



small cells  
go big. go fast. go now.

# Wireless Unified Networks

## Moving Beyond Co-Existence: Blending Wi-Fi and Cellular

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Oct 6<sup>th</sup>, 2015

# Alcatel-Lucent's Wireless Unified Networks

Combine the best of Wi-Fi, unlicensed spectrum, and licensed cellular (3G & 4G) to provide an unmatched experience and network. Two initiatives:

## Wi-Fi Boost

Boost Wi-Fi by  
adding in cellular  
(3G & 4G)

## Cellular Boost

Boost cellular by  
adding unlicensed  
spectrum capacity

# What characterizes a wireline experience?

- Incredible speed
- Rock solid reliability
- Congestion free / near unlimited bandwidth
- Flawless HD voice and video conferencing

This is the goal, but to deliver it **WIRELESSLY**  
in the **HOME** and in the **ENTERPRISE**



# Isn't this being done with Wi-Fi today?

## Wi-Fi is good, but not great



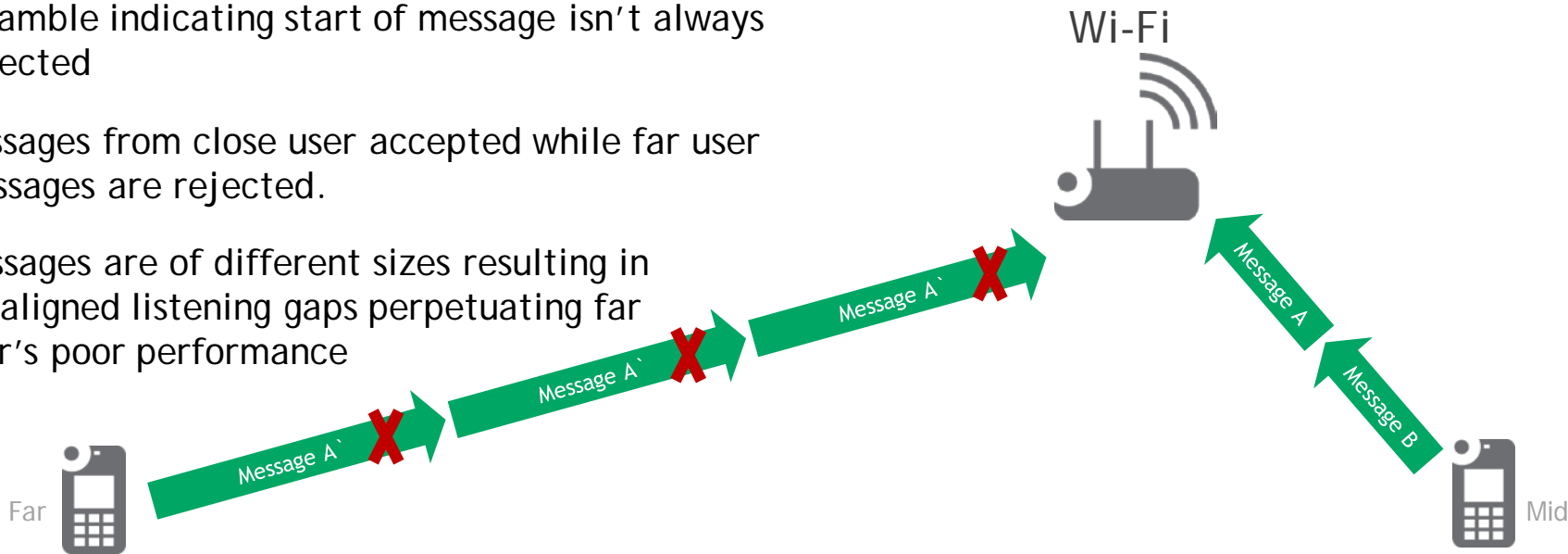
Consumers are accepting of Wi-Fi but desire better performance for the home and enterprise to improve:

- Speed at the edge
- Poor range
- Congestion/interference
- “Unfair” access depending on user’s location
- Poor uplink data rates – buffered video
- Limited / Challenging mobility
- Inconsistent performance

# Wi-Fi's Achilles heel

## Uplink interference

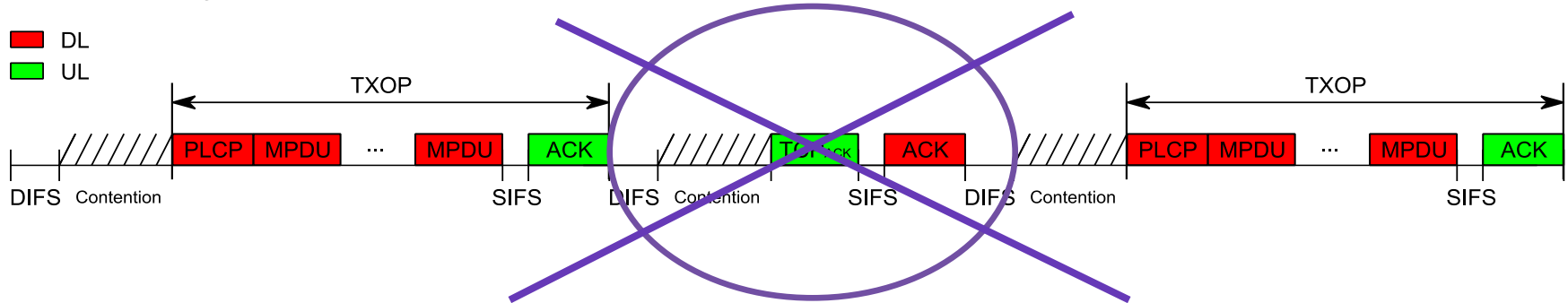
- Preamble indicating start of message isn't always detected
- Messages from close user accepted while far user messages are rejected.
- Messages are of different sizes resulting in misaligned listening gaps perpetuating far user's poor performance



Close/Mid user occupies channel - performance for other users becomes limited

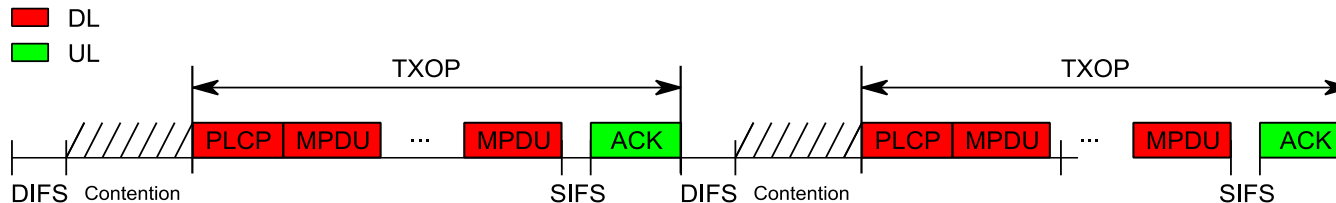
# Visualizing Uplink offload - TCP Offload to LTE: MAC Picture

- WiFi only case



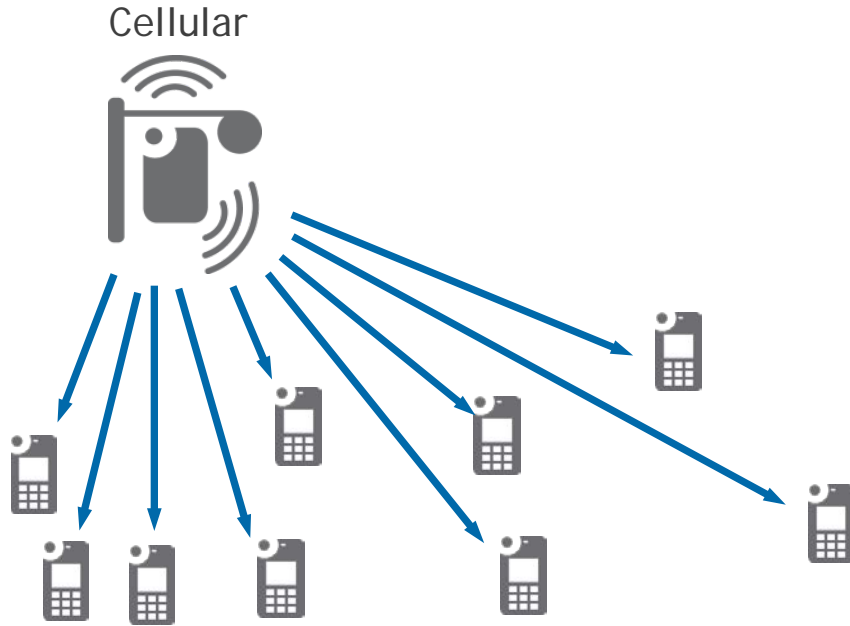
Boost offloads TCP ACKs to LTE,  
allowing 'back to back' DL transmissions

- *Boost* case



# Cellular's Achilles heel

## Limited and expensive downlink bandwidth



- Bandwidth constraints (Wi-Fi offers 8x capacity via 160MHz compared to 20MHz licensed cellular)
- Slower modulations for near users compared to Wi-Fi
- High number of users contend for limited resources (e.g. macro)

Cellular's uplink capability provide better performance, especially for edge users



Wi-Fi & Cellular are  
complimentary  
wireless technologies  
Instead of “co-  
existing” , what if we  
“blended”?

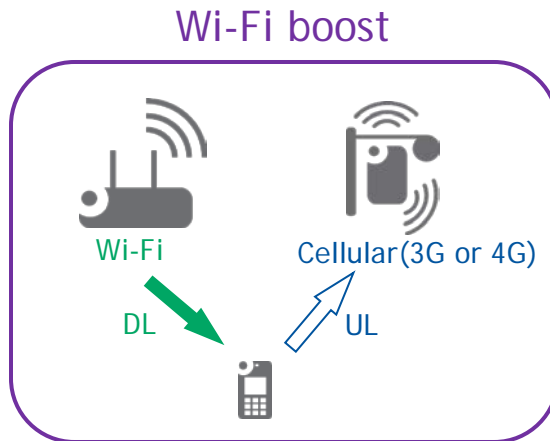


# Introducing Wi-Fi boost

## Simultaneous access to both Wi-Fi and cellular

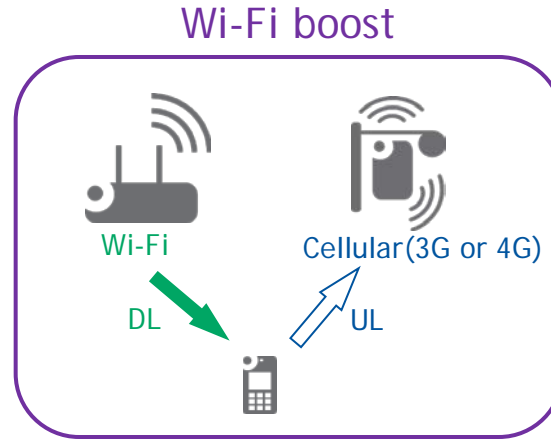
### Wi-Fi Boost

Boost Wi-Fi by adding in cellular (3G & 4G)



- Best of cellular: UL traffic (including Wi-Fi TCP ACKS) carried via cellular
- Best of Wi-Fi: DL traffic delivered via Wi-Fi alone OR through aggregation

# Benefits of Wi-Fi boost



## Wi-Fi Boost

Boost Wi-Fi by adding in cellular (3G & 4G)

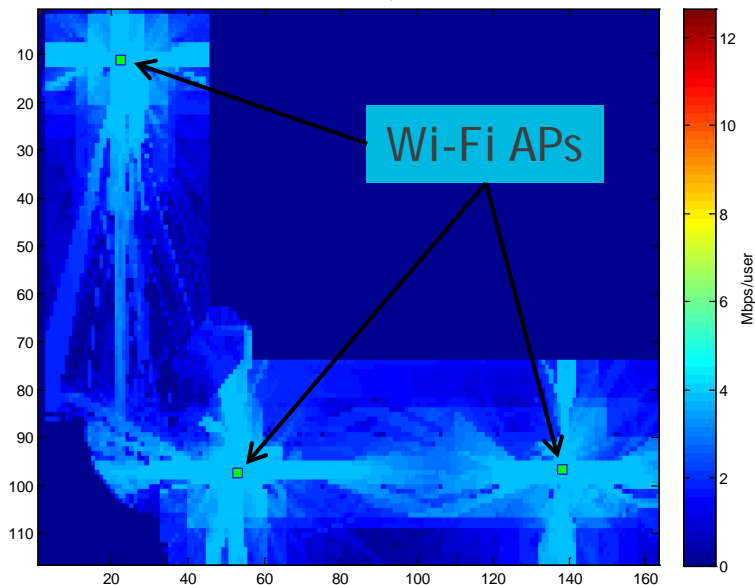
- 20% - 30% increase in Wi-Fi DL - Single User
- 70% increase in Wi-Fi DL – Multi User
- 10x or more (55x in lab tests) increase in UL (Far user)
- Wi-Fi range increased by 2x
- More consistent Wi-Fi performance (LTE DL always available on hot stand-by to respond to Wi-Fi congestion)

- Utilizes existing UE's
- Applicable to 3G and 4G
- Works with existing Wi-Fi APs
- Adding value beyond basic coverage
- Upgrade from a user experience PoV

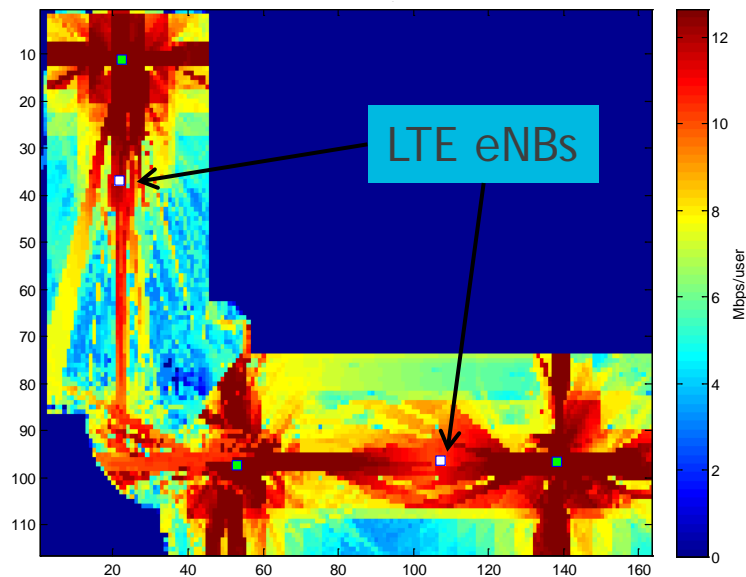
# Enterprise use case with 100 Wi-Fi users

## Significant improvement as a result of deploying Wi-Fi boost

Wi-Fi TCP DL Throughput



Wi-Fi Boost TCP DL Throughput

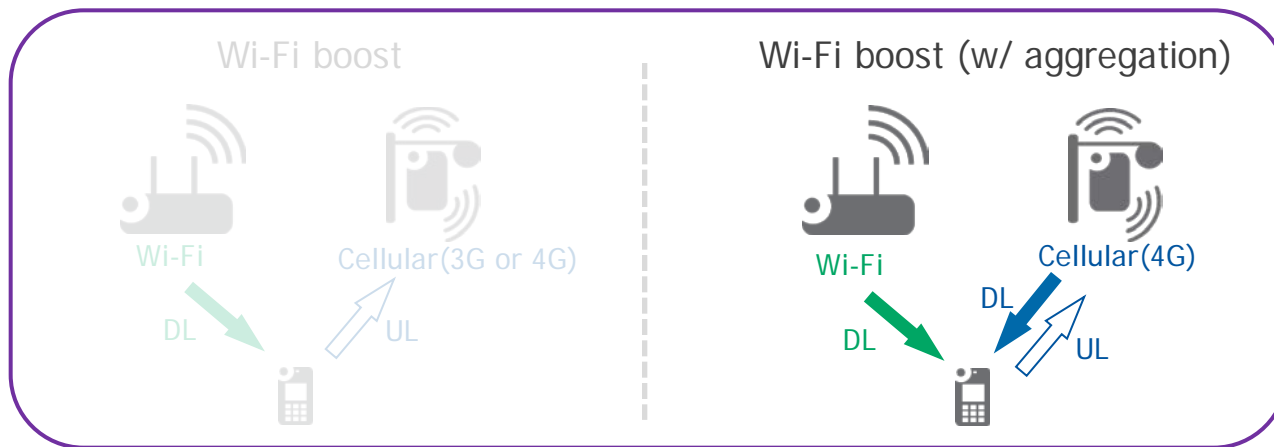


# Introducing Wi-Fi boost with aggregation

## Wi-Fi Boost

Boost Wi-Fi by adding in cellular (3G & 4G)

### Boost



- Wi-Fi boost with aggregation migrates UL traffic to cellular and aggregates DL
- Similar effort underway in 3GPP called LTE Wi-Fi Link Aggregation (LWA)



# Every success has its network