COMCAST BUSINESS
Powering Possibilities™

A “Brewster’s Millions” Story of Wi-Fi Deployment

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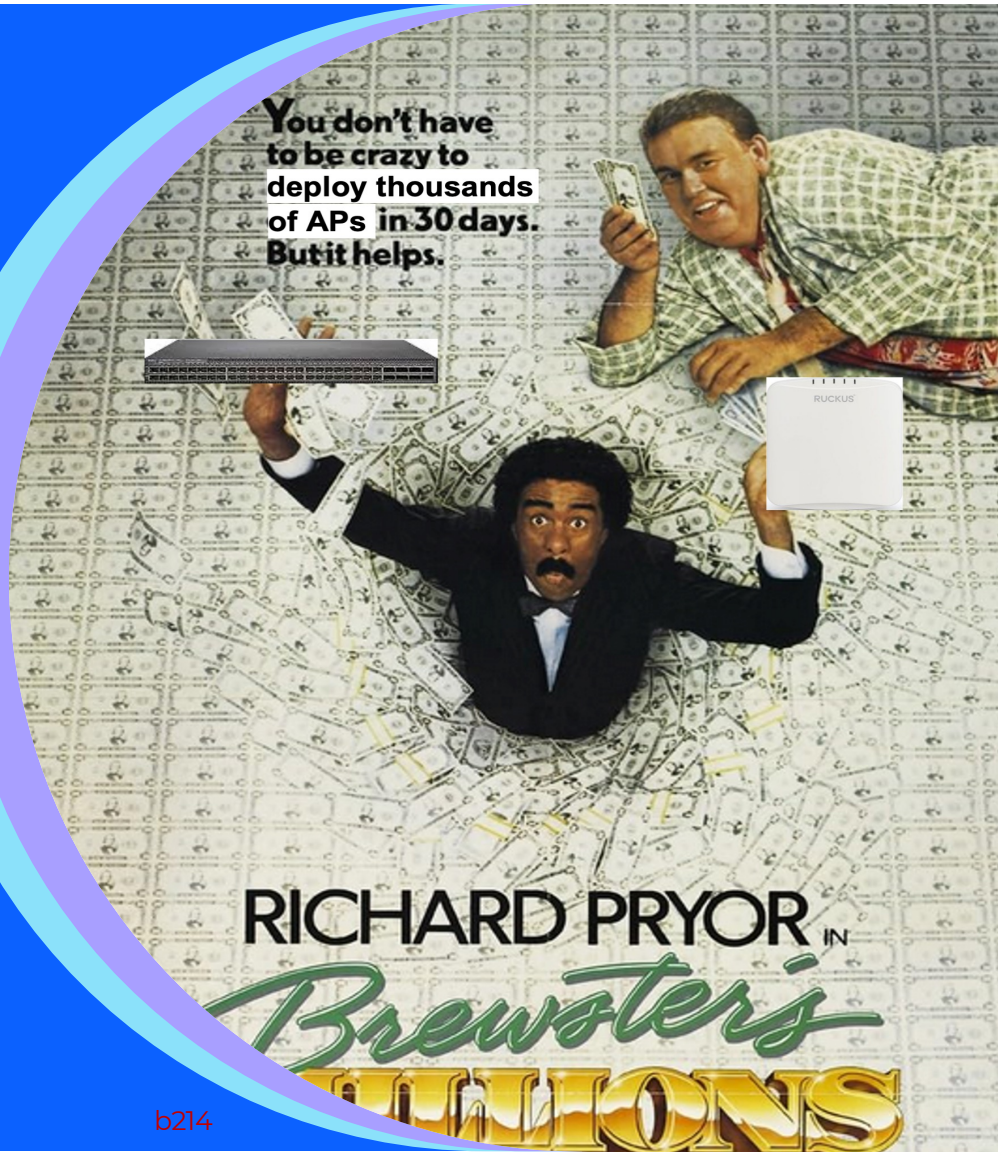

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WE CHOOSE TO [DEPLOY WI-FI NETWORKS]… NOT BECAUSE THEY ARE EASY, BUT BECAUSE THEY ARE HARD. – JFK {ADAPTED}

The Mission

https://pbs.twimg.com/media/FwvHYy5XoAIdynW.jpg

Deploy a large-scale complex network, where you are *highly constrained* in the amount of time on site to install and troubleshoot

- Short windows where property is unoccupied
- Network must be fully functional at end of window
- Upgrade is mission-critical

Vertical Applications

- Stadiums
- K-12 Schools
- Universities
- Student Housing
- Factories / Warehouses
- Retail chains (multi-site)

QUALITY IS CONFORMANCE TO REQUIREMENTS. NOTHING MORE, NOTHING LESS. - PHILLIP B. CROSBY

Step 1: Understand your Requirements and Constraints

Typical Requirements

- Coverage
- Usage
  - Client types (i.e. PCs, smartphones, tablets, barcode scanners, IoT sensors)
  - User segmentation and security (VLANs)
  - Applications (streaming video, surveillance, customer/vertical specific)
  - High Availability
- Capacity
  - Number of simultaneous clients
  - Areas of heavy usage vs. light usage
  - Usage profile (e.g. time of day peaks)

Typical Constraints

- Time
- Price / Cost
- Available internal resources
- Physical architecture
  - Layout
  - Building Materials
- Available information from customer
  - Existing Core Infrastructure (MPoE and Core Distribution)
  - Existing AP Locations
  - Existing Edge Infrastructure (Ethernet and fiber cabling)

DESIGN IS NOT JUST WHAT IT LOOKS LIKE AND FEELS LIKE. DESIGN IS HOW IT WORKS. – STEVE JOBS

Technology Selection and Design Based on Requirements & Constraints

Underlay Circuit Bandwidth

- Capacity
- High Availability (i.e. multi-WAN)
- Multi-Site (SD-WAN)

Router

- Bandwidth
- Capacity
- High Availability (i.e. multi-WAN failover)

External Core Servers (e.g. DHCP / DNS)

- Capacity
- Applications / Usage Profile
- High Availability

https://www.teepublic.com/pin/27806595-brewsters-millions-alternative-movie-poster

Switch and AP Vendor

- AP Technology (i.e. Wi-Fi 6, Wi-Fi 6E/7)
  - Device types
  - Capacity
  - Applications (e.g. BLE)
- Core and Edge Switch technology
  - Bandwidth
  - Core fiber / Ethernet infrastructure
  - Edge Ethernet infrastructure
  - AP PoE requirements (802.3at vs. 802.3bt)
- Cost
- Equipment Availability from vendors

ONLY THOSE WHO WILL RISK GOING TOO FAR CAN POSSIBLY FIND OUT HOW FAR ONE CAN GO – T. S. ELIOT

The Challenges: Time and Resources

Do as much as you can in advance

- Capture requirements & constraints
- Perform predictive modeling to work out AP locations, channel, and Tx power plan
- Develop comprehensive IP / VLAN scheme
- Site Survey (generally not an option)
- Test any new technologies (e.g. new models of firewall, switch, or AP) in lab to identify issues
- Pre-provision / upgrade equipment (if possible)

Align resources to match your install window

- Engineers
- Project Management
- Site Surveyors / Walk-Through
- Installation / Deployment Team

https://pennstatelearning.psu.edu/istudy_tutorials/timemanagement/

INFRASTRUCTURE IS MUCH MORE IMPORTANT THAN ARCHITECTURE – REM KOOLHAAS

The Challenges: Core Infrastructure with High Availability

https://bailiwick.com/images/headers/structured-cabling.jpg

Locate your MPoEs

- Dual bandwidth underlay circuits in separate locations
- Dual routers in high availability mode
- Dual core switches in virtual stack configuration

Locate your Distribution Zones

- Large campuses / complexes are generally divided into different distribution area
- Areas may be uneven in terms of size / capacity
- Support for 25 – 100 Gbps fiber links (i.e. QSFP28)

Locate your Edge Connections

- Support for 1-10 Gbps fiber or Ethernet

YOU [DEPLOY APS] WITH THE [LOCATIONS] YOU HAVE, NOT THE [LOCATIONS] YOU MIGHT WANT. – DONALD RUMSFELD {ADAPTED}

The Challenges: Existing Edge Infrastructure

Re-use existing AP locations / cabling where possible

- Too few existing APs: *coverage gaps*
- Too many existing APs: *self-interference*
  more APs ≠ more capacity

Each building / location has unique layouts

- Mix of hallway, in-room, and in-suite AP layouts
- *Mass customization*: Use the same set of components but tailor for the specific layout and wired infrastructure

Minimize the need for re-cabling

- Older infrastructure (e.g. CAT5)
- Additional APs
- Converting coverage type (e.g. hallway → in-suite)

https://www.theodysseyonline.com/just-right-challenge

IF YOU DO WHAT YOU LOVE, [THE NETWORK SHALL] WORK [ITS] BUTT OFF EVERY DAY. – JOHNY HENDRICKS

The Challenges: Unique Applications and Customer-Specific Requirements

https://images.squarespace-cdn.com/content/v1/583c906ebe659429d1106265/1610830991496-NCUDWC3IWJIFPX9L1GWP/Brewsters-Millions.jpg

Unique devices (Applications & Security)

- Printers
- Casting to TVs
- Surveillance cameras
- Electronic door locks
- Gaming consoles

Unique vertical requirements

- Eliminating support for wired ports
- Providing systems to rapidly deploy / change / customize APs for tenants
- Very high bandwidth per user
  (over ~100 Mbps per user requires 40 MHz or 80 MHz channels on 5 GHz / 6 GHz)

CREATIVITY IS ALLOWING YOURSELF TO MAKE MISTAKES. ART IS KNOWING WHICH ONES TO KEEP. – SCOTT ADAMS

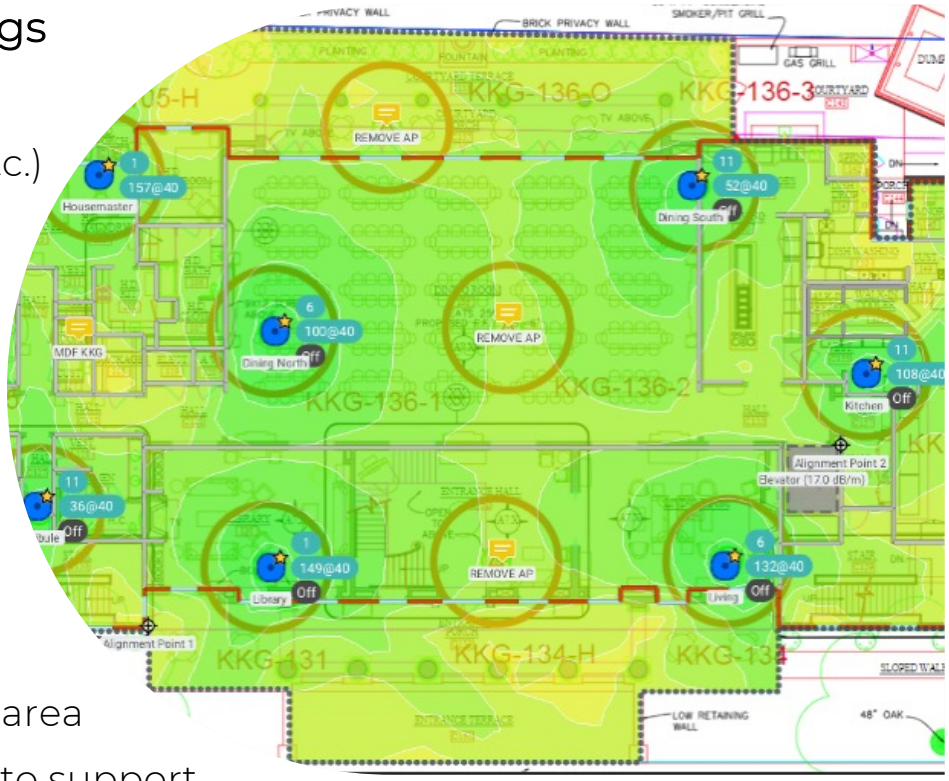
The Design Approach: Model Everything in Advance

Review the existing floor plans for each buildings

- Determine or estimate wall types
- Identify low-capacity areas (e.g. offices, bedrooms, etc.)
- Identify high-capacity areas (e.g. classrooms, dining halls, auditoriums, athletic centers, etc.)

Tweak the AP locations

- Remove excess APs not needed for capacity
- Identify APs where 2.4 GHz must be disabled
- Define new AP locations where needed for either coverage or capacity
- Create a plan for channels & transmit power
  - Static Tx power recommended to limit coverage area
  - Static channels recommended but may be hard to support



SURVEYS SHOWS THAT SURVEYS NEVER LIE. – NATALIE ANGIER

The Implementation Approach: Survey, Provision, Stage

https://www.ekahau.com/products/ekahau-connect/survey/

Week 1: Surveying Each Site / Building

- Identify MDF / IDF locations
- Confirm existing AP locations
- Spot check RF in suspected coverage hole areas
- Note where existing documentation is incorrect

Weeks 1-2: Provisioning and Staging

- Identify staging area at facility for storage of all equipment and organization by location
- Scan equipment into controller and provision (if not done previously)

MEASURE TWICE. CUT ONCE. THEN FORCE IT TO FIT. - UNKNOWN

The Implementation Approach: Installation

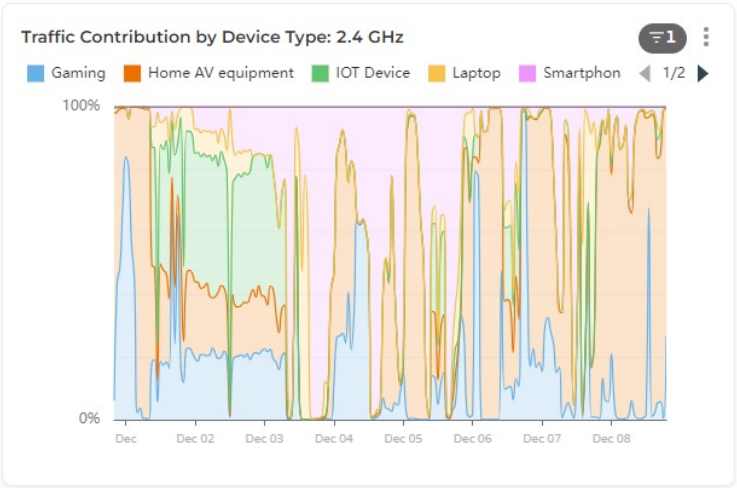
Weeks 1-4: Installation

- Tech Team 1: Installation of core
  - Routers
  - Core and distribution switches
  - Validate bandwidth and high availabilty
- Tech Team 2: New cabling (where required)
- Tech Team 3: Remove existing APs
- Tech Teams 4+: Installation of switches in edge MDFs / IDFs, confirm connectivity
- Tech Teams 5+: Installation of new access points, confirm connectivity

https://volsol.in/assets/img/sub-slide/Network-Installation.png

WE CANNOT SOLVE OUR PROBLEMS WITH THE SAME LEVEL OF THINKING THAT CREATED THEM. - ALBERT EINSTEIN

Ongoing Troubleshooting and Optimization (Ongoing)



Physical Layer Troubleshooting

- Bad Ethernet / Fiber links (no or low speed)
- Underlay circuit speeds and stability

Equipment troubleshooting

- Firmware issues (routers, switches, APs)
- DHCP / DNS issues (due to capacity, load imbalance)
- Switch stack / spanning tree issues from redundant links

Network optimization

- Wi-Fi Channel and Tx Power optimization
- Highlight areas with performance issues (e.g. low MCS rates, high roaming, etc.)
- Utilize AI tools from vendor, if available

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