High Performance Wi-Fi Essentials

BICSI Rome
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Agenda

- 10 Essential Tips for High Performance Wi-Fi
- Some hands-on illustrations here & there
- Q&A

Duration: 60 minutes
Let’s NOT deploy this:
Tip #1: Setting up Wi-Fi network is like...
Not High Capacity
High Capacity

If you have a few customers, just one bartender, even one working slowly, will suffice. It's when you have more customers that things get more tricky. Just like with high capacity Wi-Fi.

- Lots of access points
- Tons of clients
- High data demand
Tip #2:

To care or not to care?
“Worry later”

Little or no best practices, processes or tools
“Design Approach”

Interview network users, then design using best practices and tools.
Which guy would you like to be?
Life Cycle of a Wi-Fi Network

- Continuous
- Preparation & Requirements
- Predictive Design
- Pre-Deployment Site survey
- Installation and Configuration
- Post-Deployment Site Survey
- Continuous Packet analysis
- Periodic Check-ups
- Monitor
- Plan
- Troubleshoot
- Validate
- Spectrum analysis
Tip #3:

Blueprint quality has a direct correlation with Wi-Fi design efficiency.
• **CAD drawings**
  - Eliminates the drawing of walls
  - Provides scale automatically

• **Pro tip:** Charge customer more if no CAD drawings available
• **Blueprint essentials**

  • Up-to-date
  • White background
  • Room numbers visible
  • Wiring closets marked
  • Existing AP placements marked

  • If non-CAD, width / height between 1000px and 5000px is ideal.
  • If CAD, ask blueprint manager to only give you wall / door / window infrastructure, not plumbing / furniture / plants
Tip#4: Aim for high data rates
Entering the network (authentication & association)

To get their beer, people need to enter the restaurant and walk close enough to the waiter (associate) you also need to show your ID (authenticate) to get your beer.
What’s Required to Associate High Signal Strength

Authenticate
A Bartender Serves One Customer At a Time

- One device can only talk for a short period at a time…
- … and then it’s somebody else’s turn
High Data rate is vital

- How long it takes for a device to send its transmission, depends mostly on **data rate**
- The higher the data rate of all the devices, the more everyone can transmit per second
- Data rate depends on signal strength / SNR
Contributors to low data rate

Noise

Channel Interference

Low client capabilities
What have we learned so far?
Why is this guy unhappy?

- High data rates here
- High noise level
- Low signal strength, very low SNR
Tip#4: Not all client devices are equal
Not everybody should be let in

Just like no kids or intoxicated adults in your bar –

To maximize airtime, disable

- Legacy client access (802.11b/g)
- Low data rates in general
Low data rates

- You know those guys who pay with pennies?
- Low data rate clients are just like that: They slow down everyone in the network
Client device efficiency

3 spatial streams high efficiency

1 spatial stream low efficiency
MU-MIMO
Not all clients are transmitting data all the time.
Tip#5: Is More Better?
Adding more bartenders doesn’t always help!

Clumsy Bartender
(2.4 GHz Wi-Fi)
Using 5GHz Wi-Fi is like having skilled bartenders
Reduce Channel Overlap by Strategic AP Placement

APs in hallways = lots of interference

APs in rooms = no co-channel interference
MORE APS IS BETTER... CCI!
There’s Always Some Overhead

- Waiting for your turn (Clear Channel Assessment)
- Mixing the drink (Management traffic)
- Paying for the drink (Acknowledgement)
- Phrases like
  - ”How are you”, “good thanks” (Probe request / response)
Complex Drinks Are Like Extra SSIDs…

- Mixing complex drinks eats up the usable “airtime”

<table>
<thead>
<tr>
<th># of bartenders</th>
<th>Drink complexity</th>
<th>Number of APs on Channel*</th>
<th>Number of SSIDs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3.22%</td>
<td>6.45%</td>
<td>9.67%</td>
</tr>
<tr>
<td>2</td>
<td>6.45%</td>
<td>12.90%</td>
<td>19.35%</td>
</tr>
<tr>
<td>3</td>
<td>9.67%</td>
<td>19.35%</td>
<td>29.02%</td>
</tr>
<tr>
<td>4</td>
<td>12.90%</td>
<td>25.80%</td>
<td>38.70%</td>
</tr>
<tr>
<td>5</td>
<td>16.12%</td>
<td>32.25%</td>
<td>48.37%</td>
</tr>
<tr>
<td>6</td>
<td>19.35%</td>
<td>38.70%</td>
<td>58.04%</td>
</tr>
</tbody>
</table>
Tip#6: The spectrum police academy
What Can Interfere with Wi-Fi

- Microwave Ovens
- Cordless phones
- Wireless cameras
- Baby monitors
- Wireless audio systems
- Bluetooth
- Radar
- GSM networks!
Tools to Fight Interference

- Spectrum analyzer
- Site survey tool
- A hammer ;)

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Bicsi logo
Two types of Spectrum Analyzers

- External device
  - Floor level measurement
  - Can be taken anywhere

- Built into access point
  - Always out there
  - Measures where the AP is (ceiling)
CSI it like Horatio

1. What’s Wi-Fi, what’s not

2. How bad is the interferer – amplitude, duty cycle and channel

3. Is the interferer constant or periodic in nature?
Wi-Fi vs Not Wi-Fi

Wi-Fi

Not Wi-Fi
Periodic interferer
Questions before acting

- Is the interferer impacting your network?
- Can the interferer be eliminated?
- Will adjusting the network fix the problem?
- Is there a Wi-Fi substitute for the interferer?
- Can you break it ;)

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Tip#8: “Site survey just slows down everything”
Survey Phase

Predictive site surveys (network plan, simulation)

Pre-Deployment site surveys (AP on a stick)

Post-Deployment site surveys (validation)

Periodic site surveys (health check)

Question


“What does the real world RF look like”

“Does this network actually work?”

“Does it still work? What has changed?”
Survey Happiness Scale

• No surveys
• Post-deployment validation
  + Predictive
  + Periodic check-ups, AP on a stick
<table>
<thead>
<tr>
<th>Survey Type</th>
<th>The process</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predictive Survey</td>
<td>Simulate RF by defining walls, placing simulated APs</td>
<td>Simulated heatmaps of capacity &amp; coverage</td>
</tr>
<tr>
<td>Passive Survey</td>
<td>Walk around, collect beacons and probes, measure things like Signal strength,</td>
<td>SNR, RSSI, interference heatmaps for all APs</td>
</tr>
<tr>
<td></td>
<td>Interference, SNR for all APs.</td>
<td></td>
</tr>
<tr>
<td>Active Survey</td>
<td>Walk, connect to the network, test things like packet loss, RTT, association</td>
<td>Heatmaps and deeper analysis like roaming, ...</td>
</tr>
<tr>
<td>Throughput Survey</td>
<td>Measure throughput (Mbit/s, # of packets) and jitter, often spot checks</td>
<td>Momentary capacity analysis, voice analysis</td>
</tr>
<tr>
<td>Spectrum Survey</td>
<td>Detect all RF energy / interference</td>
<td>Interferers, duty cycle, etc.</td>
</tr>
</tbody>
</table>
Tip#9: High Capacity Means Asking the Right Questions
Calculating Capacity

Number of clients

Distribution of clients

Beer, wine or shots?

Client types
Number of Thirsty People?

- Number of wireless users
- Number of devices per user
  - One often active at a time
  - Idle devices eat some capacity, too
- The device type of the user
  - 802.11ac/n/g/a/b?
  - Number of spatial streams supported
  - MU-MIMO capable?
How Thirsty Are the Customers?

- **Applications**
  - What applications are the users primarily using
  - How frequently are the applications used
Calculating capacity need

- **Excel based tools / calculators**
  - Calculates the required number of Aps
  - Can go to great detail
  - Revolution Wi-Fi capacity calculator

- **Map-based tools**
  - Calculates number of APs
  - Suggests AP placement and channels
  - Predicts coverage & capacity
  - Ekahau Site Survey Pro
## Process for Designing High Capacity Wi-Fi

<table>
<thead>
<tr>
<th>Folks want beer.</th>
<th>1. Business need</th>
<th>Wireless access everywhere</th>
</tr>
</thead>
<tbody>
<tr>
<td>They want it cold and fast.</td>
<td>2. Tech Requirements</td>
<td>Every user 5MB/sec</td>
</tr>
<tr>
<td>Enough taps &amp; bartenders.</td>
<td>3. Infrastructure</td>
<td># of access points (APs)</td>
</tr>
<tr>
<td>Placement of counters, taps.</td>
<td>4. Predictive design</td>
<td>AP placement &amp; antennas</td>
</tr>
<tr>
<td>Build the bar, buy the beer.</td>
<td>5. Deployment</td>
<td>Set up the network</td>
</tr>
<tr>
<td>Check that the taps work.</td>
<td>6. Verification</td>
<td>RF walk—through site survey</td>
</tr>
<tr>
<td>Keep things clean &amp; working.</td>
<td>7. Maintenance</td>
<td>Keep network running</td>
</tr>
</tbody>
</table>
Tip#10: Learn More
Summary

- Ensure high data rates
  - High signal strength
  - Low noise
  - Smart network design
  - Site Survey
  - High signal strength
  - Fairly new clients & APs

- Calculate capacity need
  - Number of users
  - Number of devices
  - Data usage per device

- Maximize Airtime
  - Prefer 5GHz
  - Minimize CCI
  - Minimize SSIDs

- Areas to cover

- Number of devices

- Number of users

- Data usage per device

- Site Survey

- Smart network design
Thank you!

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