

# Wi-Fi @ CERN

CS 40<sup>th</sup> Anniversary



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# Agenda

- Beginnings
- External Wi-Fi cards
- The Day which changed everything
- Evolution
- Revolution
- Wi-Fi service at CERN
- Future
- Different challenges over the years
- VDSL & Wi-Fi in LCH tunnel
- Environment changes...
- Not everyone likes Wi-Fi...



# Beginnings

- Adoption of 802.11 standard (up to 2 Mbit/s) -> 1997
- Adoption of 802.11b standard (up to 11 Mbit/s) -> 1999
- Adoption of 802.11a standard (up to 54 Mbit/s) -> 1999
- Adoption of 802.11g standard (up to 54 Mbit/s) -> 2003
  
- No one remembers when the first AP was deployed at CERN...
- But tender was launched in 2003 to supply 802.11g APs
  - Proxim Orinoco started to be deployed (802.11g & 802.11a)

LE#

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

CERN - MEYRIN/GENEVA

PRICE ENQUIRY DO-????/IT

SUPPLY OF 802.11g WIRELESS BASE STATIONS

TENDER FORM

*(two copies to be returned daily completed, signed and dated)*

**BIDDER**

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

MANUFACTURING ADDRESS \_\_\_\_\_

TELEPHONE \_\_\_\_\_

TELEX \_\_\_\_\_

TELEFAX \_\_\_\_\_

**NAMES OF THE PERSONS IN CHARGE OF THIS TENDER**

COMMERCIALY \_\_\_\_\_ Tel. ext. \_\_\_\_\_

TECHNICALLY \_\_\_\_\_ Tel. ext. \_\_\_\_\_

\_\_\_\_\_ Date: \_\_\_\_\_



# External Wi-Fi cards

- At the beginning external PC Wi-Fi cards were used to interconnect machines to Wi-Fi network



# The Day which changed everything

- Apple announces iPhone -> 2007



- Things went fast afterwards...
  - Global smartphone adoption
  - Laptops without ethernet ports



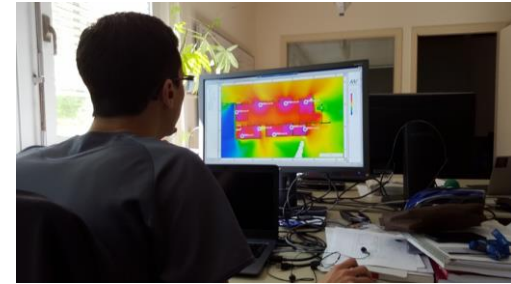
# Evolution



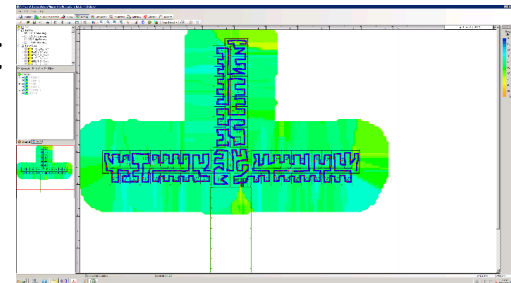
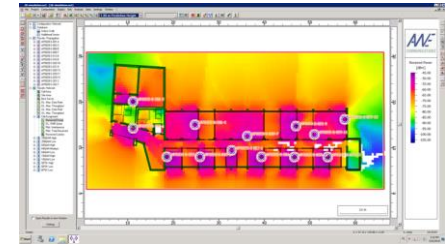
- Infrastructure based on 802.11n compatible HP APs
- Structured deployment process
- More than 1000 autonomous APs deployed across CERN campus around 2014
- APs deployed on corridors of office buildings and in on-demand locations in technical areas
- Central configuration and management developed in CFMGR
- Manual channel and power assignment on the radios
- WIND - Openlab project to develop monitoring tools for Wi-Fi infrastructure



# Revolution



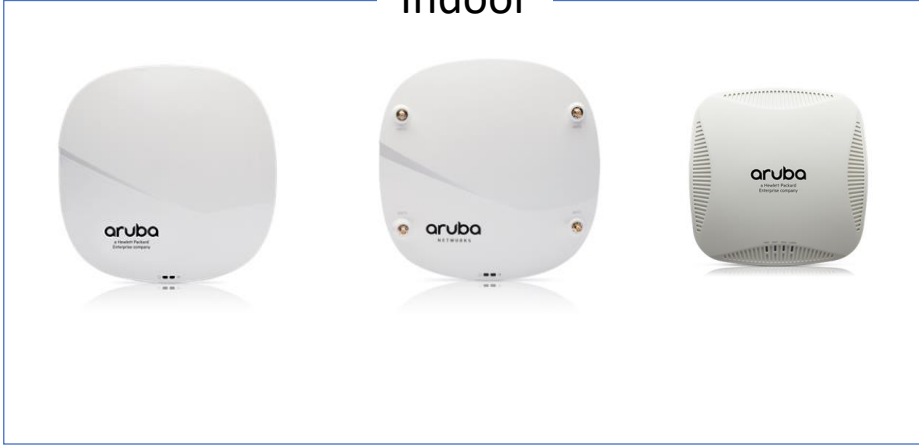
- Tender to supply Wi-Fi controller-based solution supporting 802.11ac standard was launched in 2015
- Full coverage of all office buildings across CERN campus
- High density coverage with APs inside offices (1 AP per 3 offices)
- Dedicated cabling for Wi-Fi infrastructure
- RF simulations, pre-deployment and post-deployment site surveys





# Revolution

Indoor



Outdoor



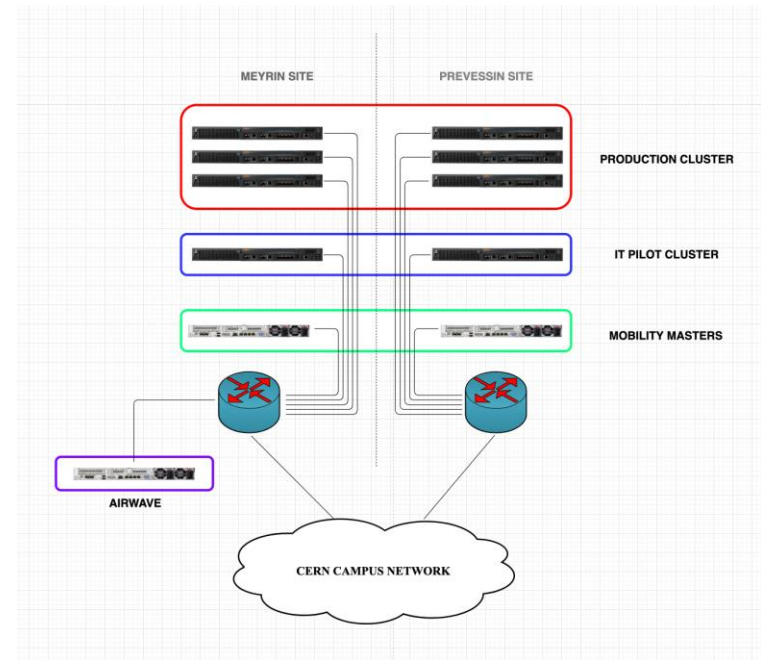
# Wi-Fi service at CERN



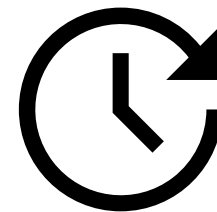
- 200 fully covered buildings
  - Almost 300 dedicated switches
  - Around 8000 UTP outlets cabled
  - Around 250 000 m<sup>2</sup> covered (indoor)
  - Outdoor coverage for main pedestrian paths and CMS site
  - On demand coverage in underground areas
- 
- Up to 14,000 unique devices per day
  - More than 9,000 simultaneous users every day

# Wi-Fi service at CERN

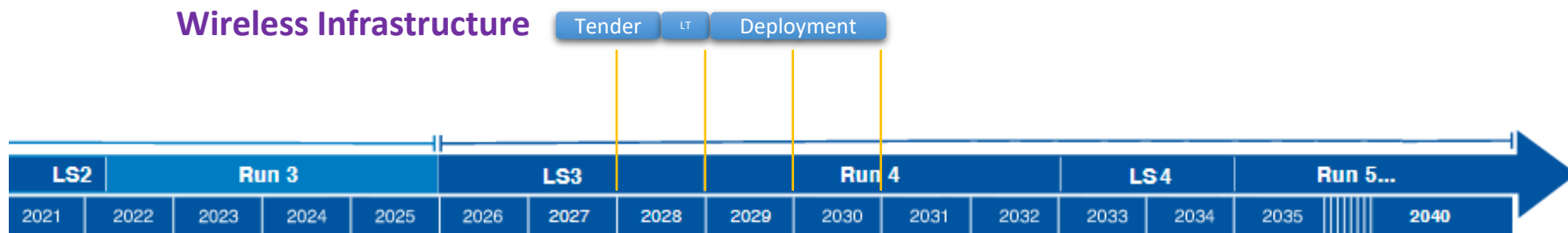
- 2 zones across CERN campus
- 9 controllers
- Around 5000 APs deployed
- 802.11ac and 802.11ax standards
- 3 SSIDs
  - CERN
  - eduroam
  - CERN-Visitors
- Roaming inside buildings and popular outdoor areas
- Bluetooth IoT support
- Additional monitoring with dedicated sensors



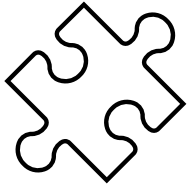
# Future



- Wireless is the future of campus network
- Wireless tender will be launched to renew Wi-Fi infrastructure
- The newest 802.11 standard
- Adoption of new 6GHz band



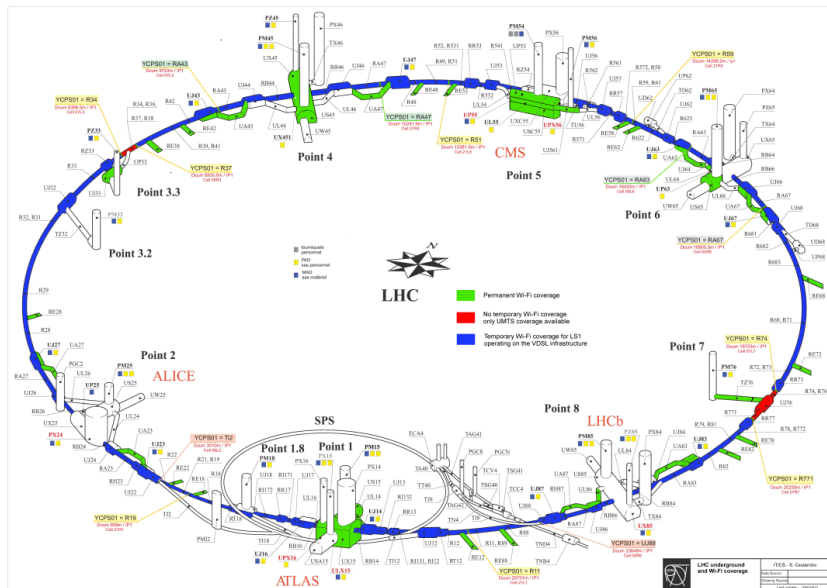
# Different challenges over the years



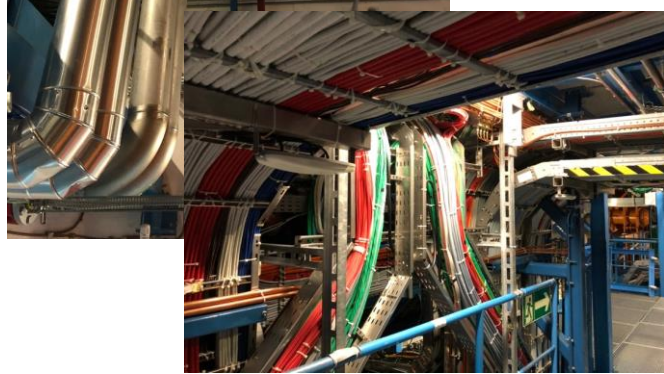
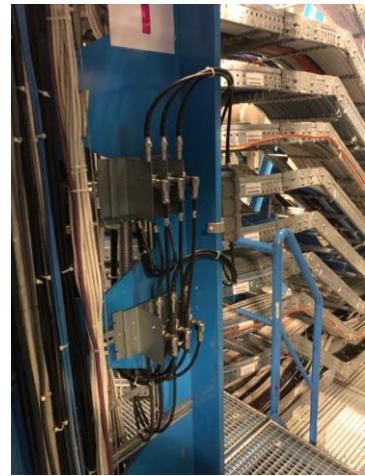
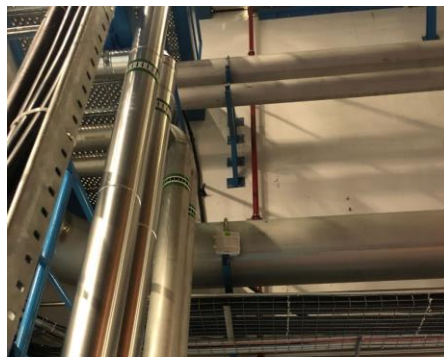
- Poor implementation of the 802.11 standards on users' devices
- Manual channel and power assignments
- Interferences and rouge APs on 2.4GHz band
- Moving people to 5GHz band
- Problems with DFS channels
- Management of huge network of autonomous APs
- Underground deployments exposed on radiation
- From coverage-oriented deployment to one focused on the capacity
- Building automation for controller-based solution
- Reliability of controller-based solution
- Deliver enough electrical power to run Wi-Fi APs

# VDSL & Wi-Fi in LHC tunnel

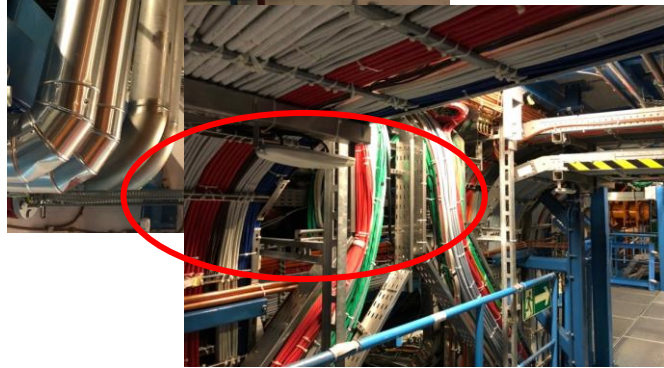
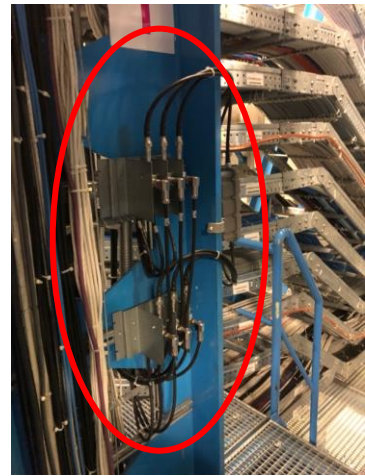
- VDSL2 : Very high bit rate Digital Subscriber Line version 2
- Temporary Wi-Fi/VDSL modems deployment for the period of LS1
- 278 Wi-Fi/VDSL modems deployed in LHC tunnel
  - 802.11bgn (2.4GHz) up to 80Mbps half-duplex shared
- GPN plugs available every 100m



# Underground areas



# Underground areas





# Environment changes...



# Not everybody likes Wi-Fi...



Thank you!



