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February 9, 2016

Via Electronic Filing

Marlene H. Dortch, Secretary
Federal Communications Commission
445 Twelfth Street, SW
Washington, DC 20554

Re: *Ex Parte* Notice: *Terrestrial Use of the 2473-2495 MHz Band for Low-Power Mobile Broadband Networks* – IB Docket No. 13-213

Dear Ms. Dortch:

Globalstar, Inc. ("Globalstar"), through its counsel, hereby informs the Commission that on February 8, 2016, Commissioner Ajit Pai; Brendan Carr, Legal Advisor to Commissioner Pai; Gigi Sohn, Counselor to Chairman Tom Wheeler; and Gabrielle Whitehall from Chairman Wheeler's office visited the Washington School for Girls ("WSG") and observed students using Globalstar's Terrestrial Low Power Service ("TLPS") along with Wi-Fi Channels 1, 6, and 11.[1] As shown during this visit,[2] the TLPS deployment at WSG has been a success and further confirms the significant public interest benefits of the rules the Commission proposed in the above-captioned proceeding.[3] WSG's students are the first in the nation to gain access to TLPS and now have more 2.4 GHz spectrum available to meet their educational needs than any other students in the country.[4]

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[1] Globalstar has deployed TLPS at WSG pursuant to an experimental license granted by the Commission. *See* Globalstar Experimental License, Call Sign WH2XNQ.

[2] L. Barbee Ponder IV, Globalstar General Counsel & Vice President, Regulatory Affairs, for Globalstar; Mark Lowenstein, Managing Director of Mobile Ecosystem; Joshua Lamel of BGR Group; Gonzalo Casado and Sai Sushma Mallela of AT4 wireless; and I met with Commissioner Pai and Commission staff at WSG on February 8 and discussed the attached presentation.

[3] As described in the attached presentation, measurements conducted by AT4 wireless indicated that downlink throughput increased 45% and uplink throughput increased 34% when WSG's access points were tuned to a fourth channel, Channel 14 (for TLPS), in addition to Channels 1, 6 and 11.

[4] The Washington School for Girls, whose motto is "In the Spirit of Courageous Women," is the only full-scholarship private school for girls in Anacostia. The school, established in 1997, has grown to include grades three through eight. Rather than recruiting students based on

In its November 2012 petition for rulemaking, Globalstar committed to provide 20,000 TLPS access points to schools and other institutions. Globalstar recognized that, as the public's demand for mobile broadband spectrum grows, students in particular will benefit from the additional broadband capacity of TLPS. Globalstar is proud that the students at WSG are among the first to benefit from this innovative use of spectrum and hopes to bring similar benefits to thousands of other students across the United States within the near future.

Globalstar urges the Commission to adopt the rules it proposed more than two years ago.[5] The Commission's proposed rules will make additional broadband spectrum and the associated public interest benefits available to students and consumers across the country.

Pursuant to section 1.1206(b)(2) of the Commission's rules, 47 C.F.R. § 1.1206(b)(2), this *ex parte* notification and the attached presentation are being filed electronically for inclusion in the public record of the above-referenced proceeding.

Respectfully submitted,

/s/ *Regina M. Keeney*
Regina M. Keeney

Attachment

cc: Commissioner Ajit Pai
Gigi Sohn
Brendan Carr
Gabrielle Whitehall

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academic prowess, WSG intentionally recruits girls whose socioeconomic and personal circumstances present barriers to their academic and social development. Despite these barriers, 98% of WSG's graduates go on to complete high school and 80% continue their education further, most matriculating to college. By contrast, less than half of the students in the surrounding community graduate from high school.

[5] *Terrestrial Use of the 2473-2495 MHz Band for Low-Power Mobile Broadband Networks; Amendments to Rules for the Ancillary Terrestrial Component of Mobile Satellite Service Systems*, Notice of Proposed Rulemaking, 28 FCC Rcd 15351 (2013).

Terrestrial Low Power Service (TLPS) Deployment

The Washington School for Girls (WSG)

Washington, D.C.

February 8th, 2016

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Overview of TLPS Deployment at WSG

- **Purpose:**
  - Integrate TLPS on IEEE 802.11 Channel 14 into the existing wireless network of WSG and measure the incremental benefits achieved.
- **Test Scenarios:**
  - Scenario 1 – Baseline Measurement
    - Measure aggregate network throughput with three existing Aruba access points (APs) and one newly deployed Ruckus AP operating on Channels 1, 6 and 11 (two on Channel 1, one on Channel 6 and one on Channel 11).
  - Scenario 2 – Network with TLPS Enabled
    - Measure aggregate network throughput with the newly deployed Ruckus AP reconfigured to operate on Channel 14 and the three Aruba APs operating on Channels 1, 6 and 11.
- **Observations Summary:**
  - **Significant increases in aggregate WLAN throughput when Channel 14 is utilized** compared to reusing other channels.
    - **TLPS operations increased downlink (DL) aggregate WLAN throughput by approximately 45% and uplink (UL) aggregate WLAN throughput by approximately 34% with no negative impact on Channel 11** performance, based on the throughput achieved by the test clients.

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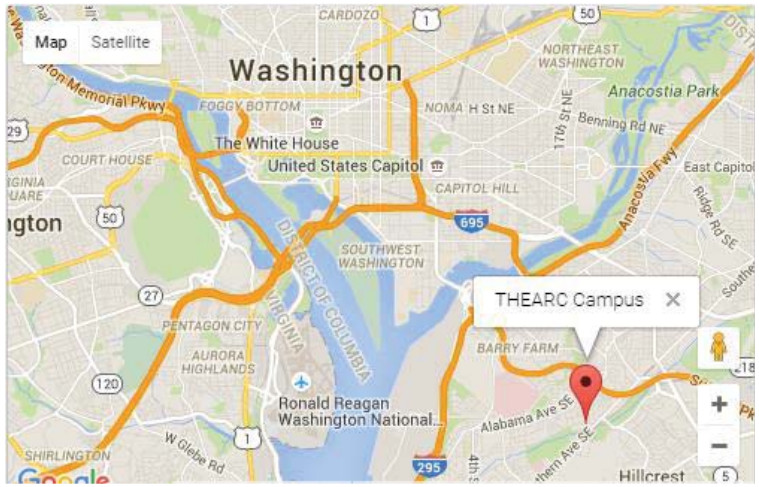
Location

- **The Washington School for Girls:**
  - WSG's middle school is located in approximately 12,500 sq. ft. (188 ft. x 66 ft.) on the second floor of the Town Hall Education Arts Recreation Campus (THEARC), 1901 Mississippi Avenue, SE, Washington, DC 20020.
  - THEARC's other tenants include Children's Medical Center, Covenant House and The Washington Ballet, with multiple 2.4 GHz wireless networks.



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Equipment in TLPS Deployment at WSG

- **Access Points:**
  - Three Aruba 200 Series APs from existing school Wi-Fi network.
    - For initial test data, each AP was operating on one of the three public non-overlapping IEEE 802.11 2.4 GHz channels: AP1 – Channel 11; AP2 – Channel 1; AP3 – Channel 6.
  - Three Ruckus ZoneFlex 7982 APs capable of operating on Channels 1, 6, 11 and 14 were added to WSG's wireless network.
    - For initial test data, aggregated throughput included only one Channel 14-capable AP.
    - Test data throughput was generated locally within the school network using full buffer TCP flows.
- **Client Devices:**
  - 25 Chromebooks were deployed at the school for school usage.
  - For initial test data, four laptops running Linux OS with Asus USB (USB-AC56) Wi-Fi dongles connected were used.

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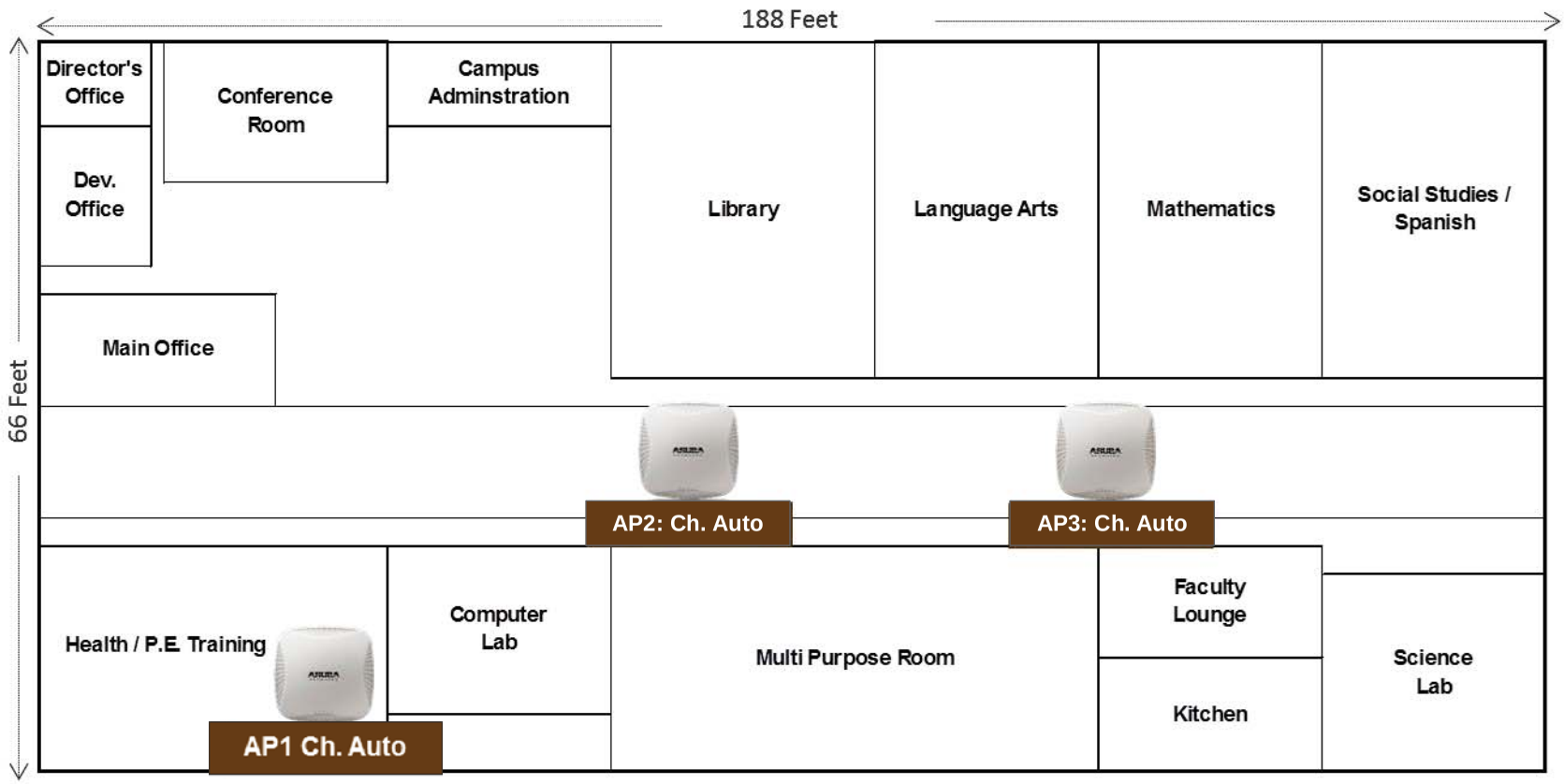
School Wireless Network – Prior to TLPS Installation

- Prior to deploying TLPS, WSG utilized a network of three Aruba Series 200 APs.



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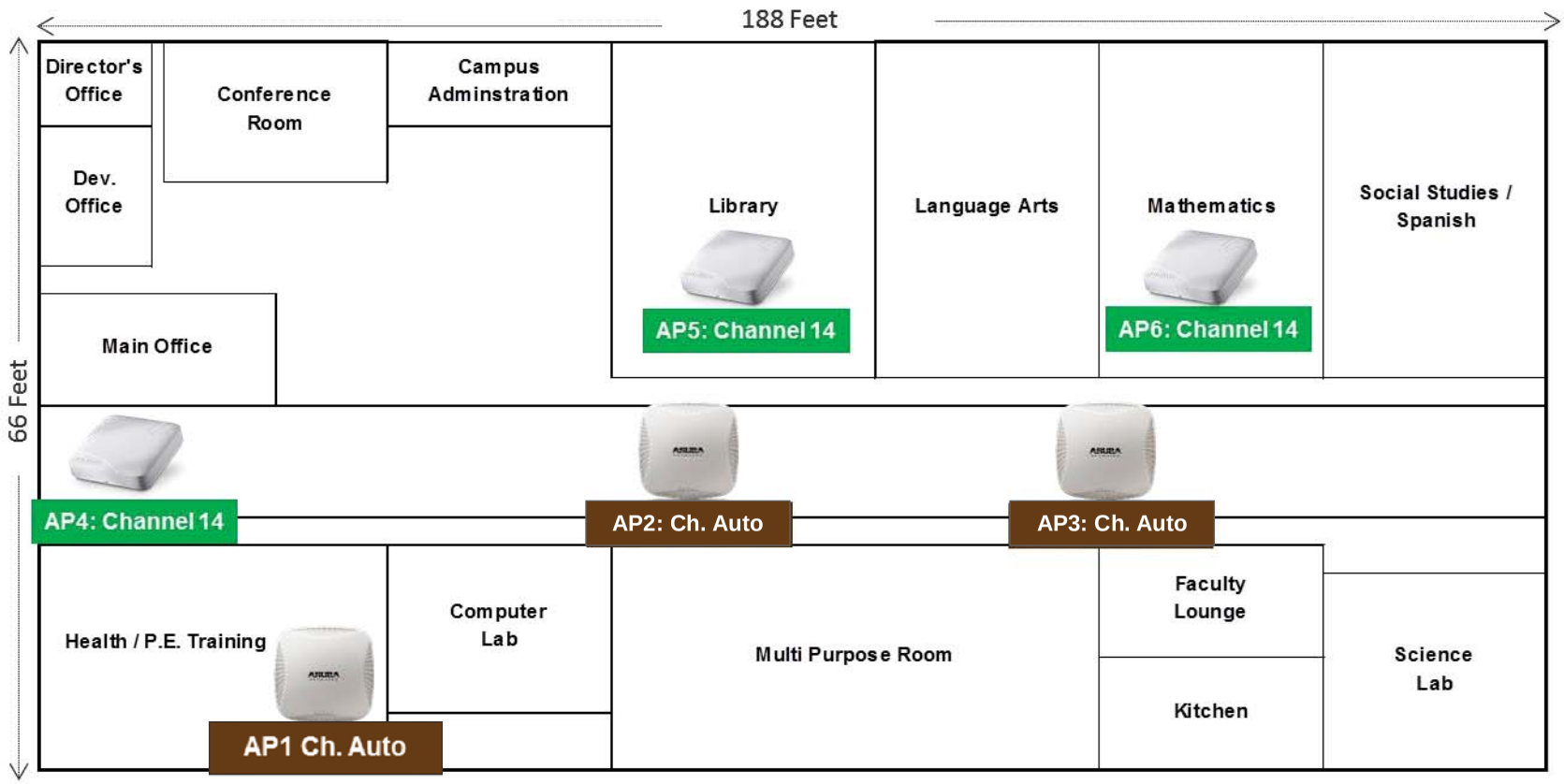
School Wireless Network – TLPS Installation

- Three TLPS-enabled Ruckus 7982 APs were installed and integrated into WSG's wireless network.



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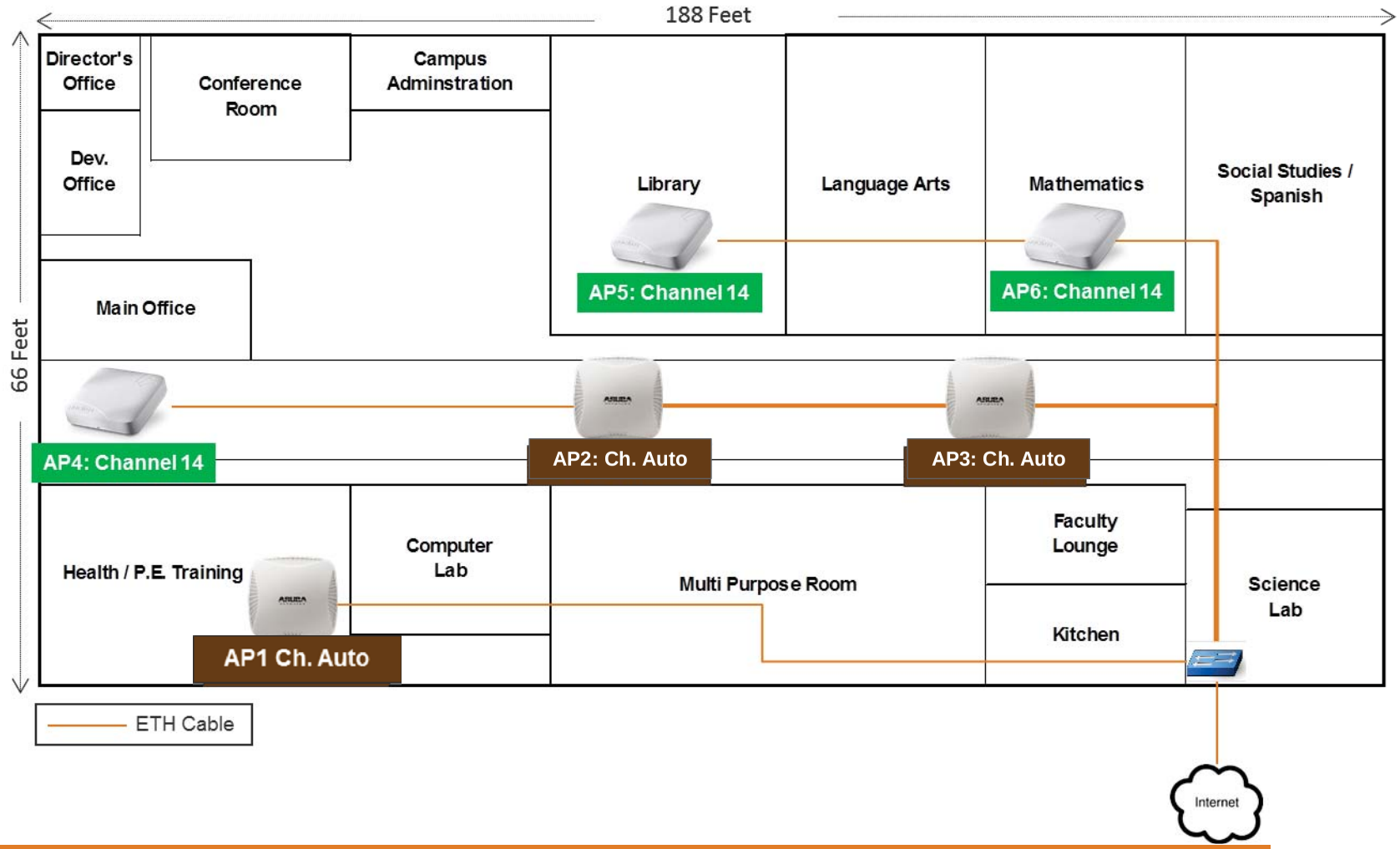
School Wireless Network – Ethernet Connections

- Internet access was provided via a centralized switch.
- TLPS was integrated into WSG's wireless network without interrupting service to network users.



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Scenario #1: Baseline Measurement

- Purpose: *Demonstrate baseline performance on Channels 1, 6 and 11 with high channel utilization*
- Environment:
  - 4 laptops, each connected to one AP
    - RSSI levels were consistent for all Wi-Fi clients: approx. -45dBm
  - 4 APs operating on 3 channels (Channels 1+6+11+ $1^{2nd\ AP}$)
    - Set-up depicted on next slide
  - Tests were performed during regular class hours
    - Generic full buffer TCP data was used
- Steps:
  - Channels 1+6+11+ $1^{2nd\ AP}$ simultaneously
  - Executed 3 times, 3 minutes each
  - Averaged DL and UL throughput per channel

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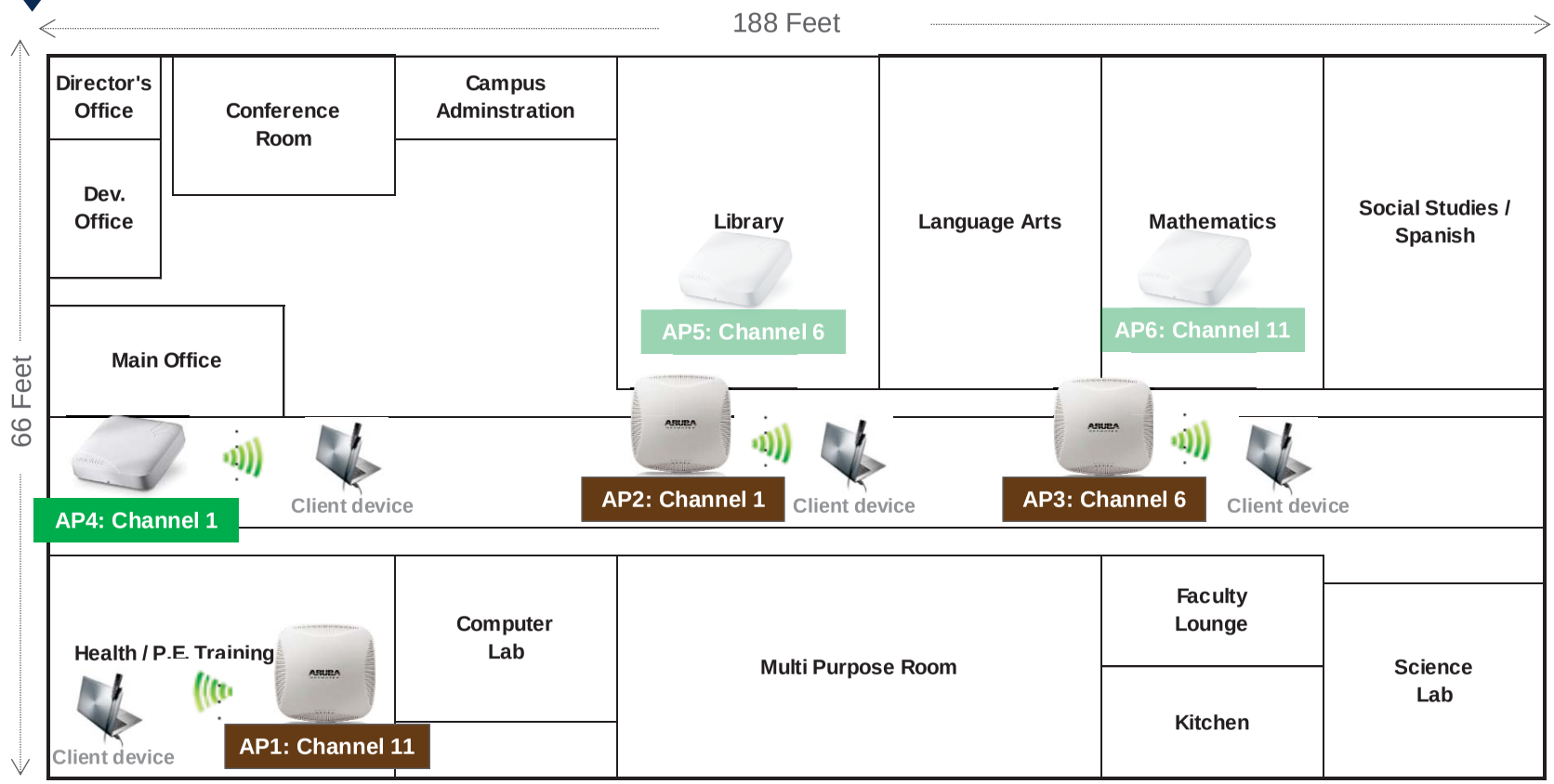
Scenario #1: Baseline Measurement (cont'd)



- AP1, AP2 and AP3 were set to Auto Channel configuration. These APs were operating on the channels indicated above.
- Ruckus AP4 continued to operate on Channel 1 during this testing for baseline measurement.
- AP5 and AP6 had no test devices connected for purposes of this scenario.

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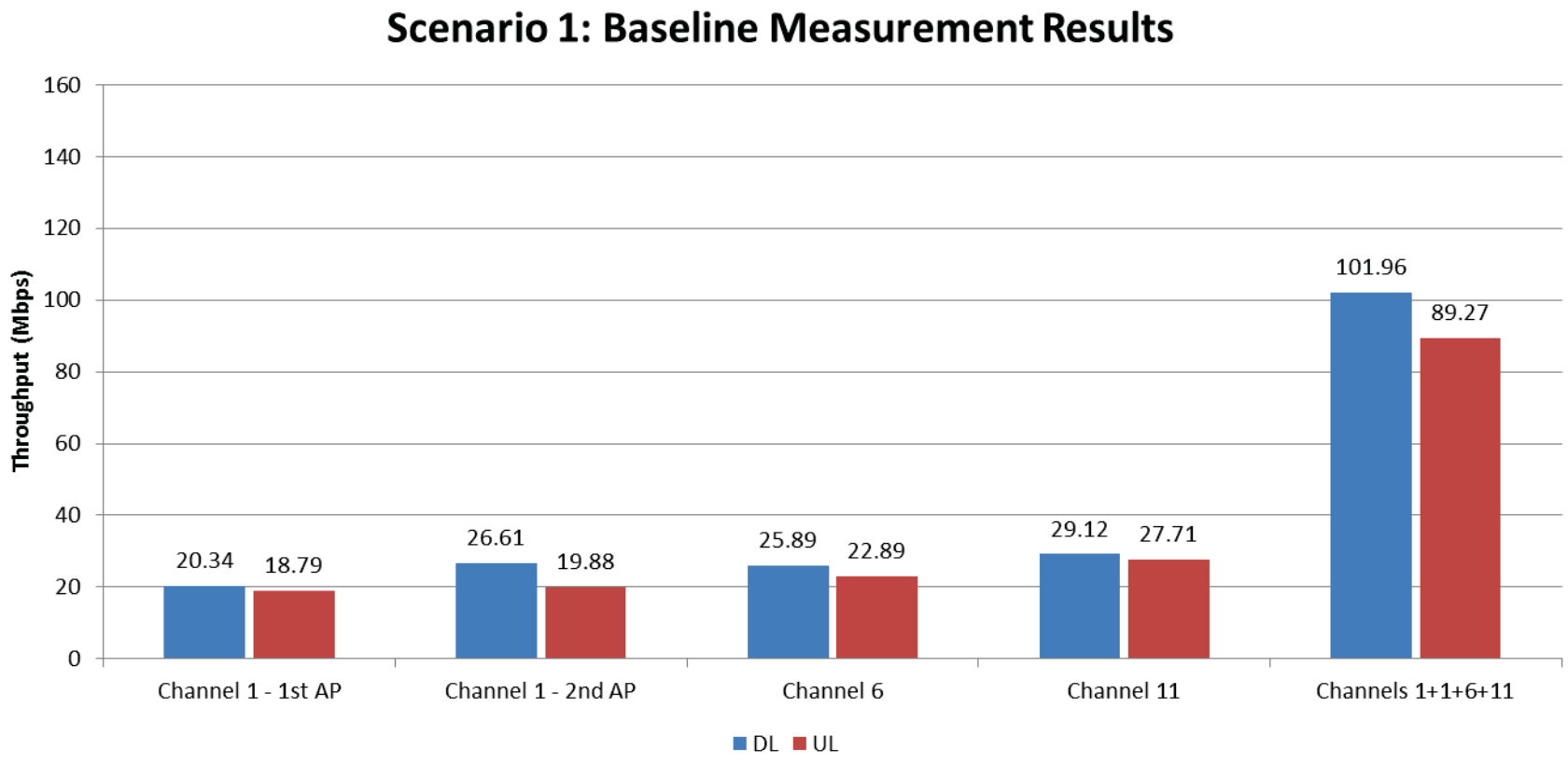
Scenario #1: Baseline Measurement (cont'd)



- Aggregated DL network capacity was approx. 100Mbps; UL was approx. 90 Mbps.
- Two APs set to Channel 1 to establish a baseline with same number of active APs before introducing TLPS in next scenario.

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Scenario #2: Network with TLPS Enabled

- Purpose: *Demonstrate what, if any, increase in throughput is achieved by adding Channel 14 operations and measure any impact on the performance of Channels 1, 6 and 11.*
- Environment:
  - 4 laptops, each connected to one AP
    - RSSI levels were consistent for all Wi-Fi clients: approx. -45dBm
  - 4 APs operating on 4 channels (Channels 1+6+11+14)
    - Set-up depicted on next slide
  - Tests were performed during regular class hours
    - Generic full buffer TCP data was used
    - Similar environmental conditions as previous test's scenario
- Steps:
  - Channels 1+6+11+14 simultaneously
  - Executed 3 times, 3 minutes each
  - Averaged DL and UL throughput per channel

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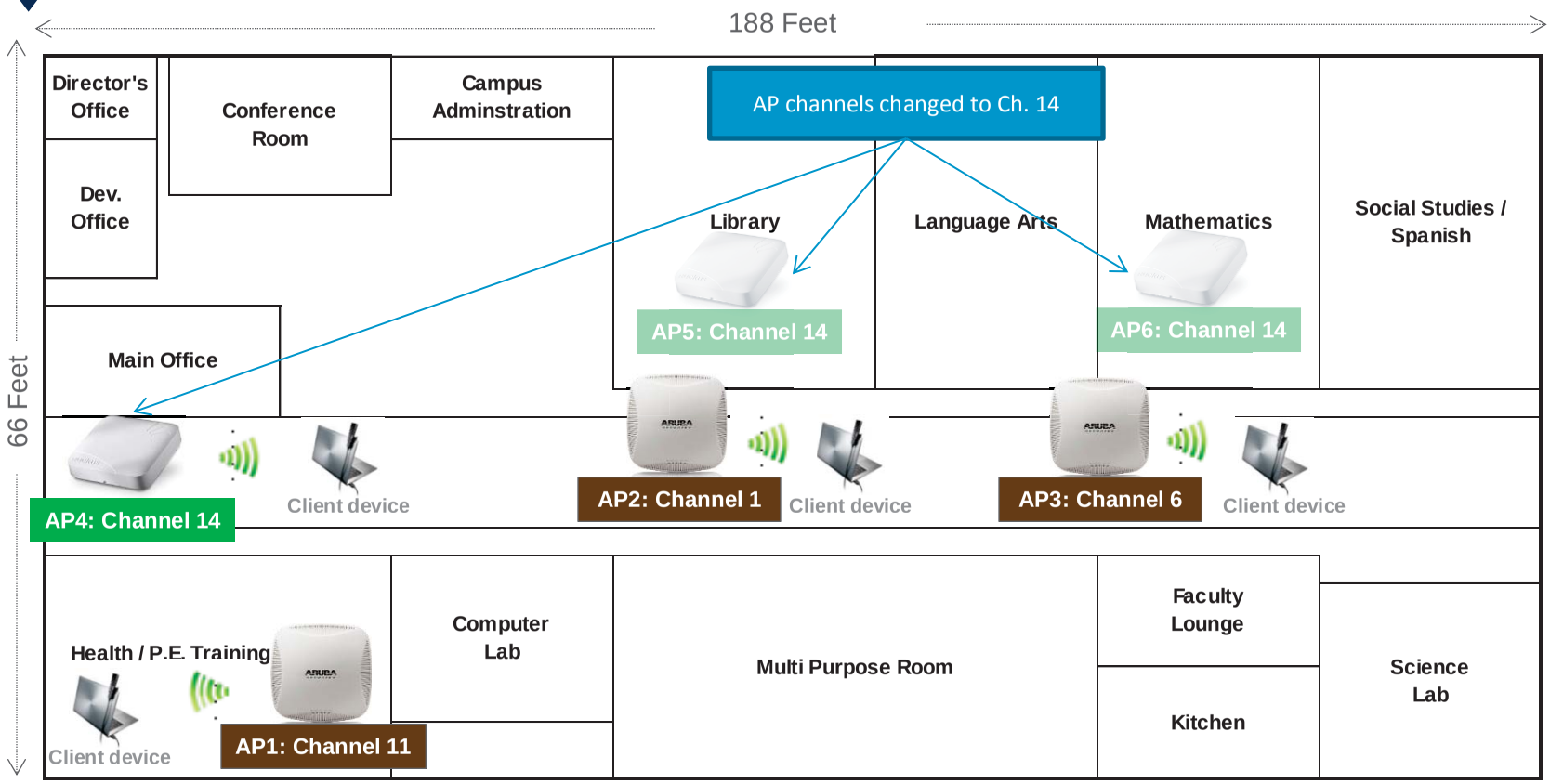
Scenario #2: Network with TLPS Enabled (cont'd)



- AP1, AP2 and AP3 were set to Auto Channel configuration. These APs were operating on the channels indicated above.
- AP4 was configured to operate on Channel 14.
- AP5 and AP6 had no test devices connected in order to maintain one AP per channel.

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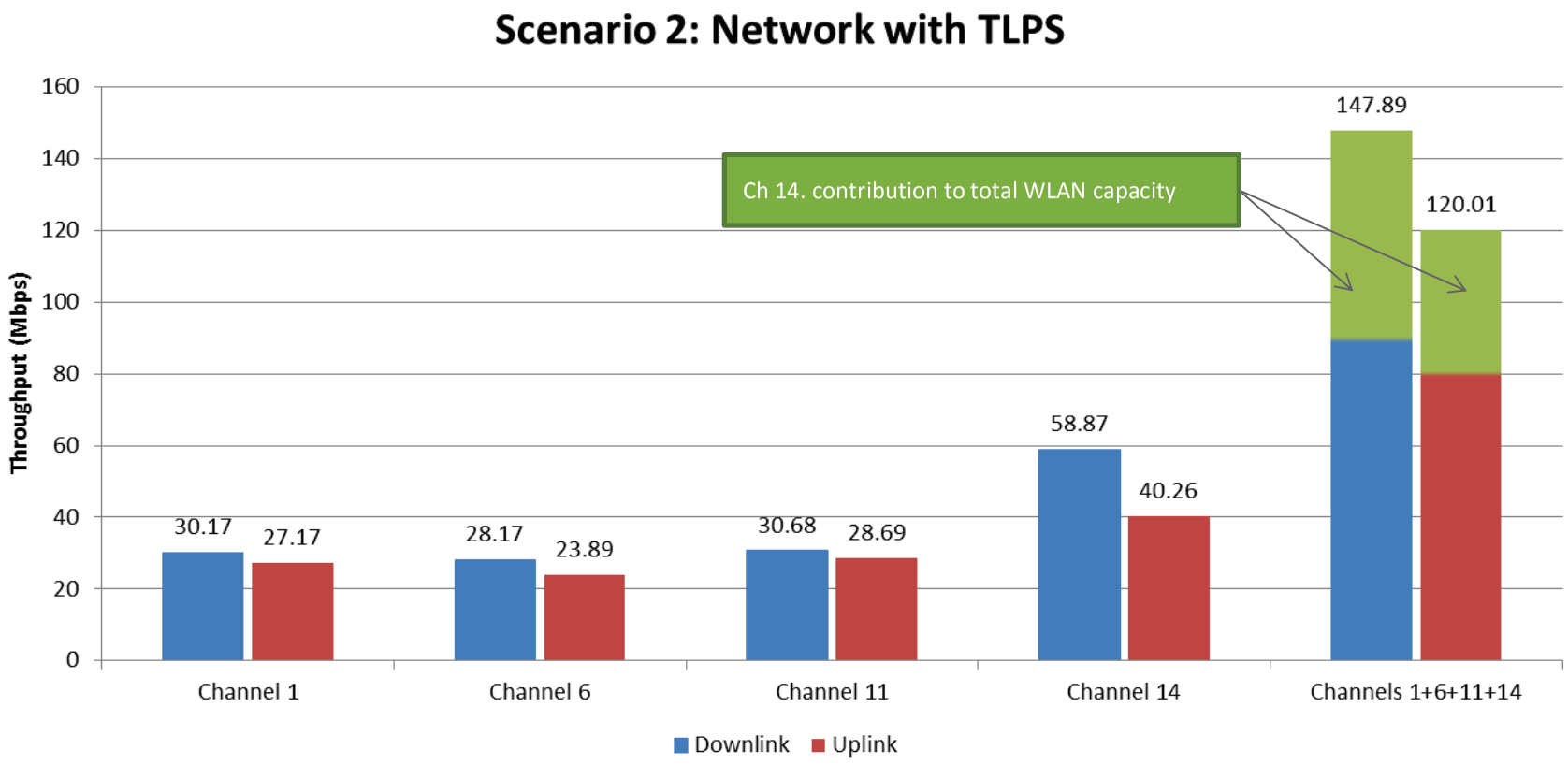
Scenario #2: Network with TLPS Enabled (cont'd)



- Aggregated DL network capacity was approx. 150Mbps; UL was 120 Mbps.
- Channel 14 increased DL capacity by 45% and UL capacity by 34%.
- Channel 14 operations had no impact on other channels.

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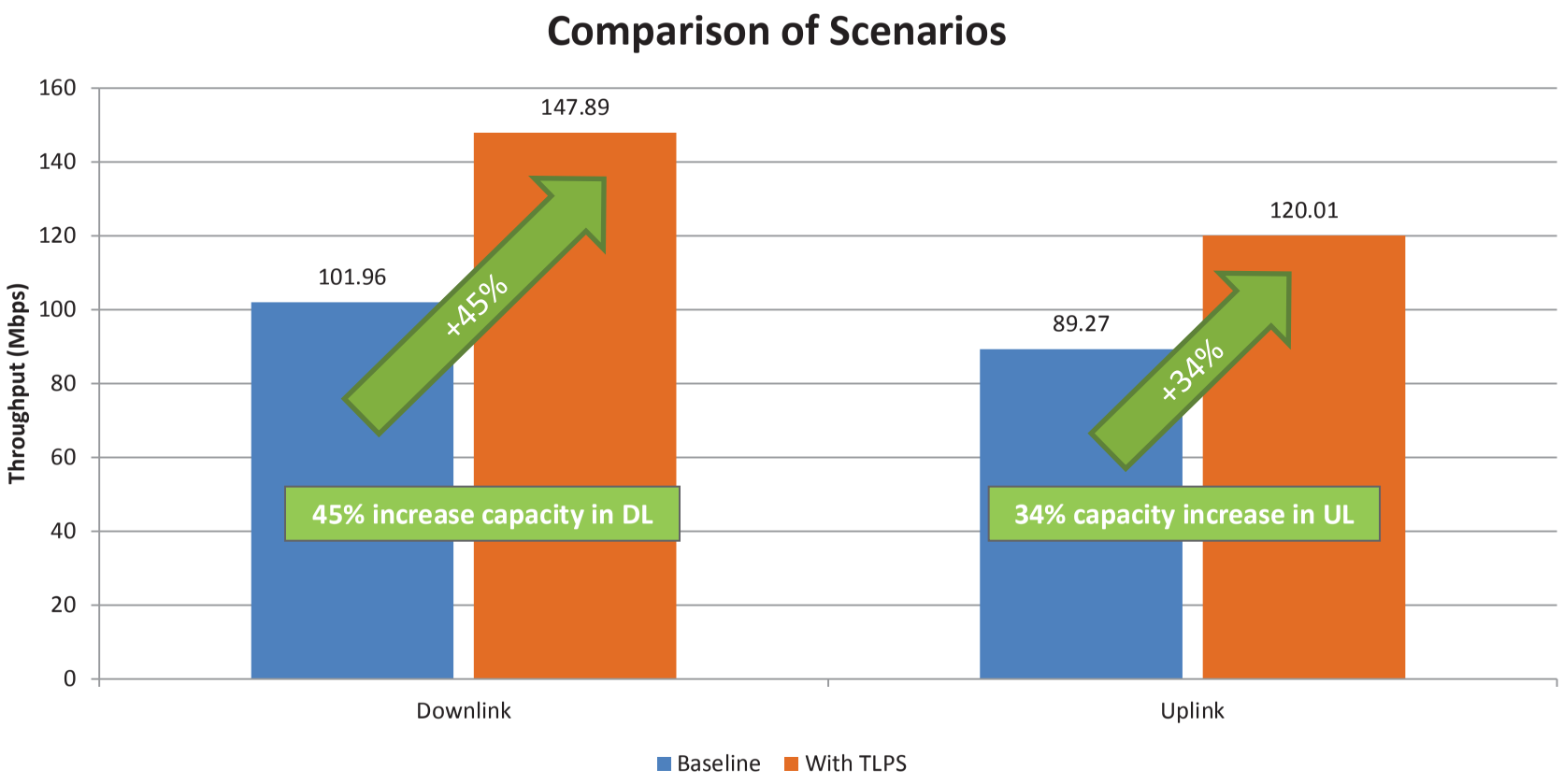
Comparison of Scenarios: WLAN Capacity



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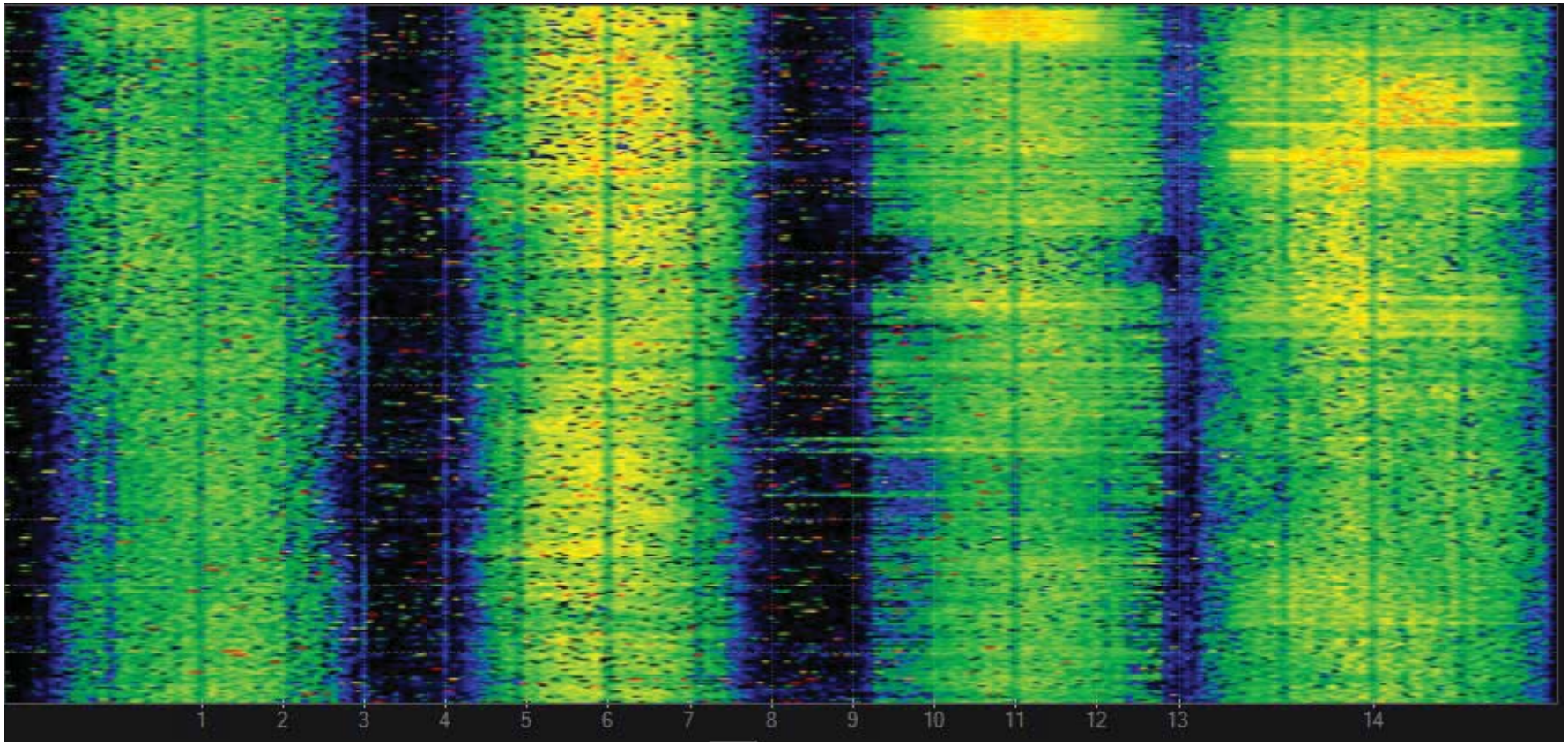
RF Environment



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