High Density Wireless

Why doesn't the conference network work?

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Talk materials available at
http://talks.lang.hm/talks/topics/Wireless

How I became the Wireless Manager for SCaLE

March 2008, Me to SCaLE networking folks:

Wireless at ScaLE didn't work, what did you do? <cringe> That's complely wrong, I can help.

Jan 2010, SCaLE networking folks to me:

You said you know something about wifi, our vendor just backed out and we will have around 1200 people arriving in a month, can you help us?

Why does wireless always suck?

- Wifi works great when setup and tested. Then lots of people try to use it, then it doesn't degrade gracefully, it just collapses.
- Is this a fundamental limitation of Wifi?
  - Yes and No. It's primarily a Radio side issue
    - Yes, there is limited radio airtime and when you run out collapse happens
    - No, there are many things you can do to delay the collapse
- Do 'Enterprise Class' AP's solve the problem?
  - No, many of them make it worse

Defining the problem

- Conferences have lots of people in small areas
- Tech Conferences have lots of devices
  - Scale 10x 1965 people 1935 devices
    - 875 connected at once
- Radios only allow one thing to talk on a given channel at any point in time

Radio Problems

- Not enough Channels (especially on 2.4GHz)
  - Should not use the same channel in nearby locations. Ideally at least 3x service range between re-use
- Hidden Transmitters
- A small amount of interference will trash the entire packet

Protocol Problems

- Wifi Speed fallback
- “Housekeeping” traffic
  - Just staying connected to an AP generates traffic
  - When you get too many devices connected to one AP you have no airtime left to actually pass user data

Digital Network Issue

- Bufferbloat
  - In an attempt to prevent packet loss (and with cheap memory) network buffers have become gigantic
  - If there is congestion, the packets can sit in the buffers long enough that the sender retransmits them before they arrive, so data gets sent multiple times, adding to the congestion

How the collapse happens

- The combination of
  - Retries
  - Hidden Transmitters
  - Fallback to slow speeds
  - Wasted packets due to bufferbloat

Power Levels and Antennas

- Turning up power seldom helps
- In fact it usually hurts
- Better antennas are almost always better than amplifiers

A quick note on Enterprise APs

- Many radios in one spot
- Some with directional antennas
  - Hidden transmitter problem caused by antenna patterns

This is bad, now what

- So now that we've seen how the networks collapse, what can be done to make things better?
- First off, find out what you are up against
  - Site survey
    - MySpy spectrum analyzer
    - Kismet
    - Wifi analyzer
    - Bring an AP
    - Find the network jacks

Fixes

Encourage 5GHz

Fixes

- Lots of access points
- Turn down power on 2.4Ghz
  - How far down? Waaaay down
    - Scale 10x had the AP's set to 4mw
  - Remember that it doesn't help to use more power than the devices you are talking to.
- Take advantage of things that block the signal
  - Walls, Bodies, etc. Don't create more hidden transmitters

Fixes

- Use advanced antennas carefully
  - To direct the signal away from areas more than towards them
  - To reach into areas where you don't have wires

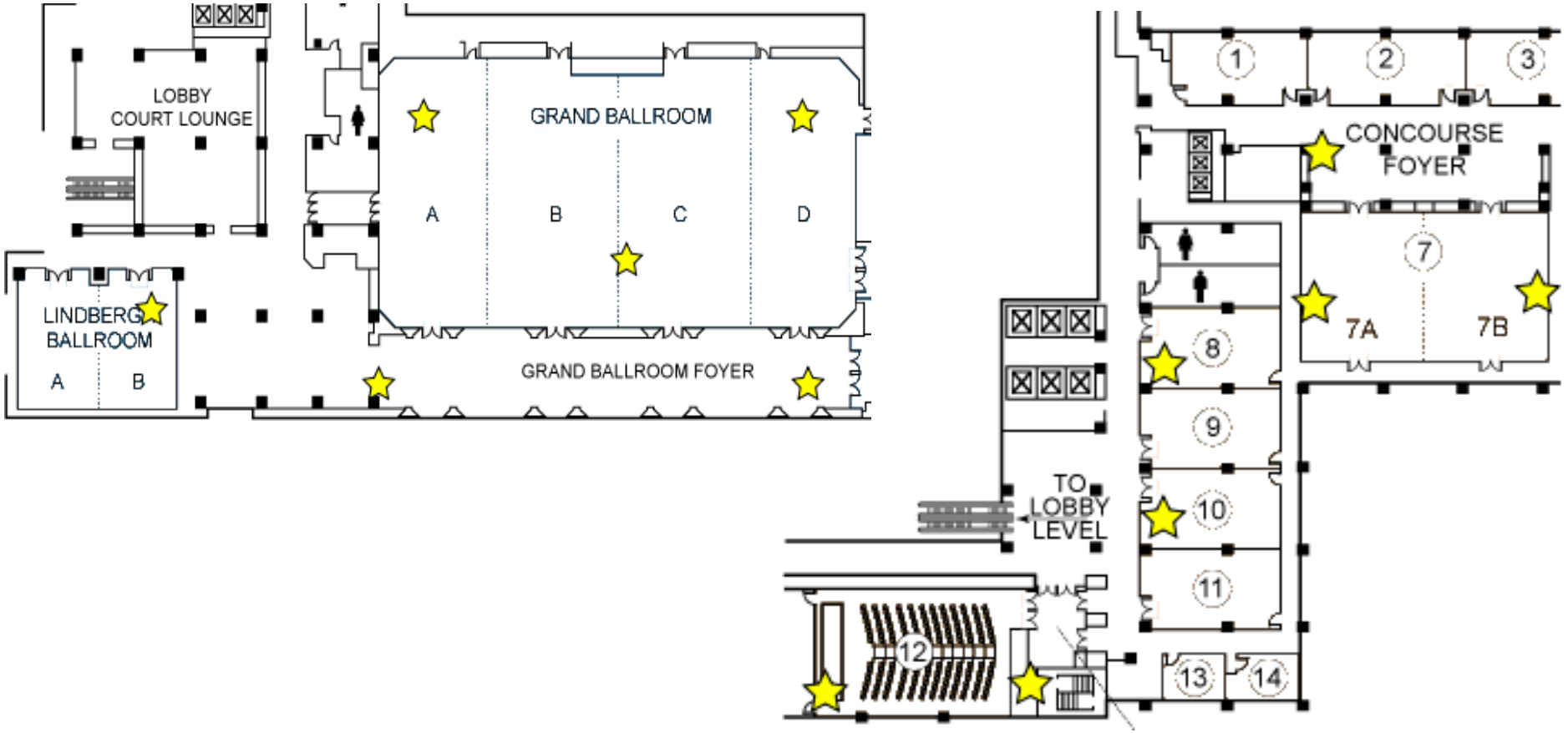
Digital Issues

- SSIDs
  - One allows roaming
  - Many allow users to specify best AP
- Use one per band

Config Items

- Enable Wireless Isolation
- Beacon Interval
  - Advertise the SSID less frequently, delays connections but saves airtime
  - Prime value to reduce sync issues
- Disable slow speeds
- Kernel buffers/FQ_Codel queuing
- Disable conntrak (netfilter)
- Short inactivity timers

Scale 8x LAX Westin 2010



http://www.hilton.com/en/hi/hotels/meeting_space.jhtml?ctyhocn=LAXAHHH

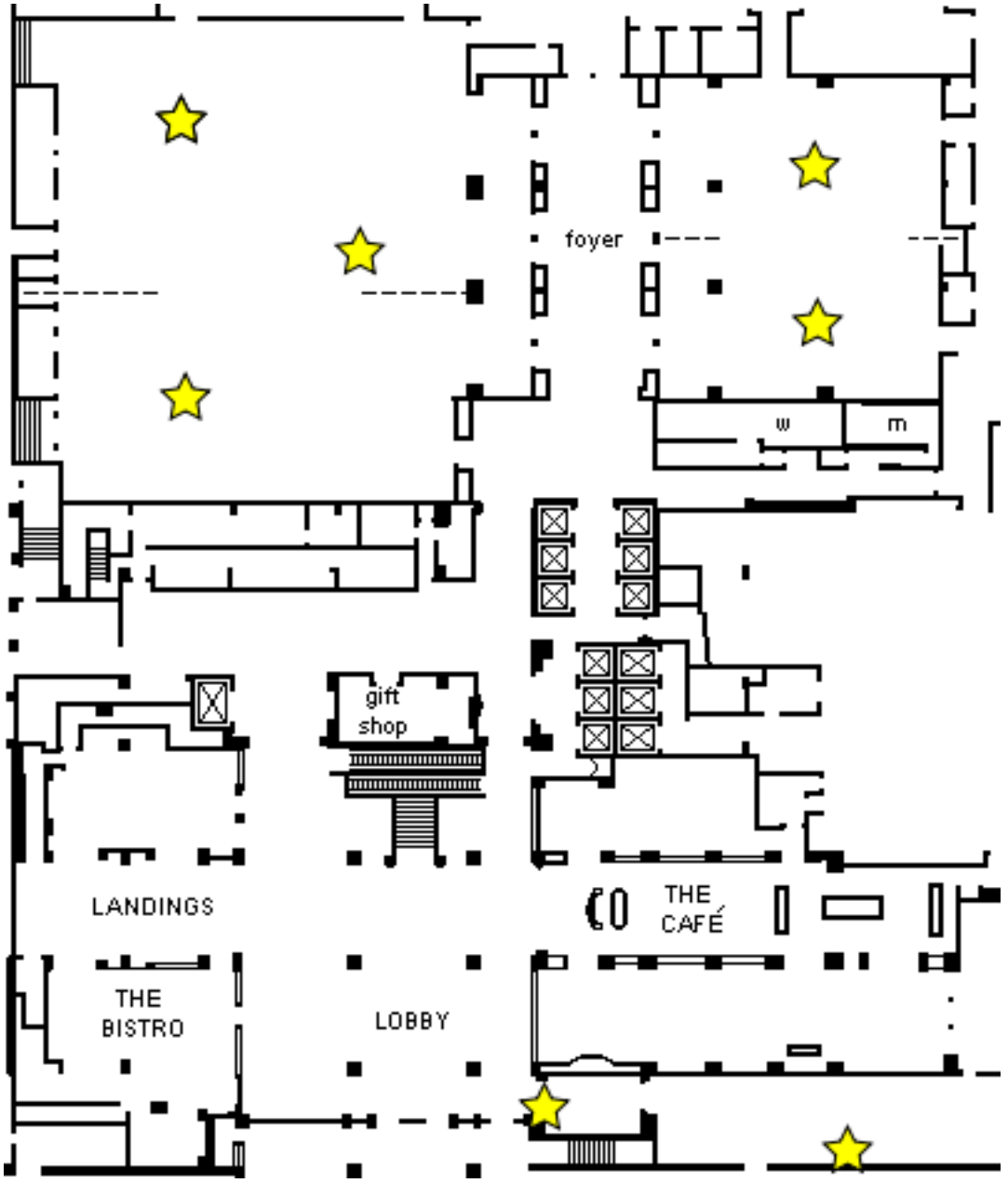
ScaLE 10x

2011

LAX Hilton

AP locations

1st Floor



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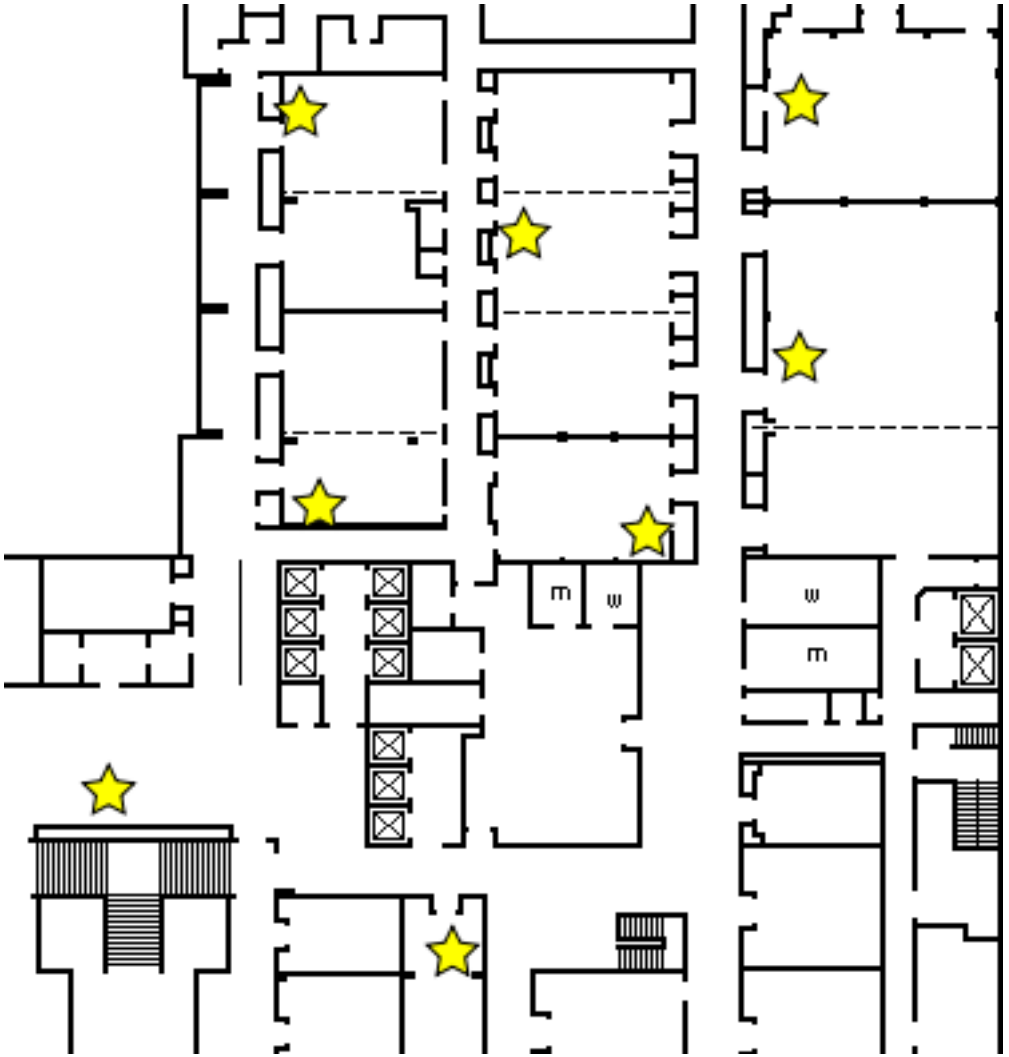
ScaLE 9x

2011

LAX Hilton

AP locations

2nd Floor



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ScaLE 9x

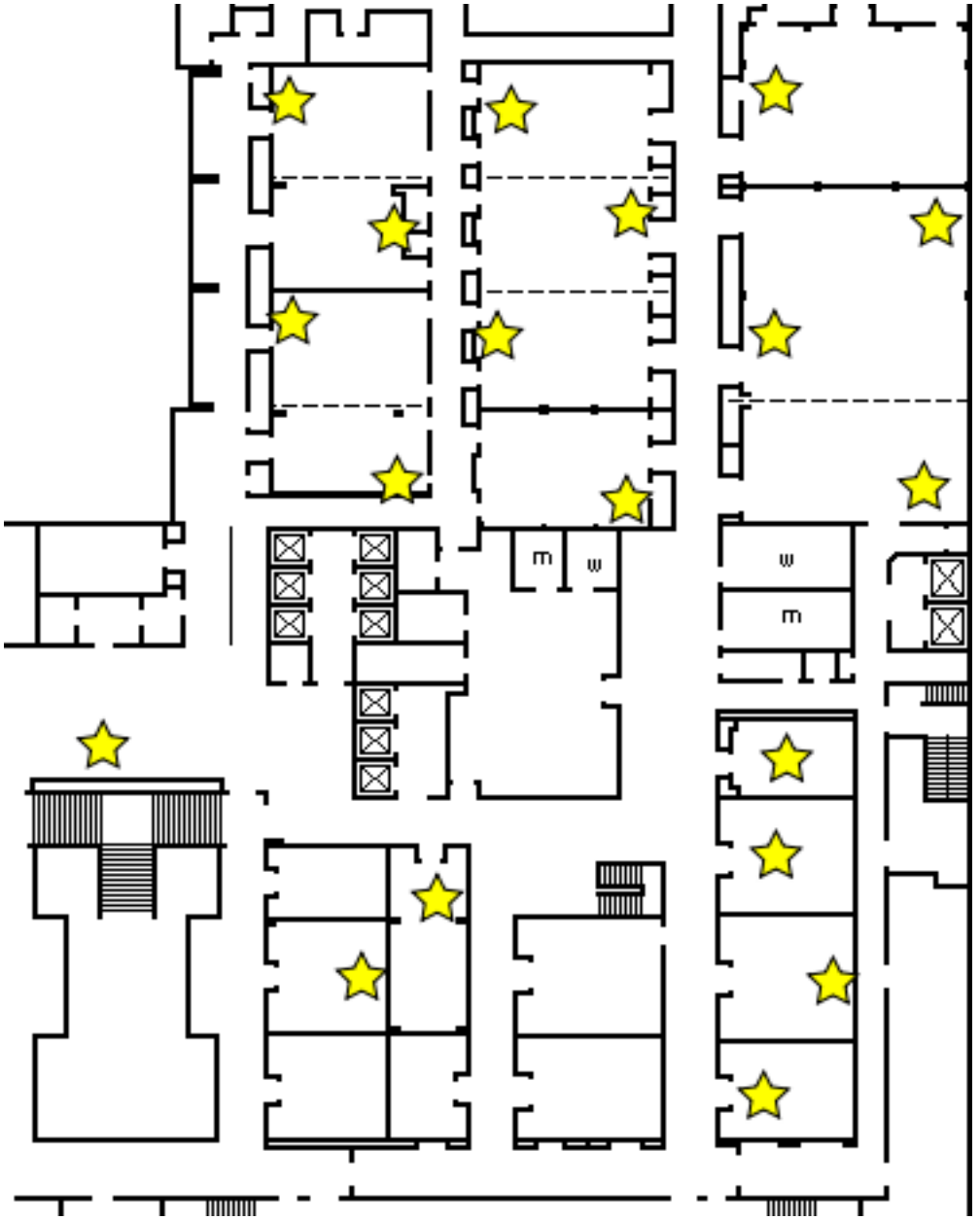
2012

LAX Hilton

AP locations

2nd Floor

(1st Floor same as 2011)



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ScaLE 10x

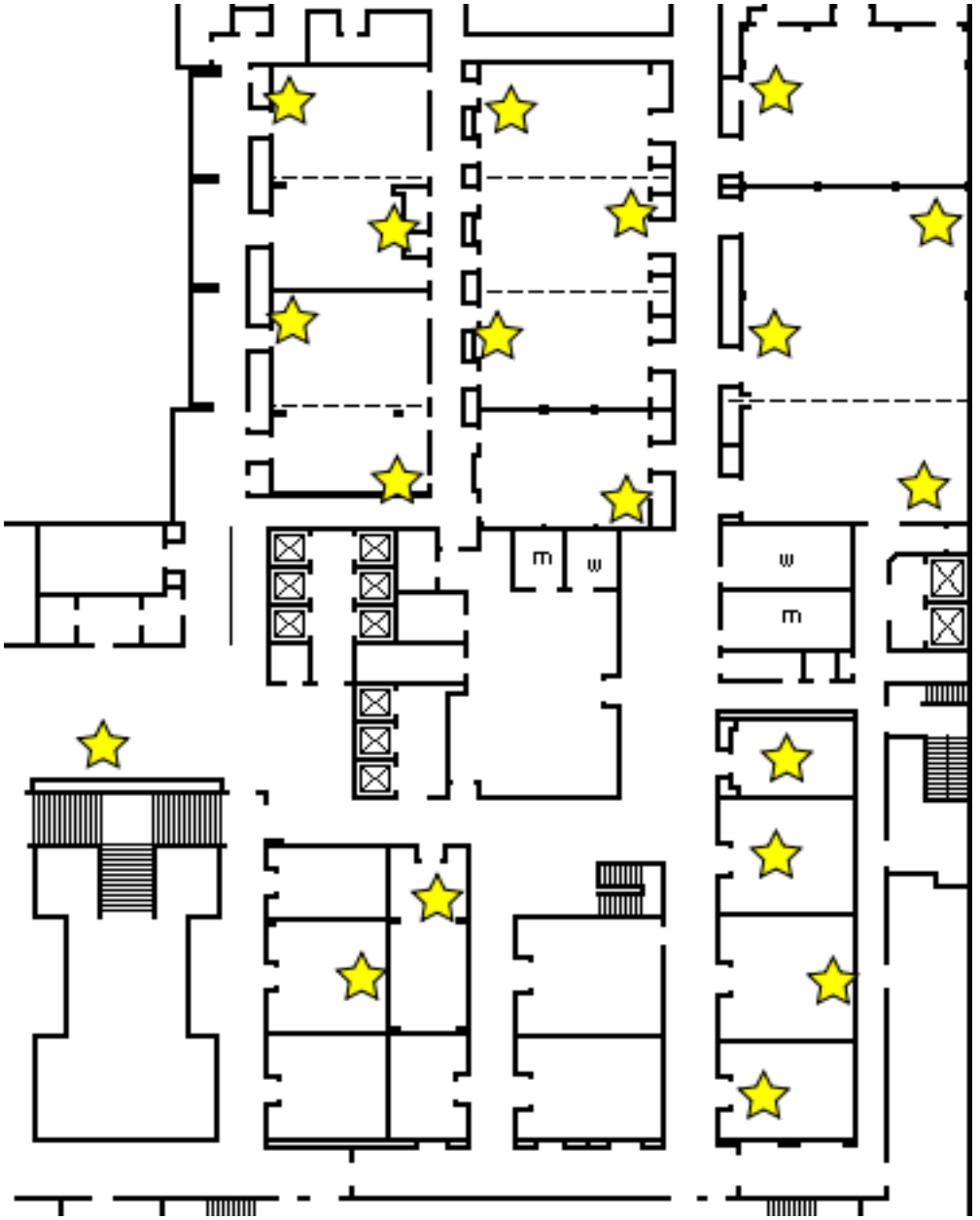
2012

LAX Hilton

AP locations

2nd Floor

(1st Floor same as 2011)



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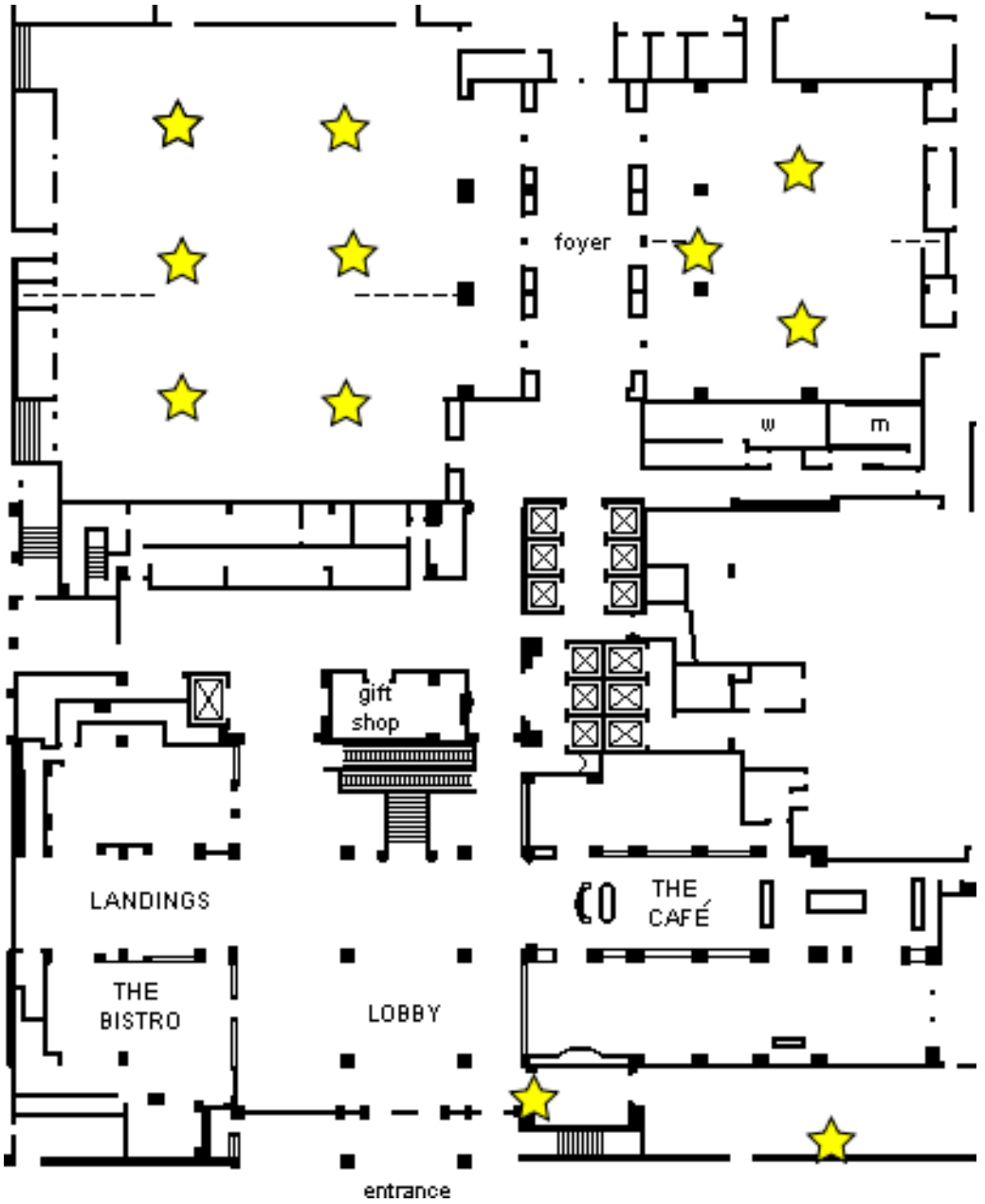
ScaLE 11x

2013

LAX Hilton

AP locations

1st Floor



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ScaLE 11x

2013

LAX Hilton

AP locations

2nd Floor

Equipment

- 2010
  - Fry's FR300 2.4GHz only Stock firmware
  - Netgear 5GHz only Stock firmware
- 2011
  - Fry's FR300 2.4GHz only DD-Wrt firmware
  - Netgear 5GHz only Stock firmware
- 2012-2013
  - Netgear WNDR3800 dual band OpenWrt firmware