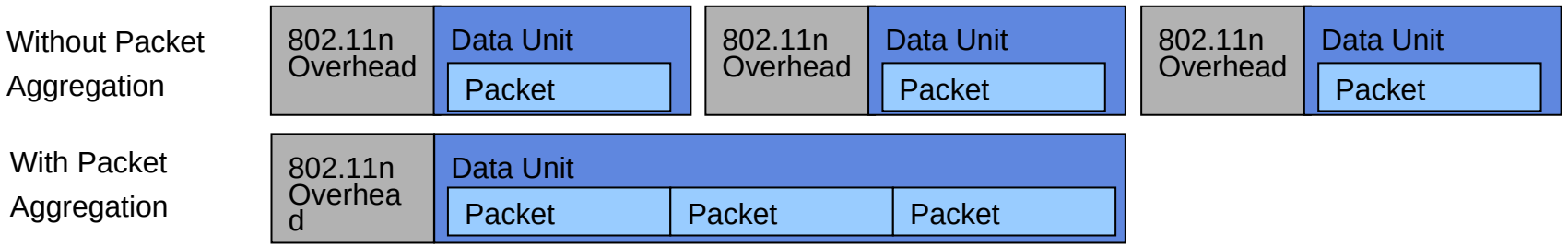
Packet Aggregation

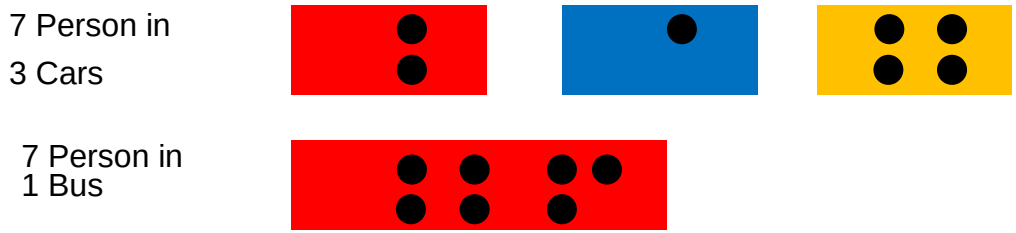
Packet Aggregation:

Combine multiple data units into one frame
Saves on 802.11n and MAC overhead

Auto Analogy:

Car pooling is more efficient than driving by yourself





Packet Aggregation

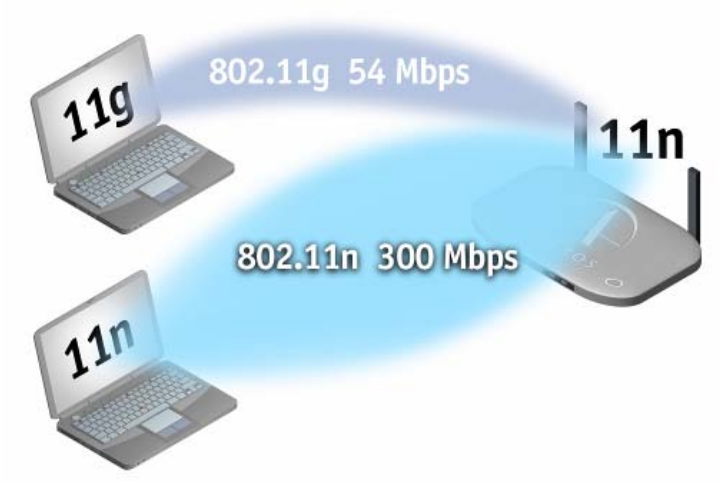
- Radio frame

- Radio frame with Aggregation

All frames must be sent to the same destination

802.11n Interoperability

- Standard guarantees backwards Compatibility with Existing 802.11a/b/g clients
- Support for all 802.11n draft 2 compliant client devices



- Verbindung zu 802.11g -Client mit 54 Mbit/s (Durchsatz +20%)
- Verbindung zu 802.11n -Client mit 300 Mbit/s (Durchsatz -50%)

802.11n Timeline

- IEEE 802.11n standard is still under development
  - Changes to the standard are still being made (base features are mostly stable, optional features are in flux)
  - Architectural and Security reviews are still underway
  - ~~Official ratification date is October 07~~
  - ~~Official ratification date is September 08~~
  - Official ratification date is June 09
  - Current Draft 4.0 (April 08)

Summary of 802.11n Key Benefits

- Higher Throughput
- More Predictable Coverage
- More Reliable Coverage
- Interoperability
  - Backwards Compatibility with existing 802.11a/b/g

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802.11n in the real World

Case 1: Point to point bi-directional traffic (50% up and 50% down)

PHY Rate (Mbps)	w/ A-MSDU (Mbps)	w/o A-MSDU (Mbps)
130 (20Mhz Channels)	68	30
300 (40Mhz Channels)	100	35

Case 2: 8 Clients data only, Cisco packet mix

PHY Rate (Mbps)	w/ A-MSDU (Mbps)	w/o A-MSDU (Mbps)
130 (20Mhz Channels)	32	12
300 (40Mhz Channels)	48	14

Case 3: 5 voice calls, 1 video and 5 data clients

PHY Rate (Mbps)	w/ A-MSDU (Mbps)	w/o A-MSDU (Mbps)
130 (20Mhz Channels)	8	7.5
300 (40Mhz Channels)	9.5	7.5

Source: Cisco

802.11n in the real World

Source: Wikipedia

Facts

- 5x higher throughput than 802.11a/g
- 50% more Coverage
- Better overall performance for all 802.11 Clients

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Deployment Considerations

Power

- For Single Radio (2.4 GHz **or** 5GHz) ~12.9W
  - ➔ PoE Standard 802.3af (15.4W)
  - ➔ Power Supply
  - ➔ Power Injector

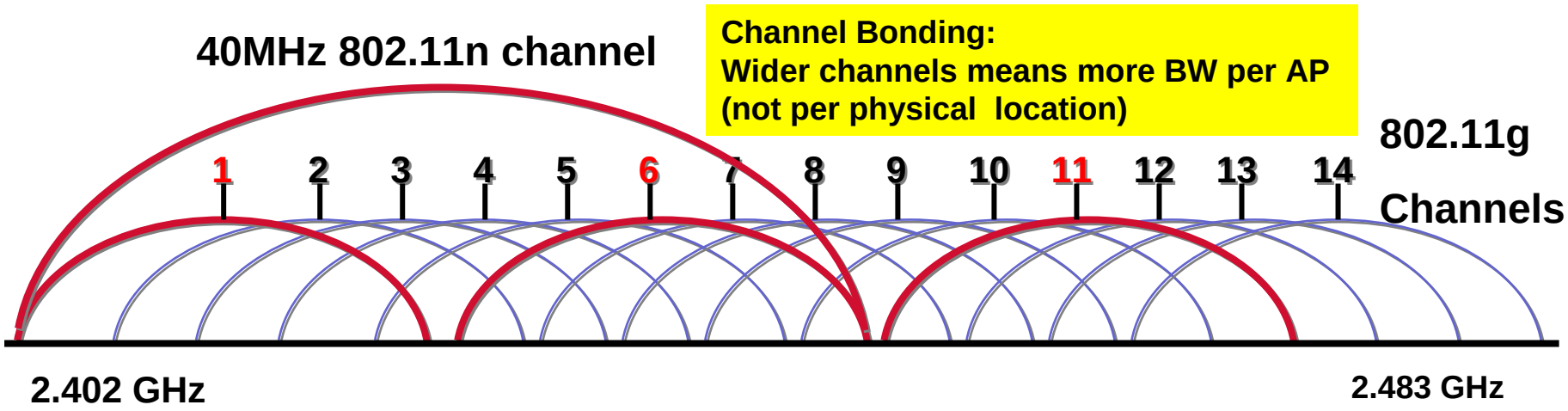
- For Dual Radio (2.4 GHz **and** 5GHz) ~16.9W
  - ➔ PoE Draft 802.3at (28W) is needed
  - ➔ Power Supply
  - ➔ Power Injector

Channel Bonding

Non-overlapping Channels:

5GHz: 11x 40MHz Channel → Use Channel Bonding

2.4 GHz: 1x 40MHz Channel → Do not use Channel Bonding
3x 20MHz Channel



Gartner

- Continue deploying a/b/g devices

  (n confuses with a/b/g) Gartner 2006-01

- If more bandwidth is required

  (consider using N draft 2) Gartner 2007-07

Recommendation Econis

- 802.11n still under development
- Consider the different power options
- Connect 802.11n AP to Gigabit LAN Ports
- 802.11n only in 5 GHz Channel
- 802.11g in 2.4 GHz Channel for old Clients/Voice
- New WLAN-Client must support 802.11n in 5GHz Channel

Recommendation Econis

- Not the right time to change existing WLAN Infrastructure
- Synchronize WLAN Infrastructure changes with Notebook refresh cycle
- Consider 802.11n in new WLAN projects

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