



# 차세대 클라우드 네트워크 기술 동향

- 빅데이터와 머신러닝, AI 연동을 통한 클라우드 네트워크
- WiFi 6 표준을 통한 고효율 무선 네트워크 구축





More Locations

More Apps

More Things

More Devices

More Users

More Network Complexity

Less Technical Resources

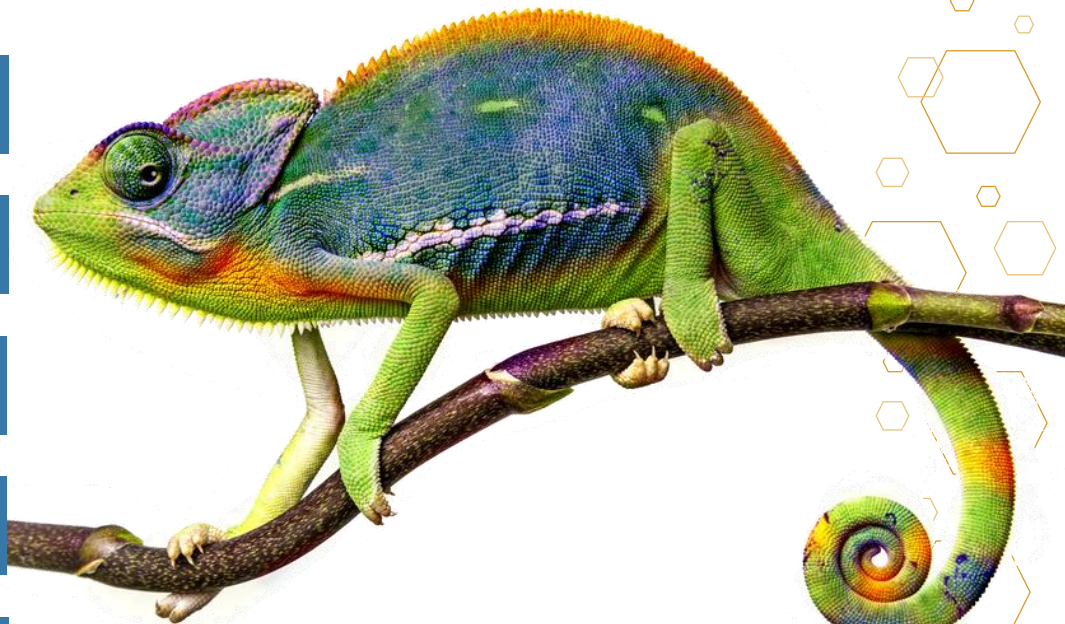
**Adapts to Change**

**Flexible Networks**

**Cost Effective**

**Scalable Architecture**

**Business Continuity**



# Cloud Enterprise Network

클라우드 기반의 Software-Defined Network을 통해  
구축 및 관리 비용을 절감하고 운영 안정성을 보장



# Connected Users



# Connected Devices



# Connected Apps



# Connected Everything





# Rise of the machines



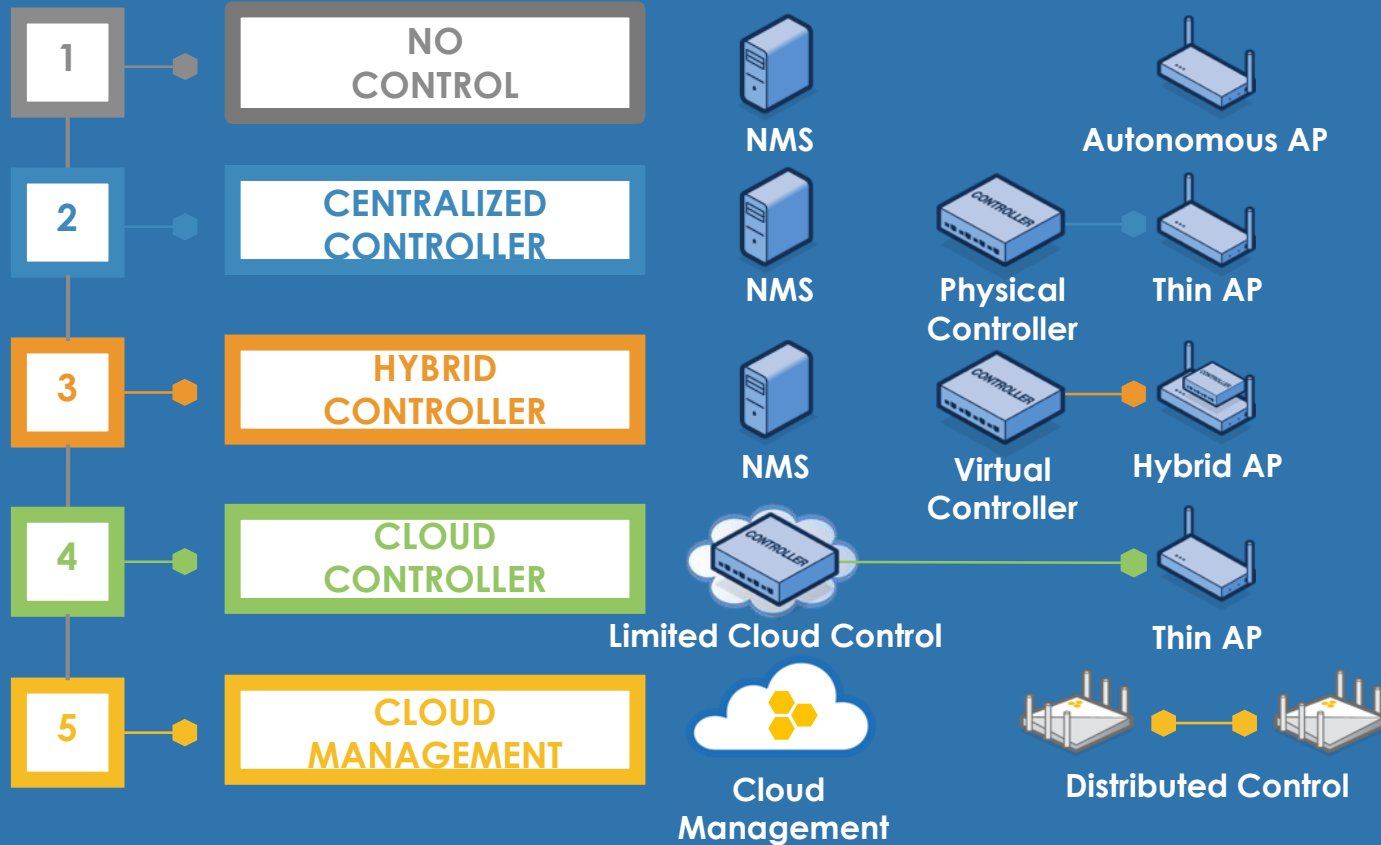
# SD-LAN + SD-WAN

LAN과 WAN을 유연하게 정의하고 관리하는

CLOUD ACCESS NETWORK TECHNOLOGY AND PLATFORMS



# The *Evolution* of Wi-Fi Architecture



# ADAPTIVE WIRELESS ACCESS



## WHEN YOUR NEEDS CHANGE SO DOES YOUR NETWORK

### **DISTRIBUTED CONTROL ARCHITECTURE**

SELF-LEARNING

SELF-HEALING

SELF-DRIVING

### **FUTURE-READY CONNECTIVITY**

SOFTWARE-DEFINED  
DUAL 5 GHZ RADIOS

INTEGRATED BLE

UNLIMITED SCALE

### **OPTIMIZATION & PROTECTION AT THE EDGE**

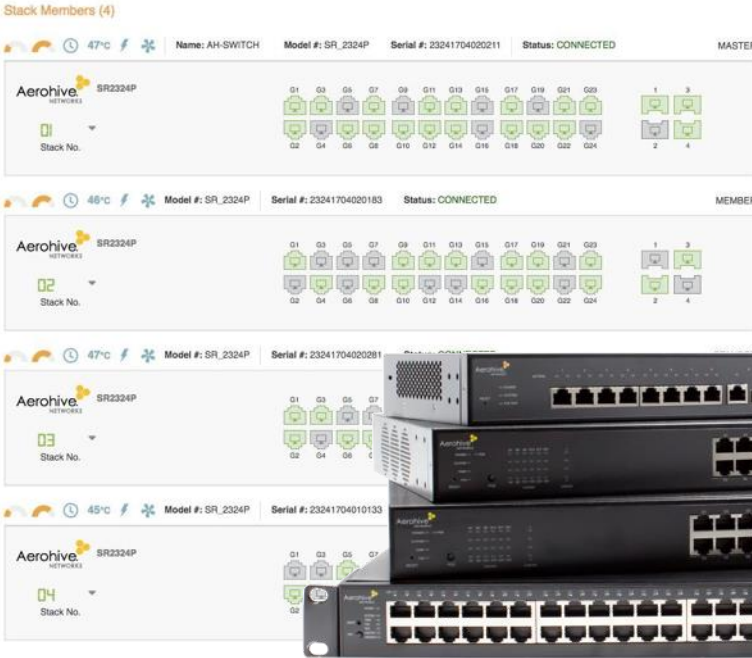
IDENTITY-DRIVEN ACCESS

USER AND APPLICATION QOS

IOT DEVICE ISOLATION



# UNIFIED ACCESS SWITCHING



**SIMPLIFIED CONFIGURATION**  
**SINGLE UNIFIED WORKFLOW FOR WI-FI AND WIRED POLICY MANAGEMENT**

**REMOTE MANAGEMENT**  
**AUTO-PROVISION THOUSANDS OF DEVICES AND DEPLOY IN MINUTES**

## KEY FEATURES



Unified Policies



Remote SSH



L2/L3 Feature Set



Dell Unified Management



Auto Provisioning



Simplified Stacking



Centralized Updates



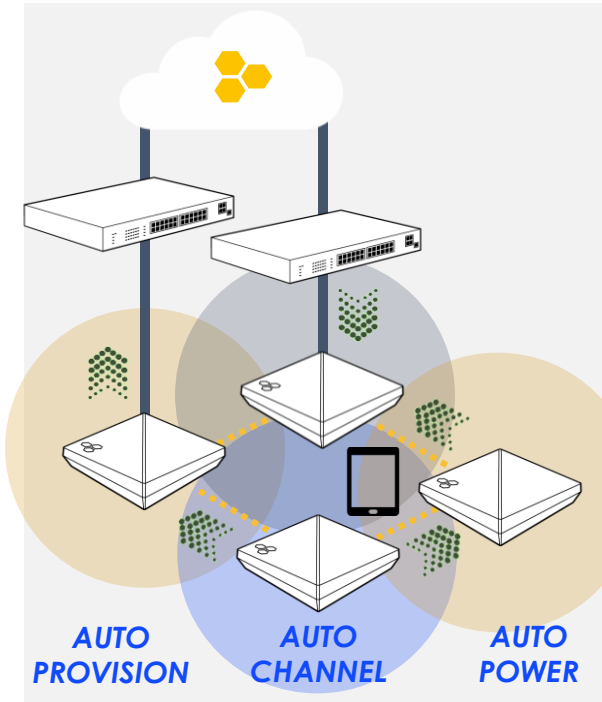
Advanced QoS



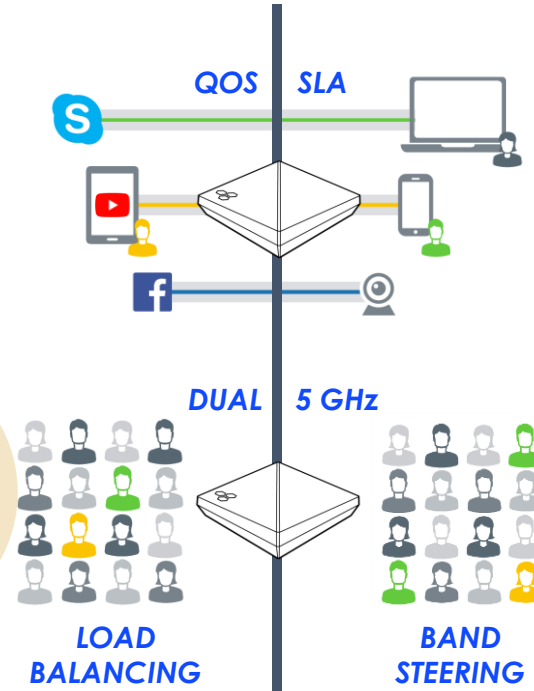
# SELF-DRIVING ARCHITECTURE

## SOFTWARE-DEFINED WI-FI FOR INCREASED SPEED, SCALE, AND ADAPTABILITY

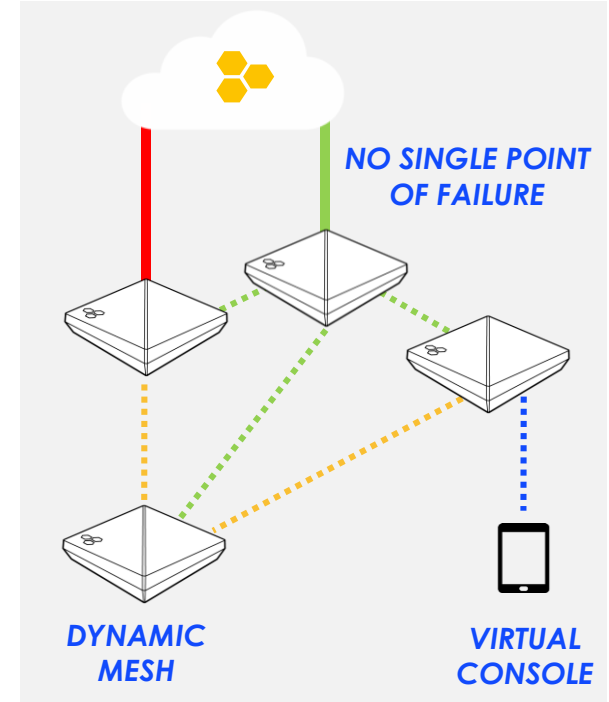
### SELF-ORGANIZING



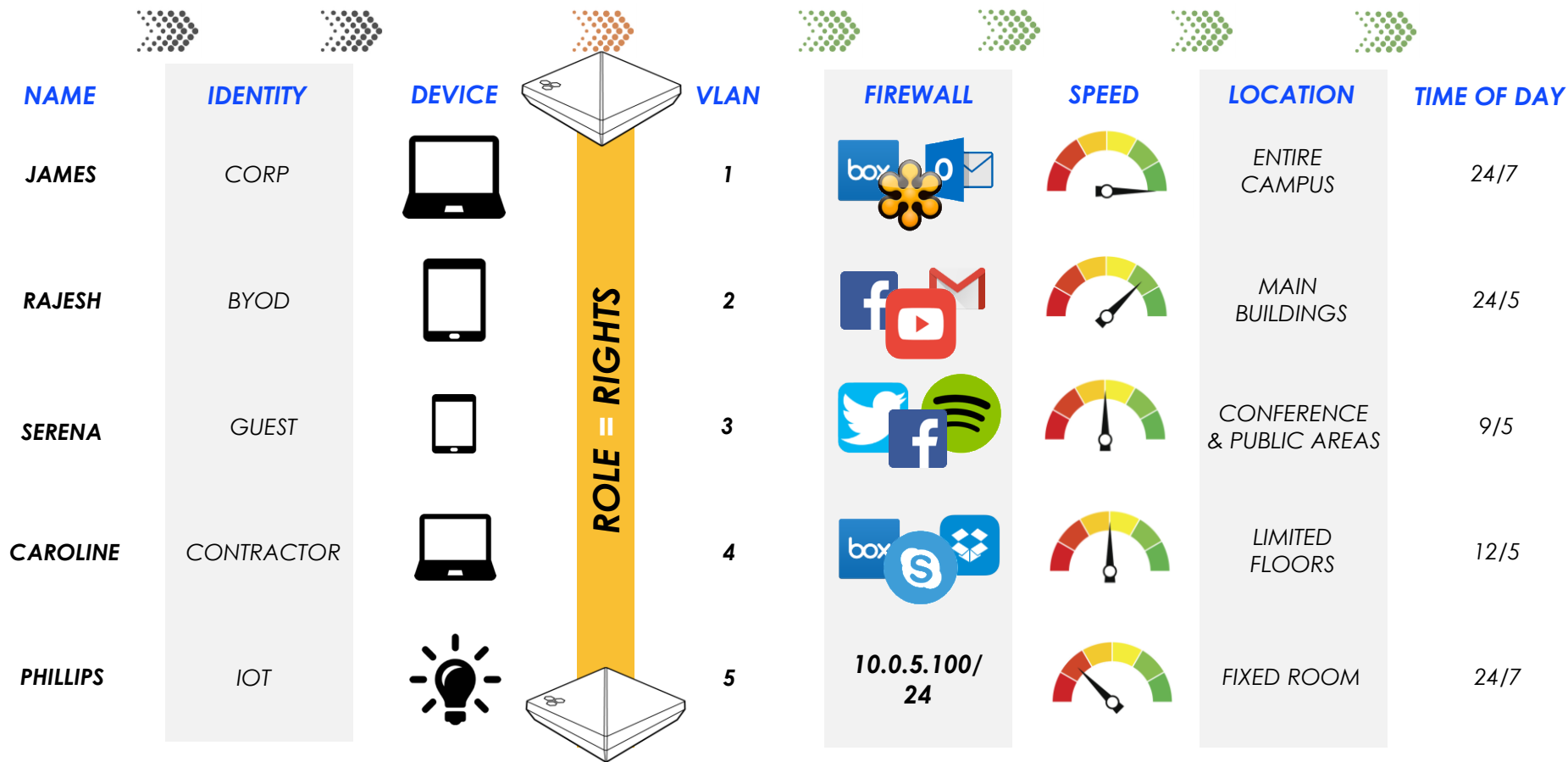
### SELF-OPTIMIZING



### SELF-HEALING



# SD-LAN - IDENTITY-DRIVEN ACCESS & OPTIMIZATION



# SD-WAN

FAST, RELIABLE, AND SECURE HQ-LIKE NETWORK ACCESS  
FOR REMOTE LOCATIONS AND TELEWORKERS

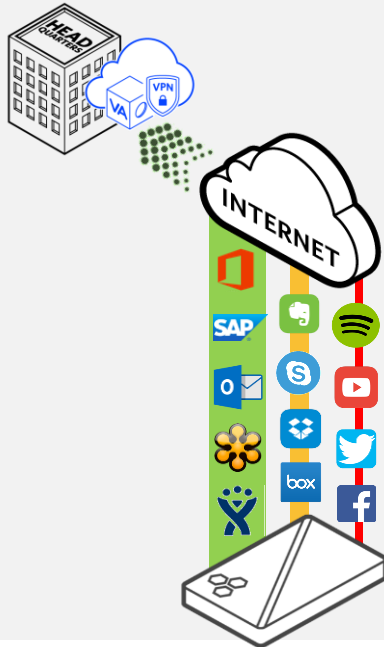




# SD-WAN - IDENTITY-DRIVEN ACCESS & OPTIMIZATION

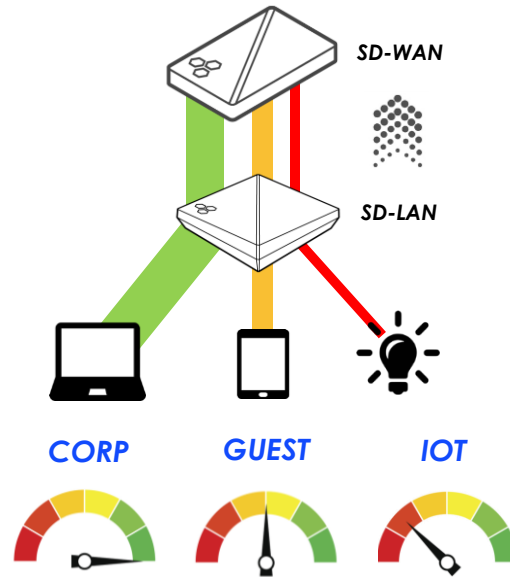
## APPLICATION TRAFFIC OPTIMIZATION

PRIORITIZE, DIRECT, RESTRICT,  
AND BLOCK APPS



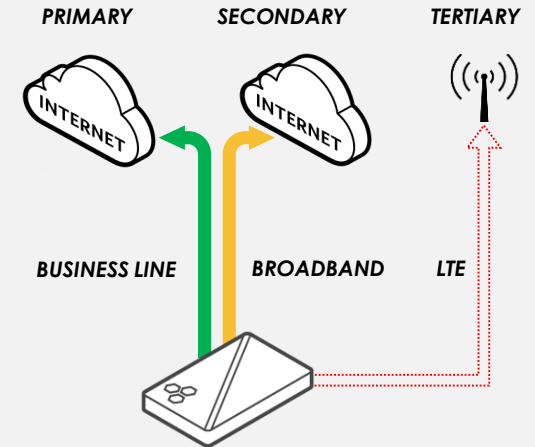
## IDENTITY-DRIVEN POLICY ENFORCEMENT

END-TO-END SD-LAN/SD-WAN USER  
CONTROLS AND OPTIMIZATION



## LINK STATE MONITORING

DYNAMICALLY SHAPING PERFORMANCE  
BASED ON BACKHAUL OPERATIONAL STATE



# USER-BASED ROUTING GROUPS

## USER ROUTING GROUP

ASSIGN LINK PRIORITY PER USER GROUP

### CORPORATE



PRIORITY	LINK
1	MPLS
2	BROADBAND
3	LTE

### GUEST



PRIORITY	LINK
1	BROADBAND
2	LTE
3	N/A

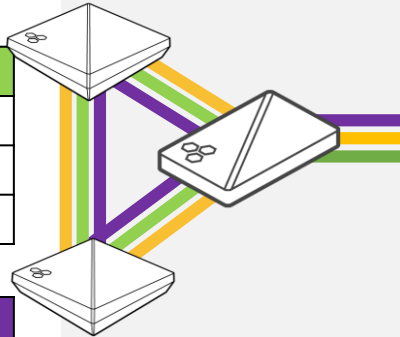
### IOT



PRIORITY	LINK
1	BROADBAND
2	MPLS
3	N/A

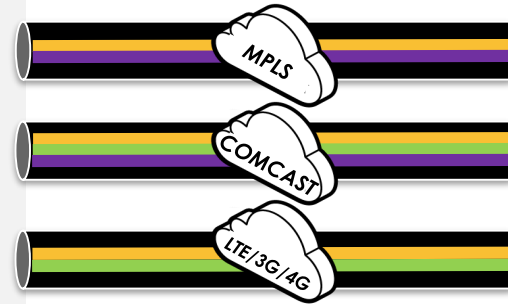
## UNIFIED POLICIES

SD-LAN TO SD-WAN MAPPING



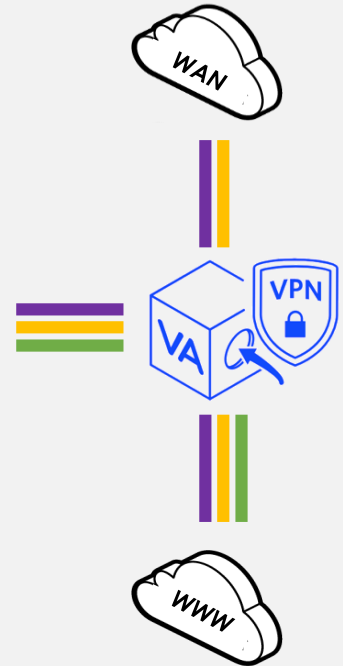
## PER PACKET ROUTING

USER LINK VARIES BASED ON LINK PERFORMANCE



## TRAFFIC ISOLATION

SECURELY DIRECT TRAFFIC BETWEEN VIRTUAL GATEWAY



# APPLICATION-BASED ROUTING

## COLLABORATION

PRIORITY	LINK
1	MPLS
2	BROADBAND
3	LTE

## OTHER APPS

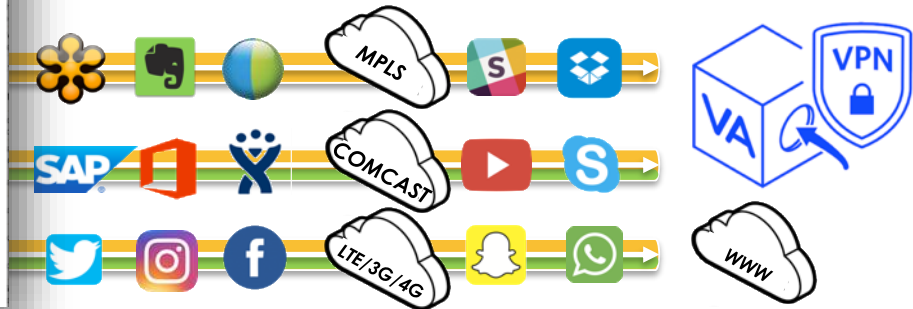
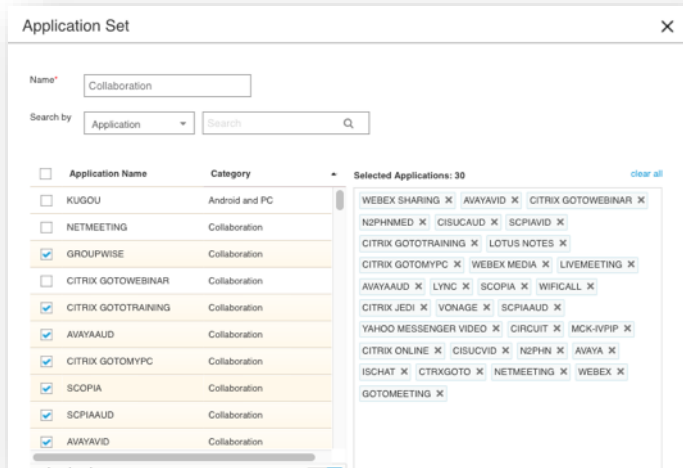
PRIORITY	LINK
1	BROADBAND
2	LTE
3	N/A

DEFINE APPLICATION GROUP ROUTING POLICIES

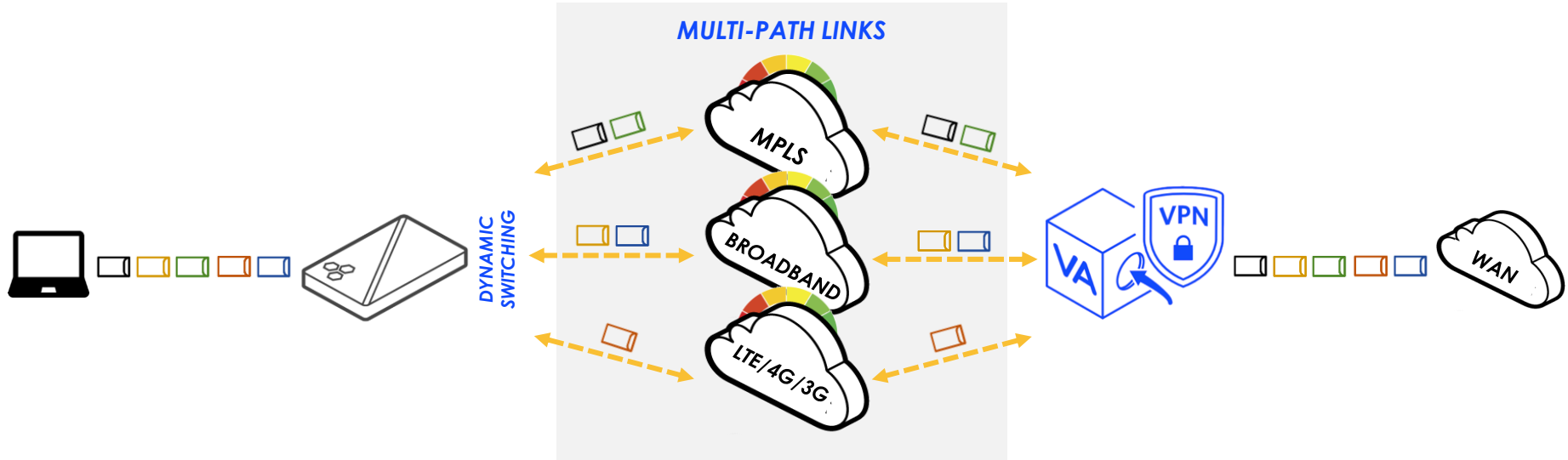
OPTIMIZE APPLICATION TYPES

BLOCK OR RESTRICT APPLICATION USAGE

DYNAMIC LOAD BALANCING WITH LINK PERFORMANCE MONITORING



# LINK MONITORING & DYNAMIC PATH SELECTION



CONTINUOUS VPN TUNNEL LINK QUALITY MONITORING:

**MEASURING UP-DOWN STATE / ROUND TRIP DELAY / JITTER / LINK UTILIZATION**

**DYNAMIC PATH SELECTION BASED ON REAL-TIME LINK QUALITY**

**PER PACKET DECISION MAKING**



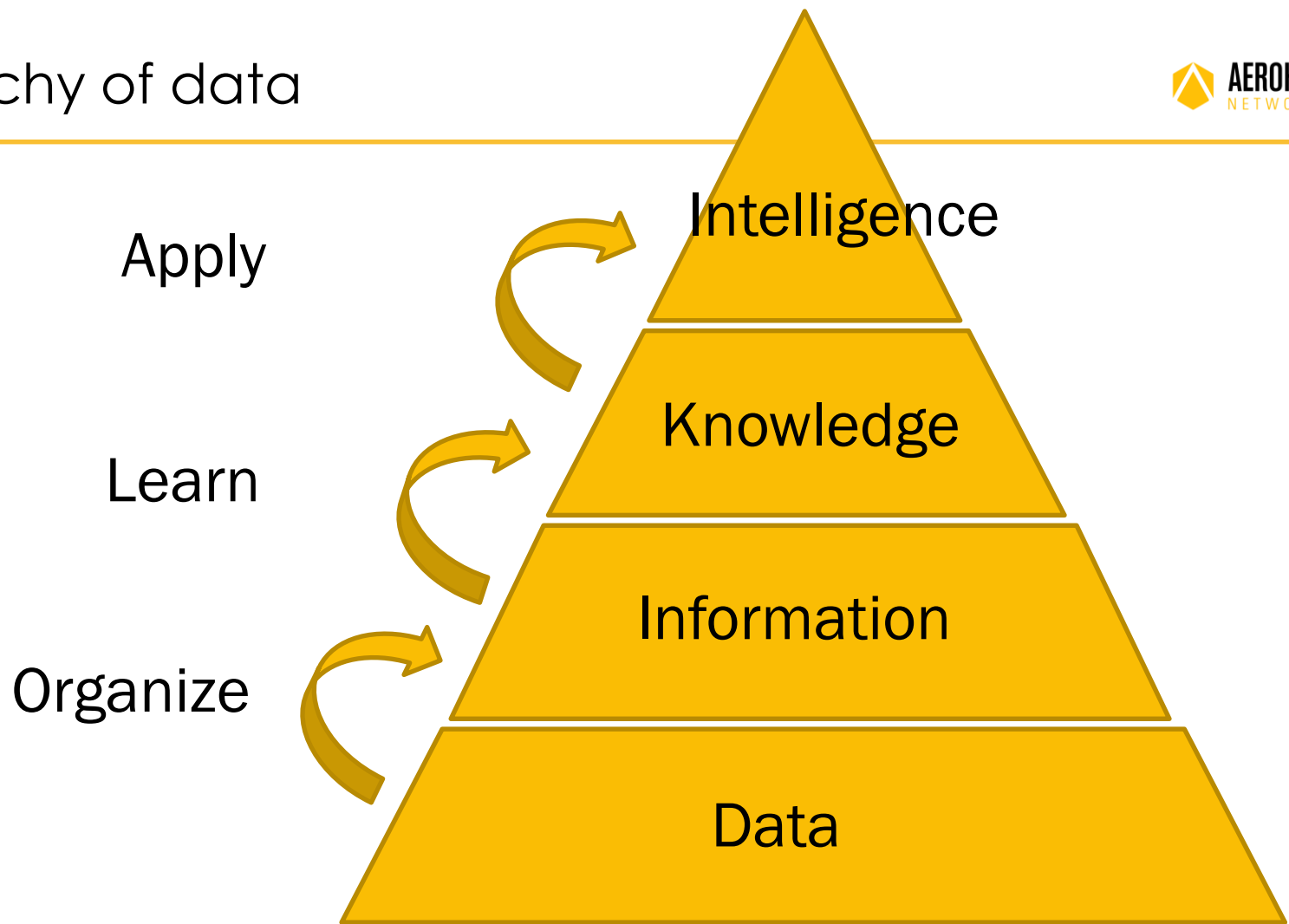
# ENTERPRISE NETWORK의 진화

BIG DATA, M/L, AI



# Hierarchy of data

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# Machine Learning - CLIENT 360

## CLIENT 모든 정보를 제공

- Client의 모든 정보를 실시간으로 제공
- Client의 모든 정보를 이력으로 제공

## CLIENT HEALTH SCORE 제공

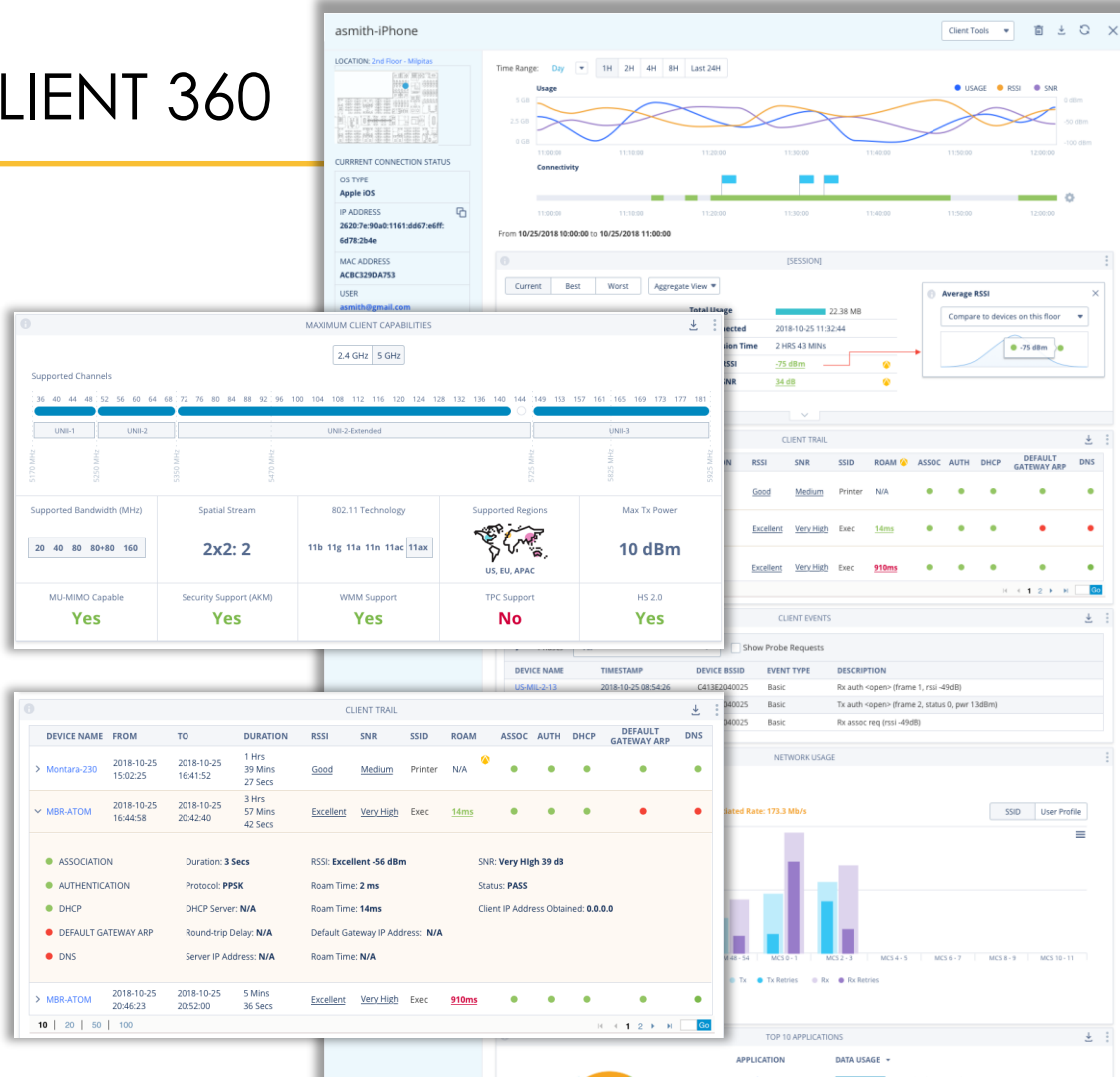
- Machine Learning 기반으로 점수 계산

## CLIENT의 이력 제공

- 30일간의 접속 및 사용 이력 제공

## 트러블 슈팅 지원

- 단말 입장에서 연결 테스트



# Machine Learning - Network 360



## NETWORK의 모든 정보를 제공

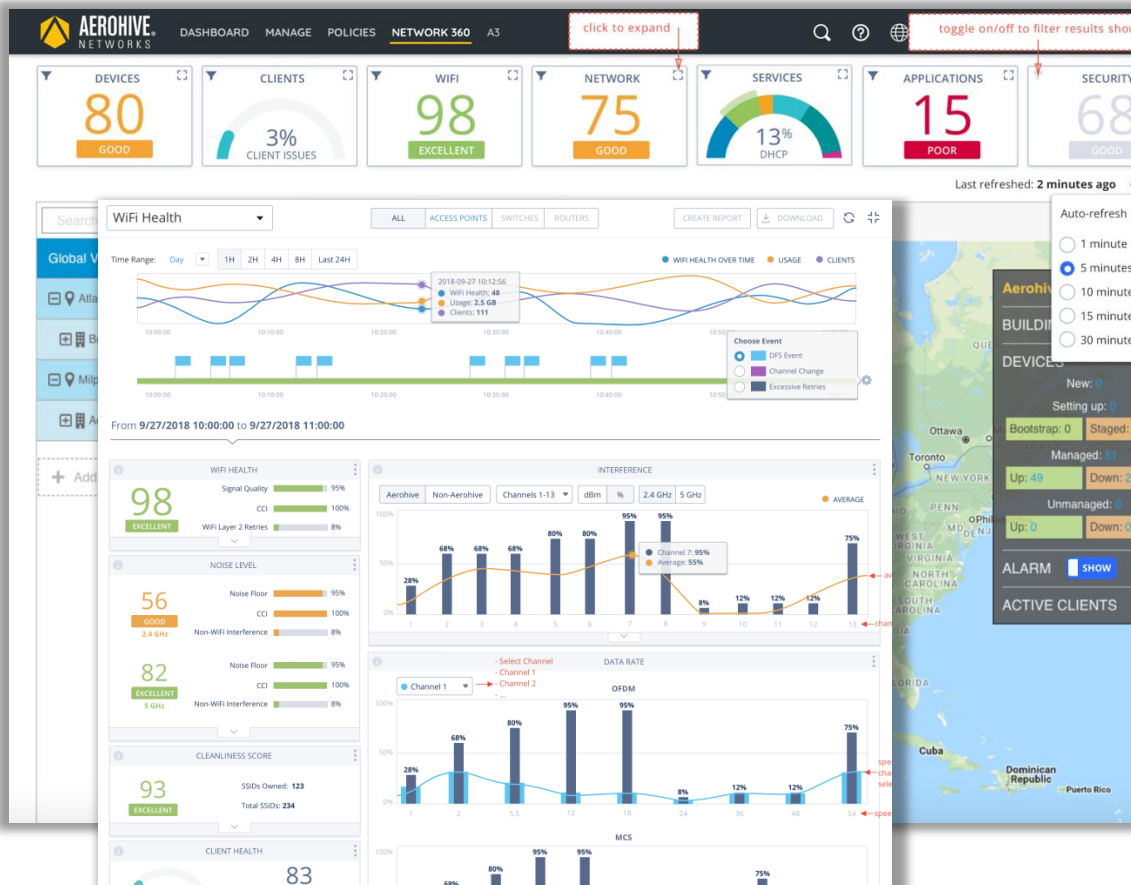
- Access Network의 상태를 실시간으로 제공
- Access Network의 상태를 이력으로 제공

## NETWORK HEALTH SCORE 제공

- Machine Learning 기반으로 점수 계산

## NETWORK의 이력 제공

- 30일간의 접속 및 사용 이력 제공





# INDIVIDUAL USER REPORTING

**SSIDs**


- All
- AH-Employee
- AH-Visitor
- AH-Employee-2.4only
- Intl-Employee
- Intl-PPSK


Less

**Users**


**User Profiles**

- All

**TOP APPLICATION GROUPS** 

**TOP APPLICATIONS** TOP 20 TOP 100 

### Summary View for ddirawan



ddirawan

**Connected**  
Active since: 2  
Days 14 Hrs 38  
Mins 42 Secs

**53 Applications**  
Last 24 Hrs

**Total Network Usage**


**Last Known Location**

**Top App:** APPLE UPD...





**Most Used App:** APPLE UPDATE

287.6 MB  
9.79 GB  
Total  
Tx Rx

Location: Ae... > Mil... > Ae... > 1st...  
[Map](#) [Floor](#)



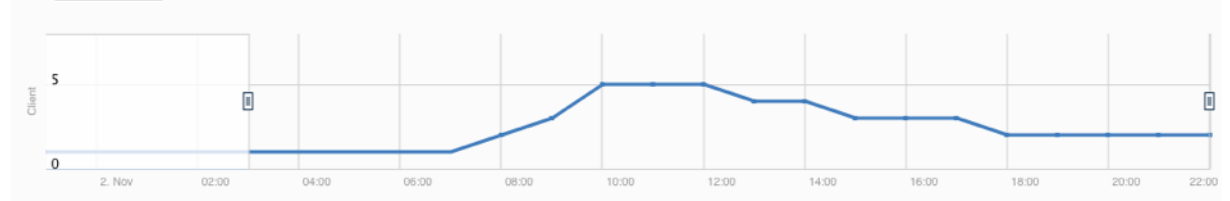
**Clients**

-  online
-  online
-  offline
-  offline

**Source:** RADIUS

**User Group:**

Show **Day** Select Range **1H** **4H** **8H** **Last 24H**



Showing data for the day **Thursday (November 2, 2017)** from 03:00 to 22:00

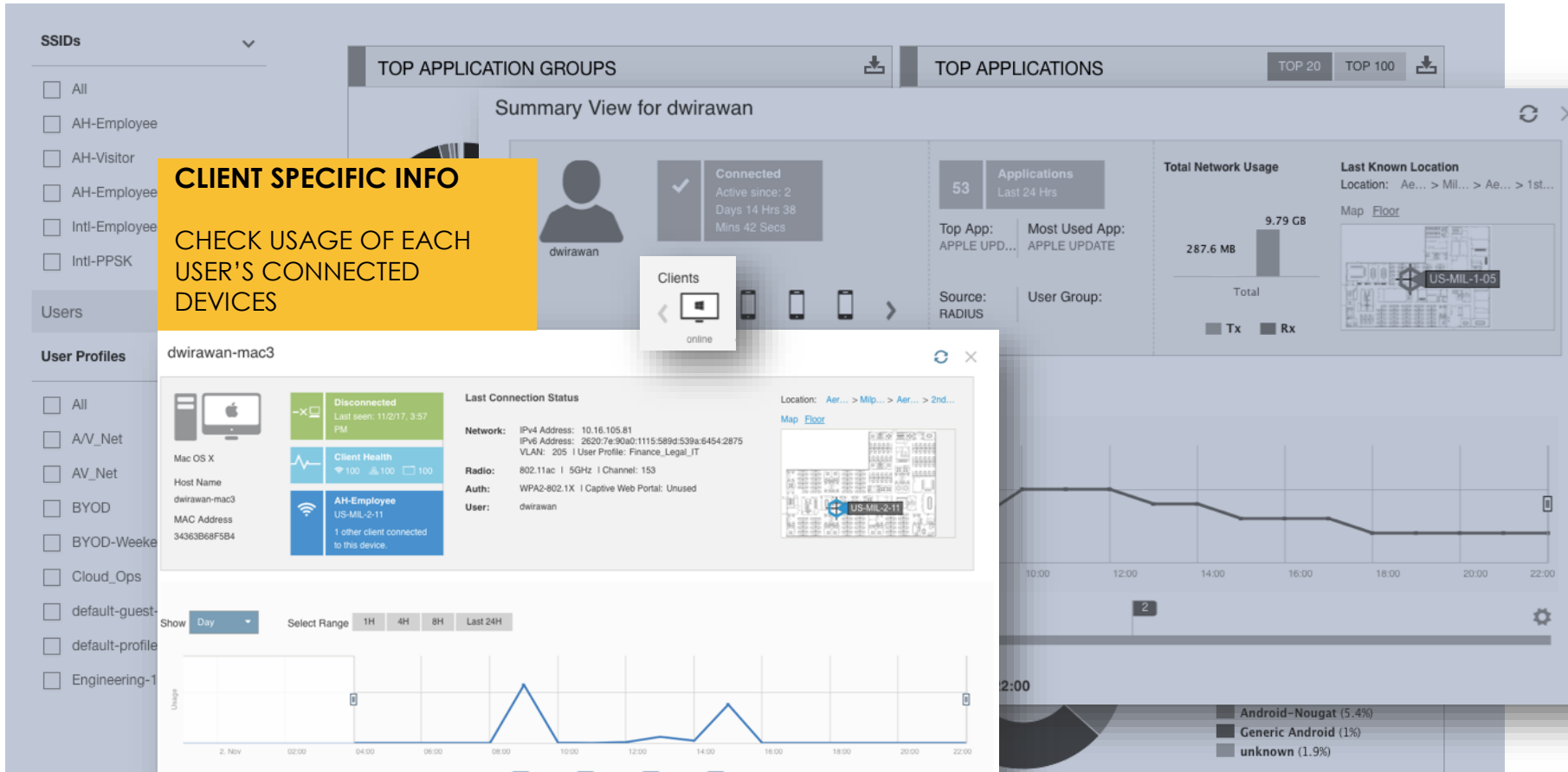
joxenrider-x1	5GB	3%	15	HTTP
cooter-mss	4GB	2%	20	ALWAYS

**Android-Nougat (5.4%)**  
**Generic Android (1%)**  
**unknown (1.9%)**

**MONITOR INDIVIDUAL USERS**

TRACK DEVICE AND APP USAGE, LOCATION, CONNECTION STATUS, AND HEALTH

# INDIVIDUAL CLIENT REPORTING



**CLIENT SPECIFIC INFO**

CHECK USAGE OF EACH USER'S CONNECTED DEVICES

**Summary View for dwirawan**

**Client Status:** Connected  
Active since: 2 Days 14 Hrs 38 Mins 42 Secs

**Applications:** 53 Applications Last 24 Hrs  
Top App: APPLE UPD...  
Most Used App: APPLE UPDATE

**Total Network Usage:** 287.6 MB Total, 9.79 GB Tx/Rx

**Last Known Location:** Location: Ae... > Mil... > Ae... > 1st...  
Map Floor: US-MIL-1-05

**Client Details (dwirawan-mac3):** online

**Client Status:** Disconnected (Last seen: 11/2/17, 3:57 PM)

**Client Health:** 100% (CPU, Memory, Disk)

**AH-Employee:** US-MIL-2-11 (1 other client connected to this device)

**Last Connection Status:** Network: IPv4 Address: 10.16.105.81, IPv6 Address: 2620:7a:90a0:1115:589d:539a:6454:2875, VLAN: 205 | User Profile: Finance\_Legal\_IT; Radio: 802.11ac | 5GHz | Channel: 153; Auth: WPA2-802.1X | Captive Web Portal: Unused; User: dwirawan

**Location:** Aer... > Mlp... > Aer... > 2nd...  
Map Floor: US-MIL-2-11

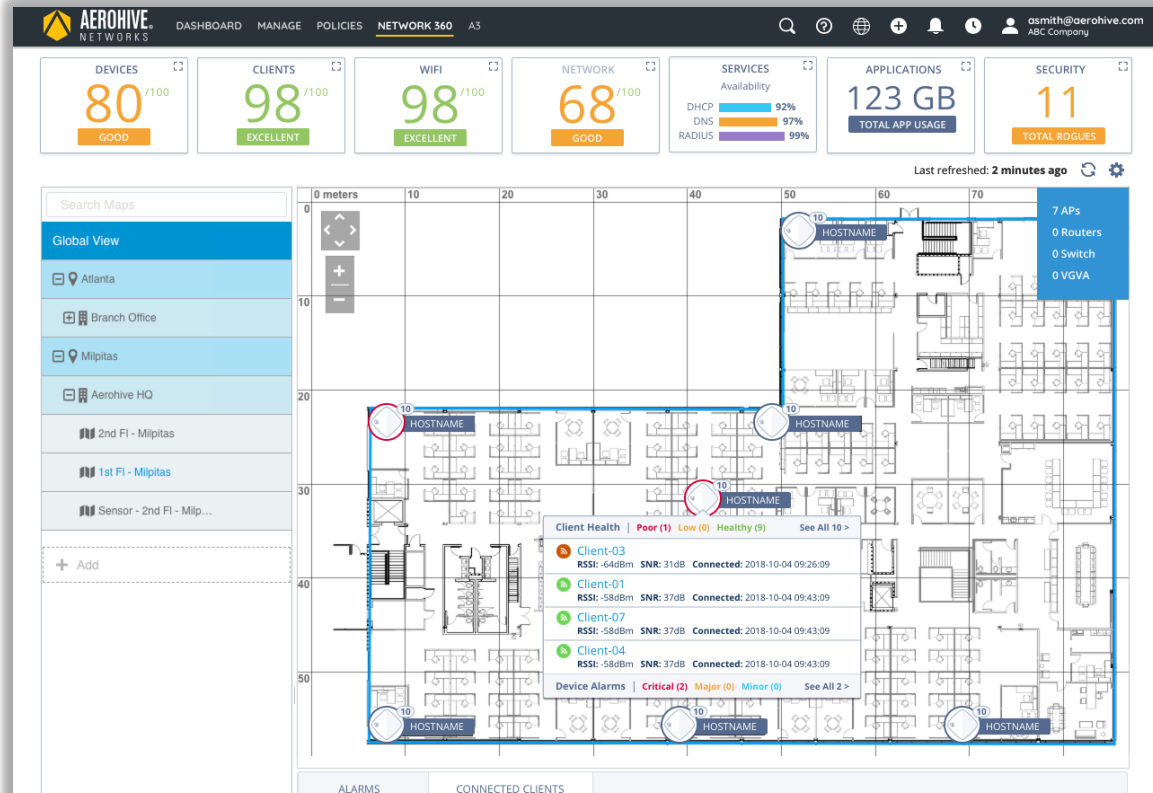
**Usage Graph:** Shows usage over time (2 Nov to 22:00). Select Range: 1H, 4H, 8H, Last 24H.

**OS Distribution:** Android-Nougat (5.4%), Generic Android (1%), unknown (1.9%)

# Network Health Reporting

Seven key network health indicators:

- Device Health (APs)
- Client Health
- Wi-Fi Health
- Network Health
- Services Health
- Application Health
- Security health



# Presence & location base analytics



<b>1H DEVICES</b> <b>79</b> GOOD	<b>1H CLIENTS</b> <b>53</b> GOOD	<b>WIFI</b> NO STATUS	<b>NETWORK</b> NO STATUS	<b>1H SERVICES</b> Availability DHCP 50% DNS 100% RADIUS 0%	<b>8H APPLICATIONS</b> <b>0.3 GB</b> TOTAL APP USAGE	<b>SECURITY</b> NO STATUS
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Where's My Data?

1H Fast Clients Last refreshed: 12 minutes ago

3 APs

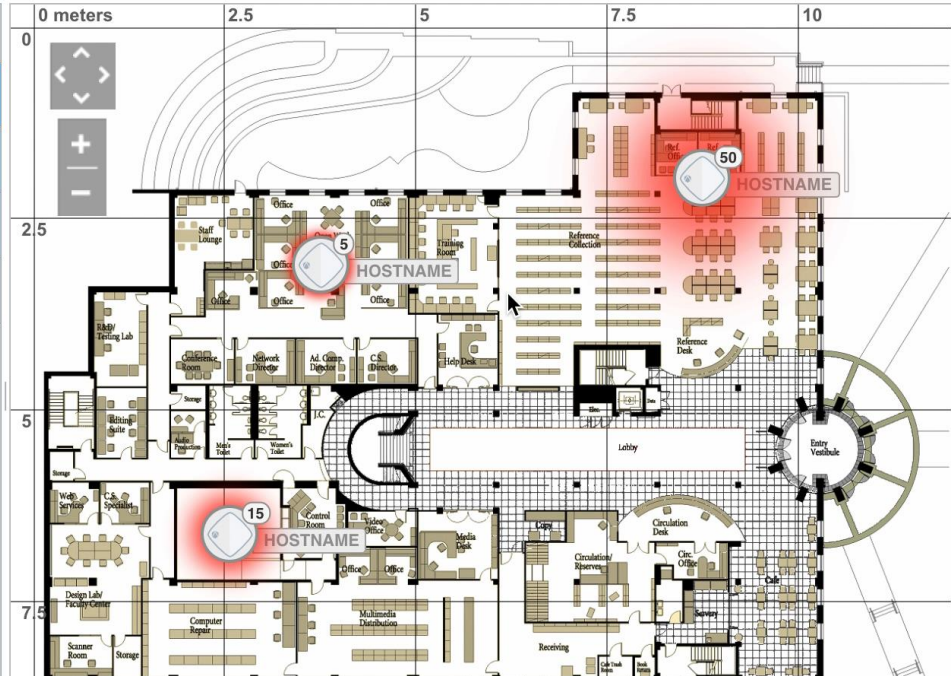
Search Maps

Global View

Milpitas CA

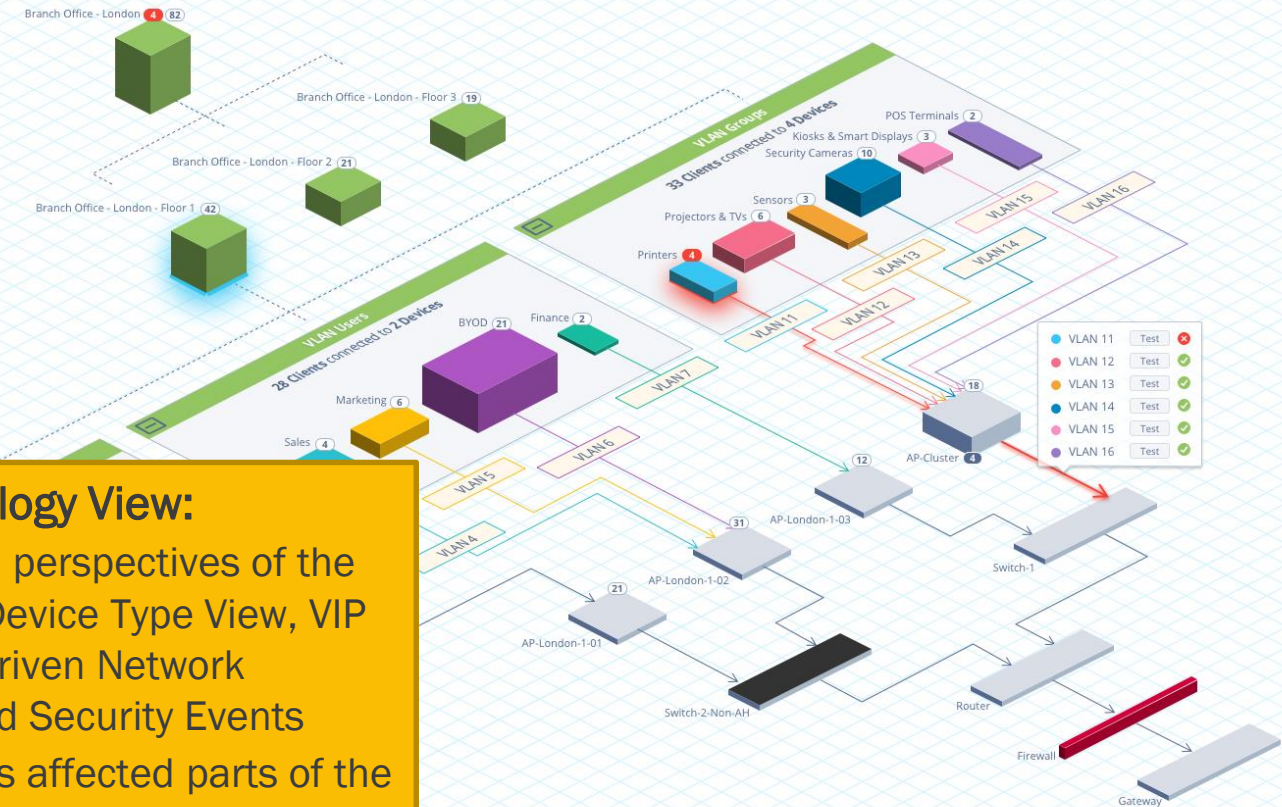
1011 McCarthy Blvd

Floor 1



## Branch Office - London

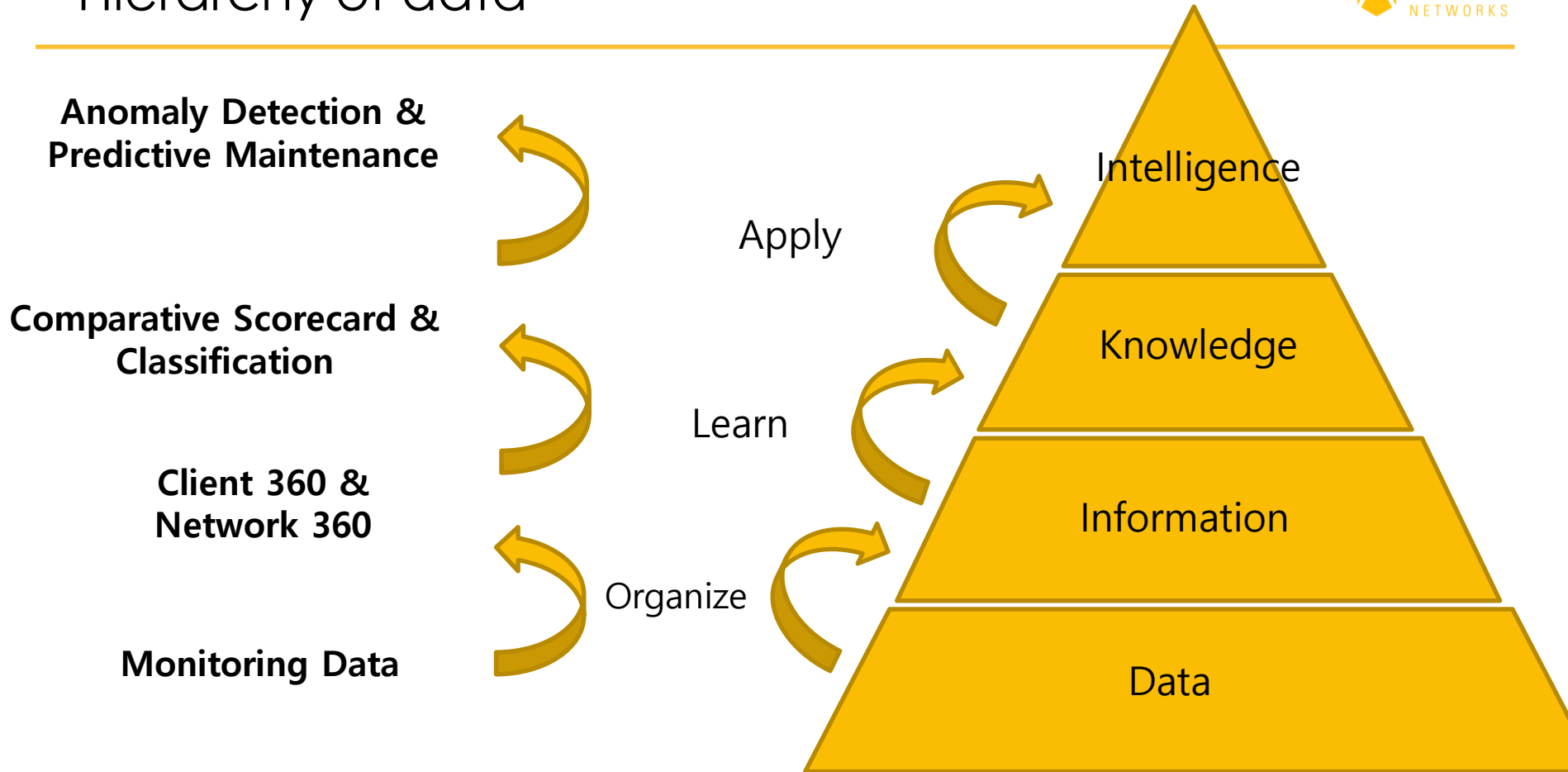
VLANs Device Type VIP Clients Network Performance 📈 Security Event



### Branch Level Topology View:

- Provides several perspectives of the issues: VLANs, Device Type View, VIP Clients, and AI driven Network Performance and Security Events
- Visually indicates affected parts of the network

# Hierarchy of data





# NEXT GENERATION WIFI



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# WiFi Generation



802.11ax

- **Wi-Fi Alliance** has introduced a new generational Wi-Fi naming system that helps users better understand the experience they can expect



802.11ac

- **Wi-Fi 6** is the next generation of Wi-Fi based on 802.11ax technology: [www.wi-fi.org/wi-fi-6](http://www.wi-fi.org/wi-fi-6)



802.11n



- **Wi-Fi Alliance 802.11ax**

- 802.11ax 표준은 기존 무선 단말들과 호환성 제공
- 802.11ax를 지원하기 위해 Wi-Fi CERTIFIED 6 브랜드 런칭 완료
- 상호 운용성 테스트 완료
- 현재 삼성, LG 등 신규 스마트폰에 802.11ax 표준 탑재하여 출시



- **802.11ax 단말들**

- 802.11ax 표준이 탑재된 단말은 이미 출시중
- 삼성 갤럭시 S10, S10+ 802.11ax 탑재
- LG 최신 스마트폰 V50 802.11ax 탑재
- HP OMEN, Asus ROG Mothership 노트북 802.11ax 탑재

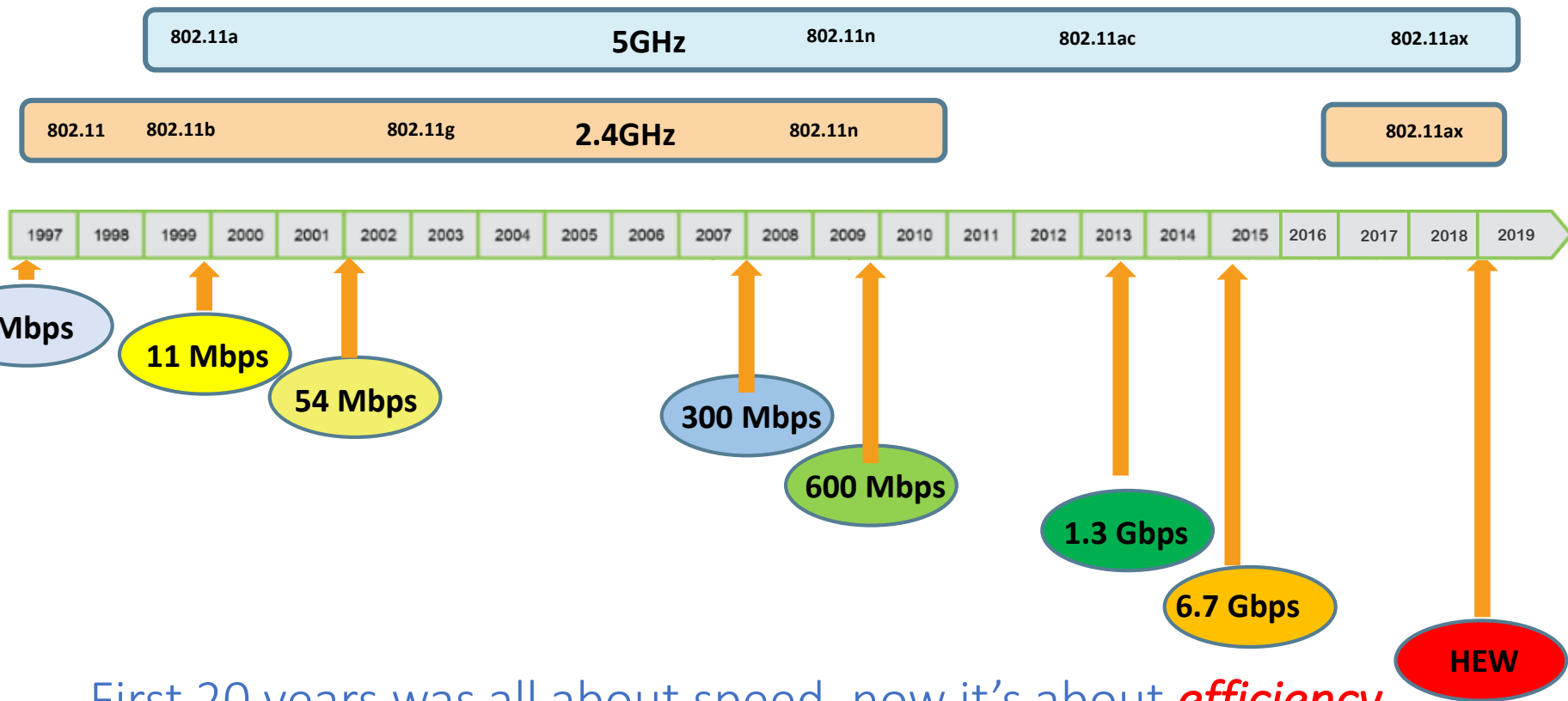


Samsung Galaxy S10 & S10+



LG V50

# Wi-Fi 표준 발전 동향



First 20 years was all about speed, now it's about *efficiency*

# Problem



# 802.11ax Hive Efficiency

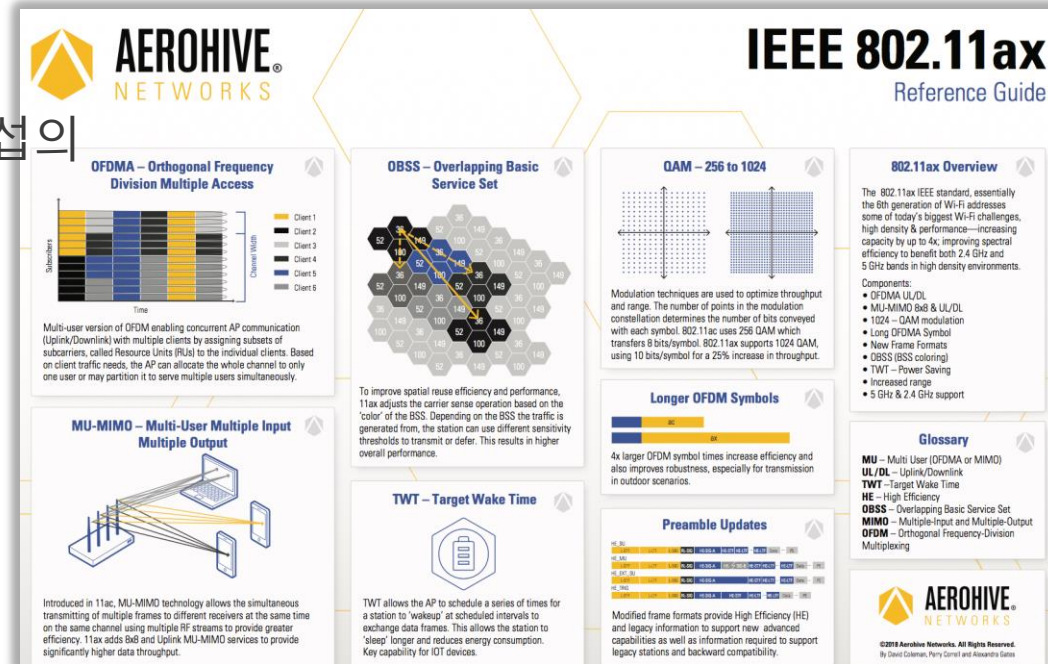
- 고밀도 (High density) 환경을 위한 표준
- 목표 : 처리량 4배 증가
  - › 속도 향상이 아닌 효율성 향상
  - › 목표는 전체 네트워크의 처리량이 아닌  
각 단말 별 처리량
- 기존의 2.4 GHz 와 5 GHz (802.11a/b/g/n/ac) 환경에서  
지원  
(호환성 제공)
  - › 802.11ac의 경우 2.4GHz 지원하지 않음
  - › 시험결과 : 5-10x 향상





# 802.11ax (aka Wi-Fi 6) FEATURES

- **OFDMA** - 주파수 대역의 효율성 증가
- Uplink and Downlink MU-MIMO  
- 최대 8대의 단말
- BSS Color/ 채널 재사용 - 채널 간섭의 영향을 줄임
- 1024-QAM - 더 높은 data rates
- Target Wake Time (TWT)  
- IoT 단말을 효율적으로 관리



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## IEEE 802.11ax Reference Guide

**OFDMA – Orthogonal Frequency Division Multiple Access**

Multi-user version of OFDM enabling concurrent AP communication (Uplink/Downlink) with multiple clients by assigning subsets of subcarriers, called Resource Units (RUs), to the individual clients. Based on client traffic needs, the AP can allocate the whole channel to only one user or may partition it to serve multiple users simultaneously.

**OBSS – Overlapping Basic Service Set**

To improve spatial reuse efficiency and performance, 11ax adjusts the carrier sense operation based on the "color" of the BSS. Depending on the BSS the traffic is generated from, the station can use different sensitivity thresholds to transmit or defer. This results in higher overall performance.

**MU-MIMO – Multi-User Multiple Input Multiple Output**

Introduced in 11ac, MU-MIMO technology allows the simultaneous transmitting of multiple frames to different receivers at the same time on the same channel using multiple RF streams to provide greater efficiency. 11ax adds BeB and Uplink MU-MIMO services to provide significantly higher data throughput.

**TWT – Target Wake Time**

TWT allows the AP to schedule a series of times for a station to "wake up" at scheduled intervals to exchange data frames. This allows the station to "sleep" longer and reduces energy consumption. Key capability for IoT devices.

**QAM – 256 to 1024**

Modulation techniques are used to optimize throughput and range. The number of points in the modulation constellation determines the number of bits conveyed with each symbol. 802.11ax uses 256 QAM which transfers 8 bits/symbol. 802.11ax supports 1024 QAM, using 10 bits/symbol for a 25% increase in throughput.

**Longer OFDM Symbols**

4x larger OFDM symbol times increase efficiency and also improves robustness, especially for transmission in outdoor scenarios.

**Preamble Updates**

Modified frame formats provide High Efficiency (HE) and legacy information to support new advanced capabilities as well as information required to support legacy stations and backward compatibility.

**802.11ax Overview**

The 802.11ax IEEE standard, essentially the 6th generation of Wi-Fi addresses some of today's biggest Wi-Fi challenges, high density & performance—increasing capacity by up to 4x; improving spectral efficiency to benefit both 2.4 GHz and 5 GHz bands in high density environments.

Components:

- OFDMA UL/DL
- MU-MIMO BeB & UL/DL
- 1024-QAM modulation
- Long OFDMA Symbol
- New Frame Formats
- OBSS (BSS coloring)
- TWT – Power Saving
- Increased range
- 5 GHz & 2.4 GHz support

**Glossary**

- MU** – Multi User (OFDMA or MIMO)
- UL/DL** – Uplink/Downlink
- TWT** – Target Wake Time
- HE** – High Efficiency
- OBSS** – Overlapping Basic Service Set
- MIMO** – Multiple-Input and Multiple-Output
- OFDM** – Orthogonal Frequency-Division Multiplexing

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By David Coleman, Perry Cornell and Alexandre Gelin

## 802.11ax (Wi-Fi 6) Business Benefits

전체 네트워크의 성능 향상

접속 속도 및 커버리지 증가

최대 지원 속도 증가

오버헤드 감소

고밀도 네트워크에서 효율성 증가

아웃도어 환경에서 안정성 증가

단말의 배터리 관리 효율 증가

트래픽 관리 최적화



# WPA3 (Wi-fi protected access 3)

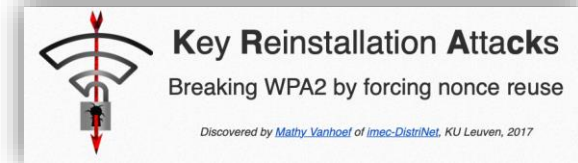
## • WPA2의 보안 이슈

- 2017년 10월 WPA2의 보안 취약 이슈 발생
- KRACK 이라고 부르는 키 재설정 공격
- WPA2의 4-Way / 그룹키 핸드셰이크 취약점을 이용한 공격
- 암호화키 재설정을 유도하여 데이터 복화와 및 위변조 가능



## • 대응 방안

- WPA2 의 구조적인 문제점으로 근본적인 대응 불가
- 기존 제조사들이 동작 방식 수정 패치를 통한 일시적 대응
- **근본적인 해결을 위해서는 차세대 보안 WPA3 사용 필요**



## • 참고 문서

- <https://sensorstechforum.com/wpa3-wi-fi-security-krack-attack/>
- <https://sensorstechforum.com/wi-fi-encryption-protocol-wpa2-now-unsafe-due-krack-attack/>
- <https://www.krackattacks.com>



# WPA3 표준 현황

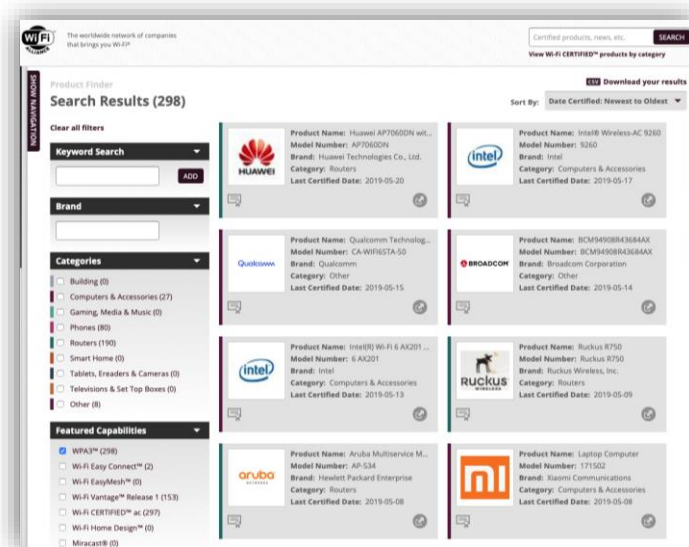
## • Wi-Fi Alliance WPA3

- WPA3는 기존 WPA2/WPA1과 호환성 제공
- Wi-Fi Alliance는 무선 보안 강화를 위해 WPA3 브랜드 런칭
- 암호화 레벨 강화 등 다수의 보안을 강화할 수 있는 기능 추가
- WPA2에서 발생했던 “KRACK 취약점” 을 보완



## • WPA3 지원 제품 현황

- 현재 Wi-Fi Alliance에서 인증 진행
- 현재 298개 제품이 인증 완료
- 현재 출시되는 신규 제품은 WPA3 지원



- 11ax의 PoE 규격은?
  - 기존 802.3 af/at로 지원이 가능한지?
- 적합한 AP 성능은?
  - 2x2? 4x4? 8x8?
- 2.5/5.0 Multi-Gig (802.3bz) 포트가 꼭 필요한지?
  - 채널 대역폭(20~80MHz), 단말 성능 등 고려 필요
- WPA3등 새로운 보안 표준이 필요한지?

# IN SUMMARY

## Cloud Enterprise Network의 진화

### REDUCED NETWORK COST AND COMPLEXITY

SIMPLIFIED DESIGN, DEPLOYMENT, MANAGEMENT, AND SUPPORT

Big Data, Machine Learning, AI의 적용

## High-Density, High-Speed 환경에 적합한 신규 표준 도입 필요

### HIGH EFFICIENCY WIRELESS (802.11ax)

FOR HIGH DENSITY (BOTH AP AND CLIENT)



**THANK YOU**

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