In less than a decade, wireless LANs have evolved from an innovative idea to an indispensable technology for millions of businesses and consumers. This technology will continue to evolve. The latest generation of high-speed wireless LAN solutions, based on the IEEE Draft 802.11n standard, are now available.

**802.11**
(2Mbps)

**Point Applications**

- Inventory Management
- Barcode Scanning

→

**802.11b**
(11Mbps)

**Mobile Data**

- Email
- Web browsing

→

**802.11ag**
(54Mbps)

**Business Ready**

- Voice, Video, Data

→

**802.11n**
(300Mbps)

**Next Generation Wireless**

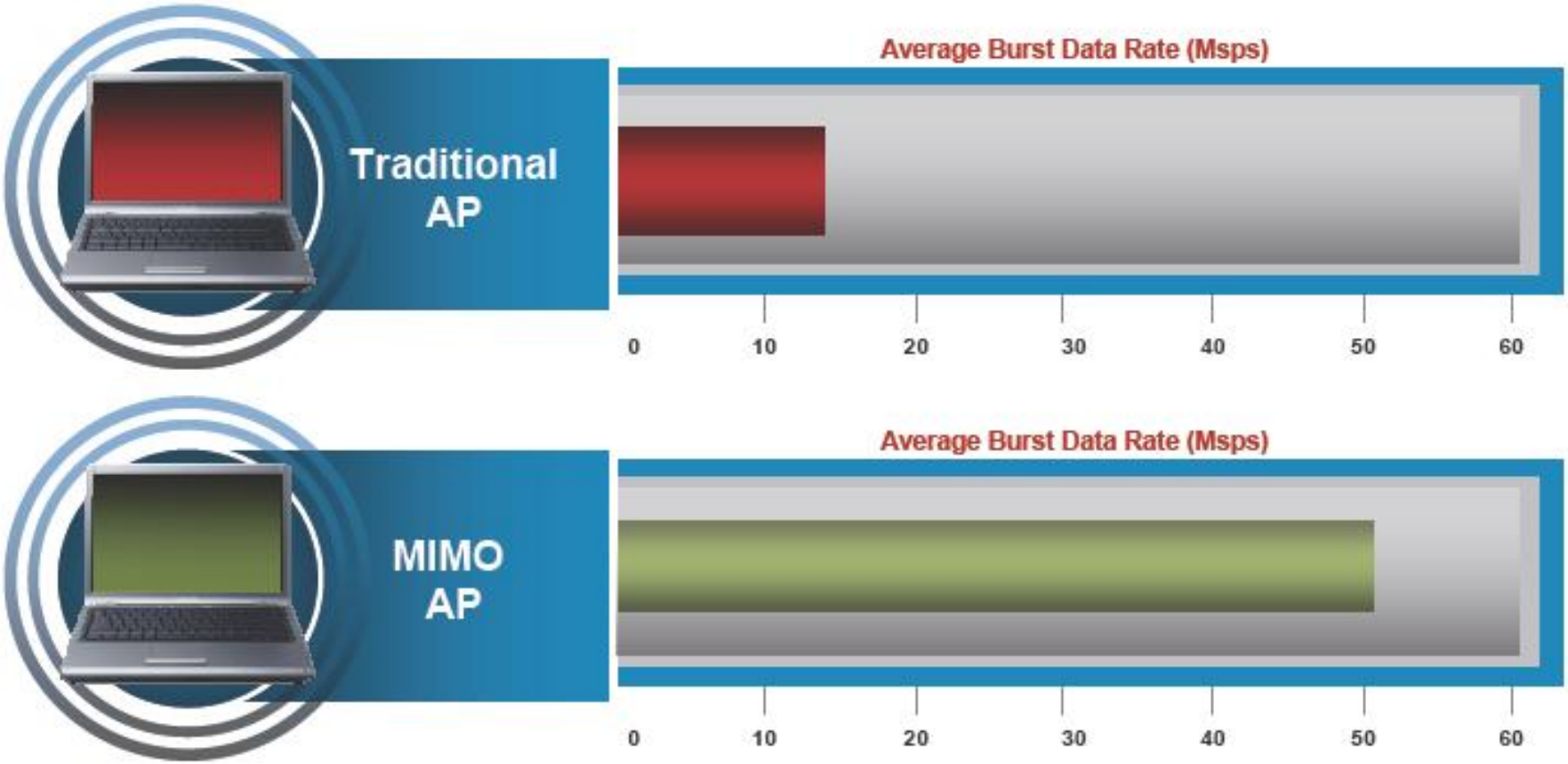
- Ubiquitous mobile computing

# What does 802.11n deliver?

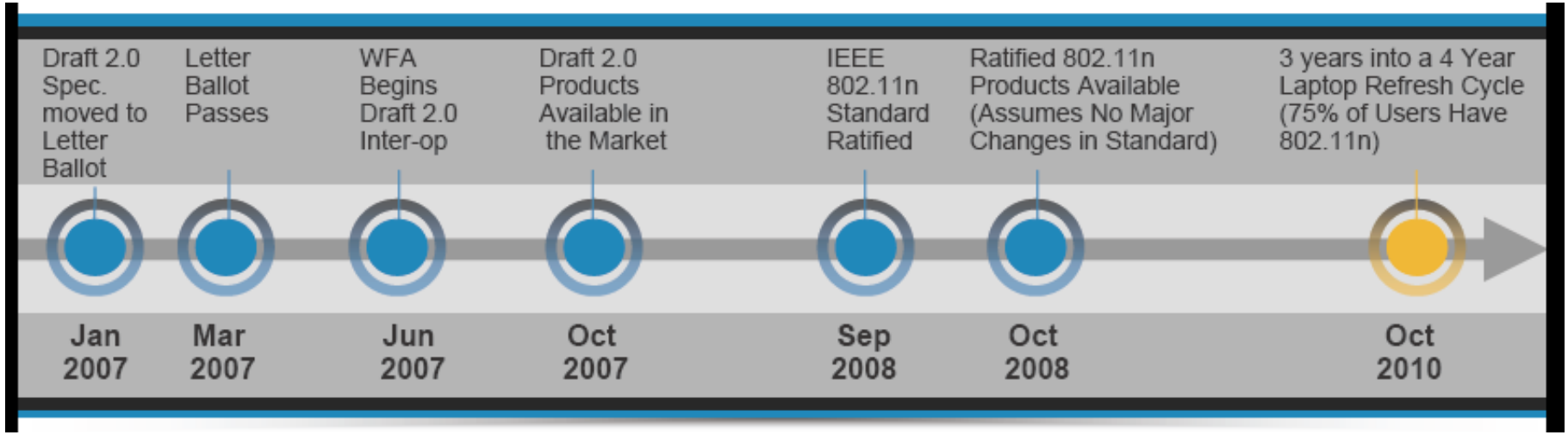
Better end-user experience for data, voice and video

- Throughput – Up to 5 times greater than existing networks
- Reliability – Fewer packet retries
- Predictability – Consistent coverage and throughput
- Compatibility – Backwards support for 802.11a/b/g clients

# Higher throughput, more reliable connections to each client



# 802.11n Standard Update



## Primary 802.11n Components:

- **Multiple Input Multiple Output (MIMO)**
  - Beam Forming
  - Spatial multiplexing
- **Channel Bonding**
- **Packet Aggregation**

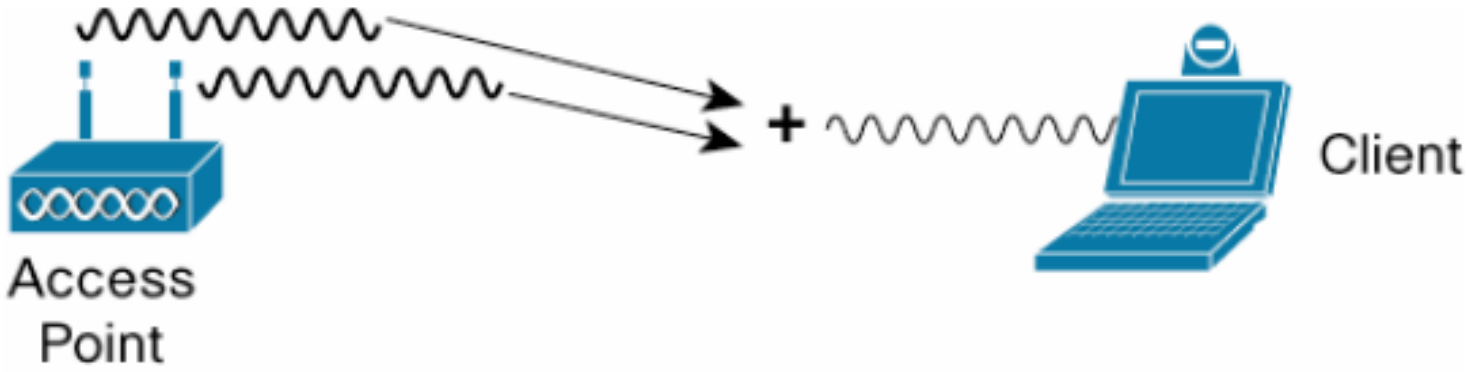
## Signal to Noise Ratio (SNR)

- Amount of information received by receive signal depends on the amount of received signal streng th exceeds the noise at the receiver

- The greater the SNR, the more information be carried and recovered by receiver

# MIMO Technology: Beamforming

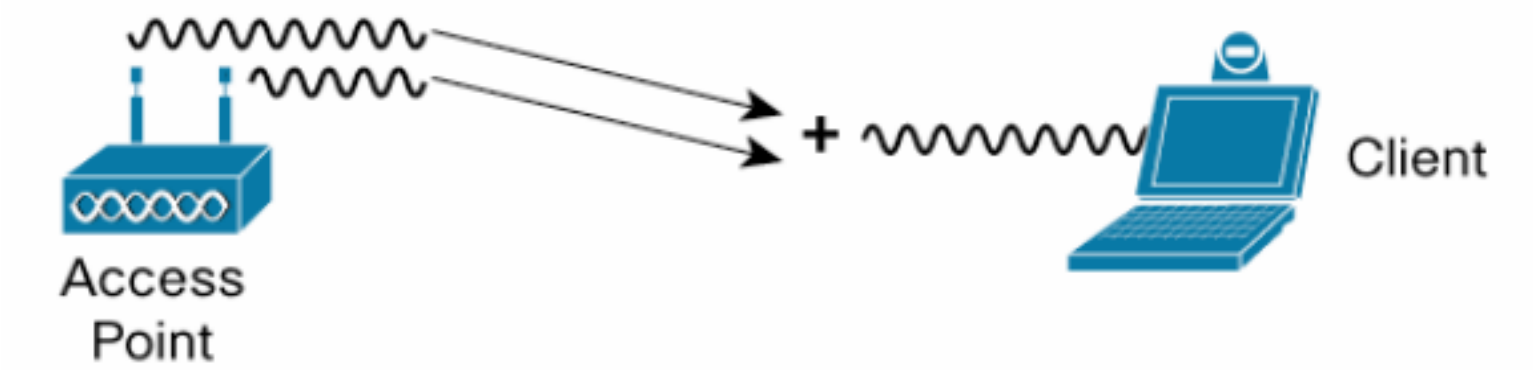
- Two radio signals sent out from different antennae, they are very likely to arrive at the receiver out of phase with each other
- Different in phase affects the overall signal strength of the received signal




**Negative Interference**

- By carefully adjusting the phase of the radio signals at the transmitter, the received signal can be maximised at the receiver, increasing SNR.

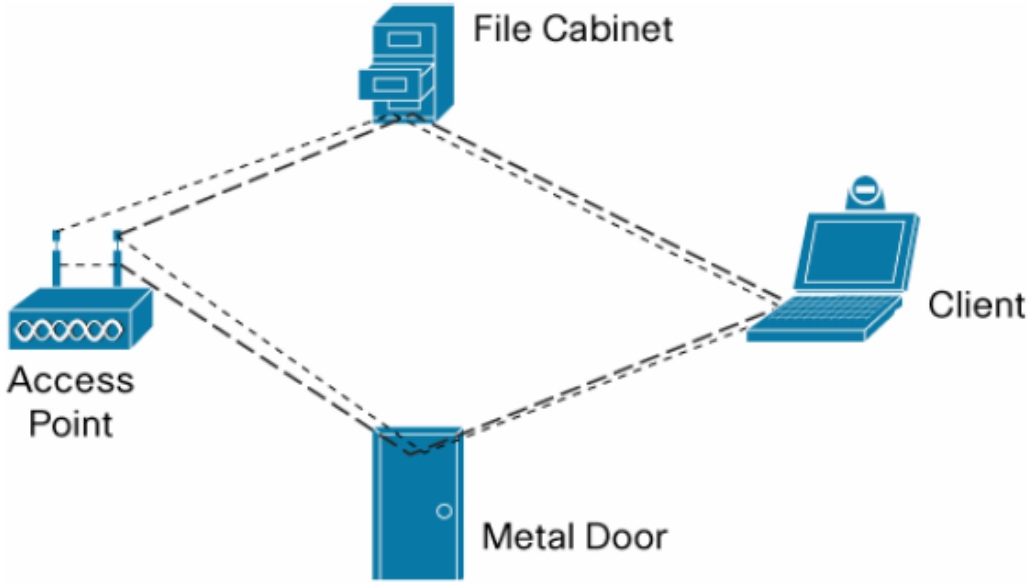
- Beamforming can effectively focuses the transmitters on a single receiver.
- Feedback from the receiver about the received signal. Help transmitter to tune each signal it sends.




**Positive Interference**

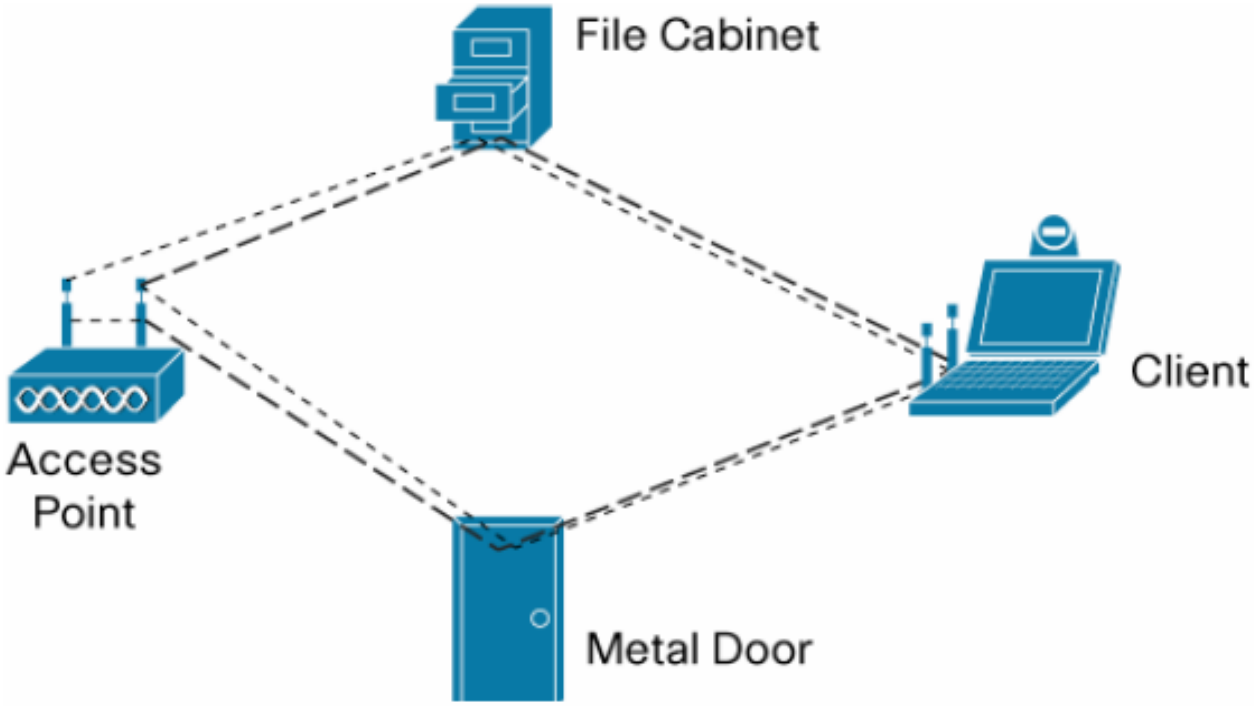
# MIMO Technology: Multipath or Spatial Diversity

- Signal travels different paths to a single receiver
- MIMO radio sends multiple radio signals at the same time and takes advantage of multipath



# MIMO Technology: Multipath or Spatial Diversity

- Each signal follows a slightly different path to the receiver
- Each radio can send a different data stream from the other radios
- Each receive radio independently decode arriving signals and each received signal is combined with signals from other receive radios



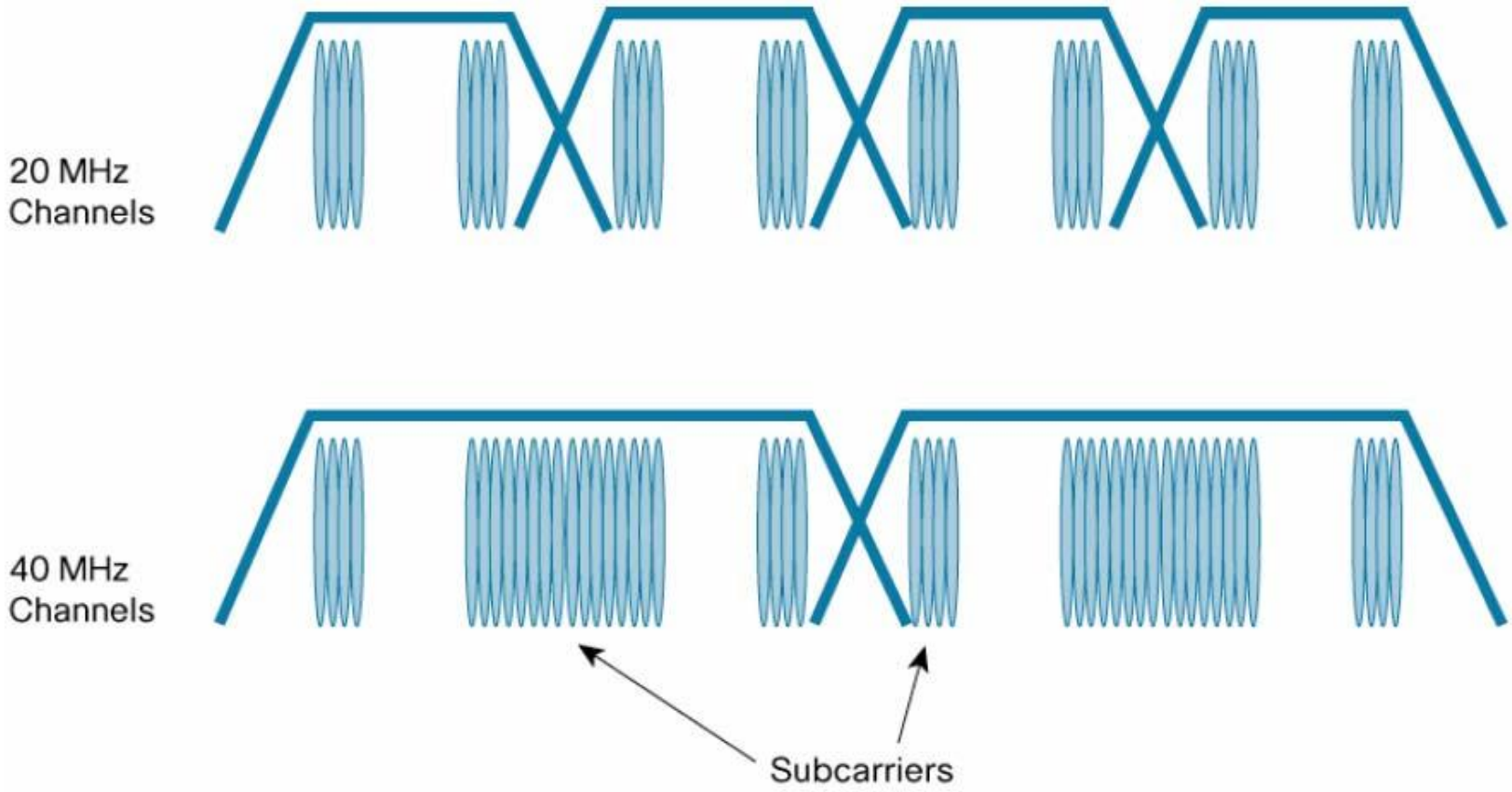
Two key significant benefits of MIMO are:

- Significant improves the SNR

- Use of multiple transmitters provide ability to use each spatial stream to carry its own information, dramatically increased data rates

## Channel Bonding: 20MHz and 40MHz Chan nels

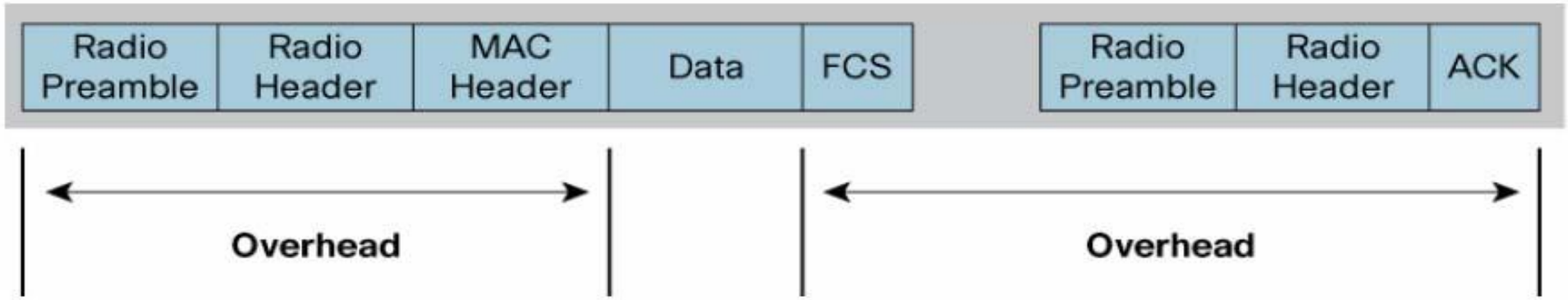
- 802.11n uses both 20MHz and 40MHz channels.
- Channel bandwidth increased and doubling data rate.



# Packet Aggregation

- Increase efficiency by aggregating multiple packets of application data into a single transmission frame
- Send multiple data packets with fixed overhead cost of a single frame

**Overhead**




**Aggregation**

# MIMO Technology Advantages

## Greater reliability

- **MIMO has able to communicate over multiple antennae eliminate dead spots**
- **Maintain optimal performance at greater distances**

## Greater throughput

- **Combination of MIMO, channel bonding and packet aggregation allow 802.11n networks to achieve data rates as high as 300Mbps per radio**

## Greater coverage predictability

- **802.11n networks can support more clients using high-bandwidth applications**

## Backward compatibility with Existing Platforms

- 802.11n networks able to backward compatible with clients built under previous 802.11a/b/g wireless standards
- 802.11n Access Points will interoperate easily in mixed environments
- 802.11n can incorporate 802.11a/g clients with minimal