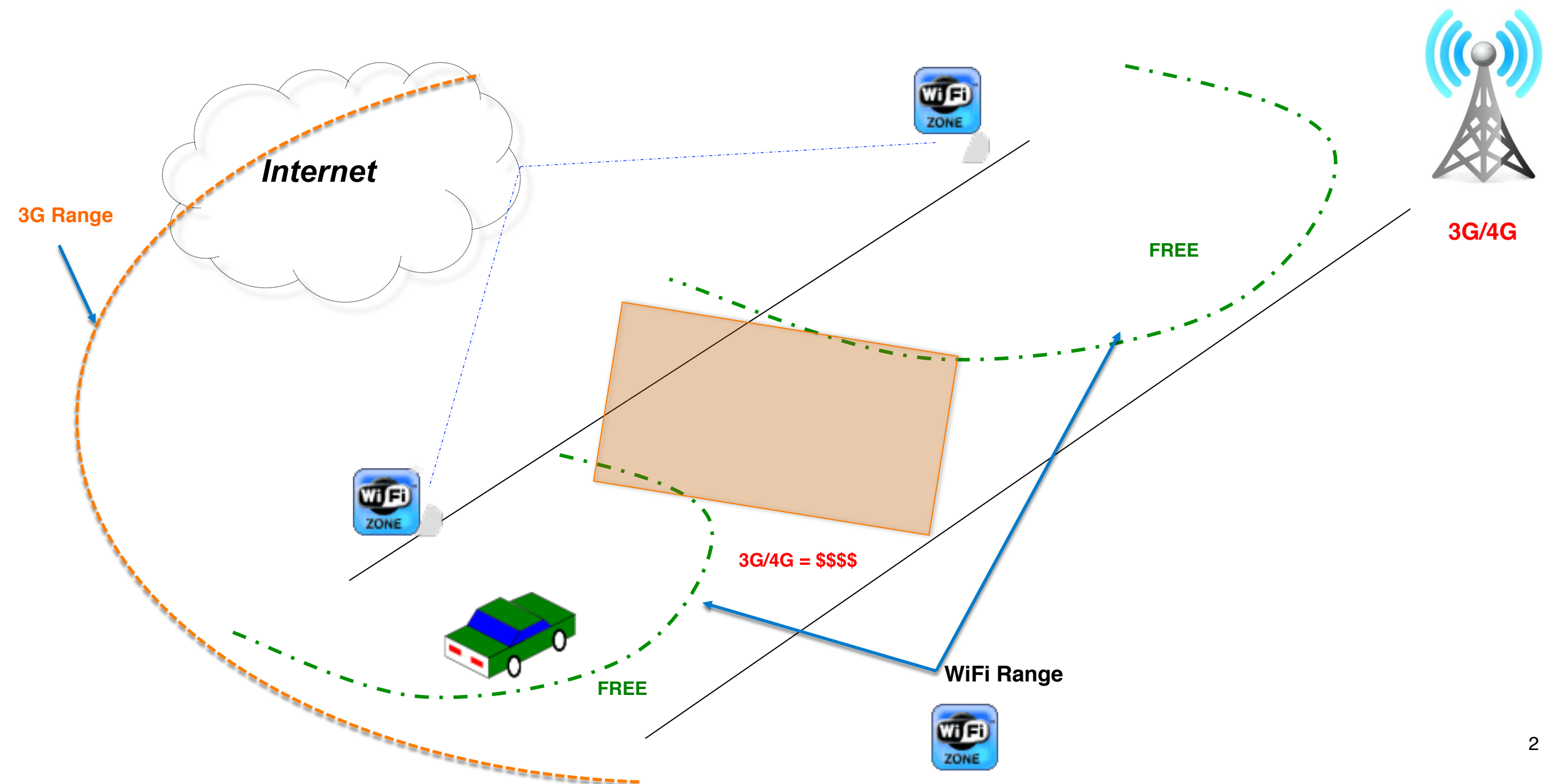# CarFi: V2X over WiFi

Monday, June 8, 15

CarFi: Next Generation V2X

WiFi Market

- **In USA:**
  - All Major **MNO** and **Cable Internet providers** offer WiFi to their customers while they are on the go.

  - The infrastructure includes AP in customer's premises as well as WiFi access points deployed on roadside.

  - Time Warner, specifically has AP installed on the **road-side** in the USA major cities.

  - An agreement known with the name of **Cable Alliance** allows customers of Cablevision, Comcast, Time Warner Cable, Cox Communications and Bright House Networks to access any WiFi AP within the alliance.
    - http://www.cablewifi.com/

  - The service is offered **Free of Charge** for customers that already have a standard Internet /Cable service.

WiFi Market

- **In Europe:**
  - Many continental europe MNO and ISP offer WiFi access to their customers.
  - In Germany **Deutsche Telekom** offers WiFi Global Roaming to its customers
    - http://www.telekom-icss.com/pressreleases/146718
  - **Fonera** offers access to WiFi piggybacking on the User's access points. It accounts for about 14 million access points. Fonera partners include British Telecom, SFR, Proxiumus, etc.
    - https://corp.fon.com/en

- **In France:**
  - All the operators Orange, SFR, Free-Telecom, Numericable offer WiFi Access to their customers free of charge on a community-network arrangement.
  - Deployment piggybacks on AP installed on the customer premises as part of the DSL/ Fiber deployment.
  - SFR/Free-Telecom offer EAP based access also for their mobile customer base in the effort of encouraging the users to relay more on WiFi and less on the 3G/4G Infrastructure

Current WiFi Technology

Timeline

- **WiFi Access requires several phases:**
  - **Scan**: Discovers which AP are available and in reach, it can be done probing for a specific ESSID.
  - **AP-Selection**: It is probably the most critical part. Selecting the wrong AP costs low bit rate and potentially waste a connection attempt.
  - **Association:** Once the AP is selected the STA needs to request to the AP the connection.
  - **Authentication**: Once the client station is associated to the AP the authentication process begins in order to establish the credentials and open the channel to user traffic.
  - **DHCP:** Finally a DHCP request is possible and a Lease is requested and may be obtained.

- **DONE Communication is possible !!**
  - Current Average: O(9-14) seconds

CarFi — the V2X WiFi

Timeline

- **Scan**: CarFi uses advanced algorithms to reduce the scanning time. Car-Fi learns from previous success and failures.

- **AP-Selection**: Car Fi Ranks AP using an advanced technique to estimate the AP performance potential and guide the selection among the available AP. This is Essential for the connection performance.

- **Association:** No modifications are requested as it is actually only 2 frames.

- **Authentication**: CarFi Supports EAP authentication methods; specifically, EAP-SIM for sim-based authentication, as well as EAP methods based on Token/passwords. FreeWiFi-Secure uses EAP-SIM (credential are based on the GSM-Card); Time-Warner Cable uses a password based EAP authentication. The authentication has been optimized to reduce latency and infer AP quality in the process.

- **DHCP: CarFi** DHCP client is re-written from scratch and optimized for latency.

- Car-FI Average Access time: O(1.5) seconds/Access Point

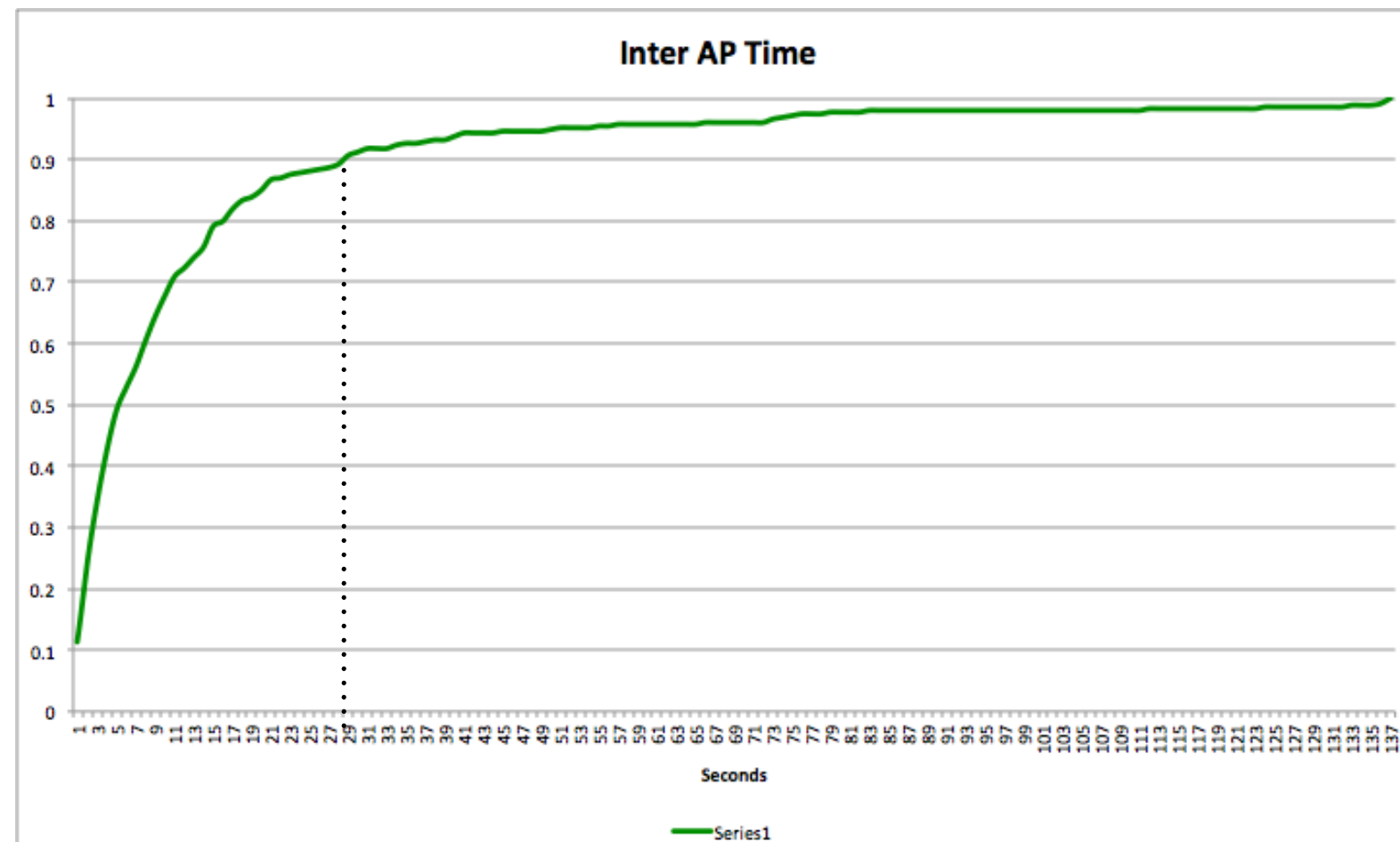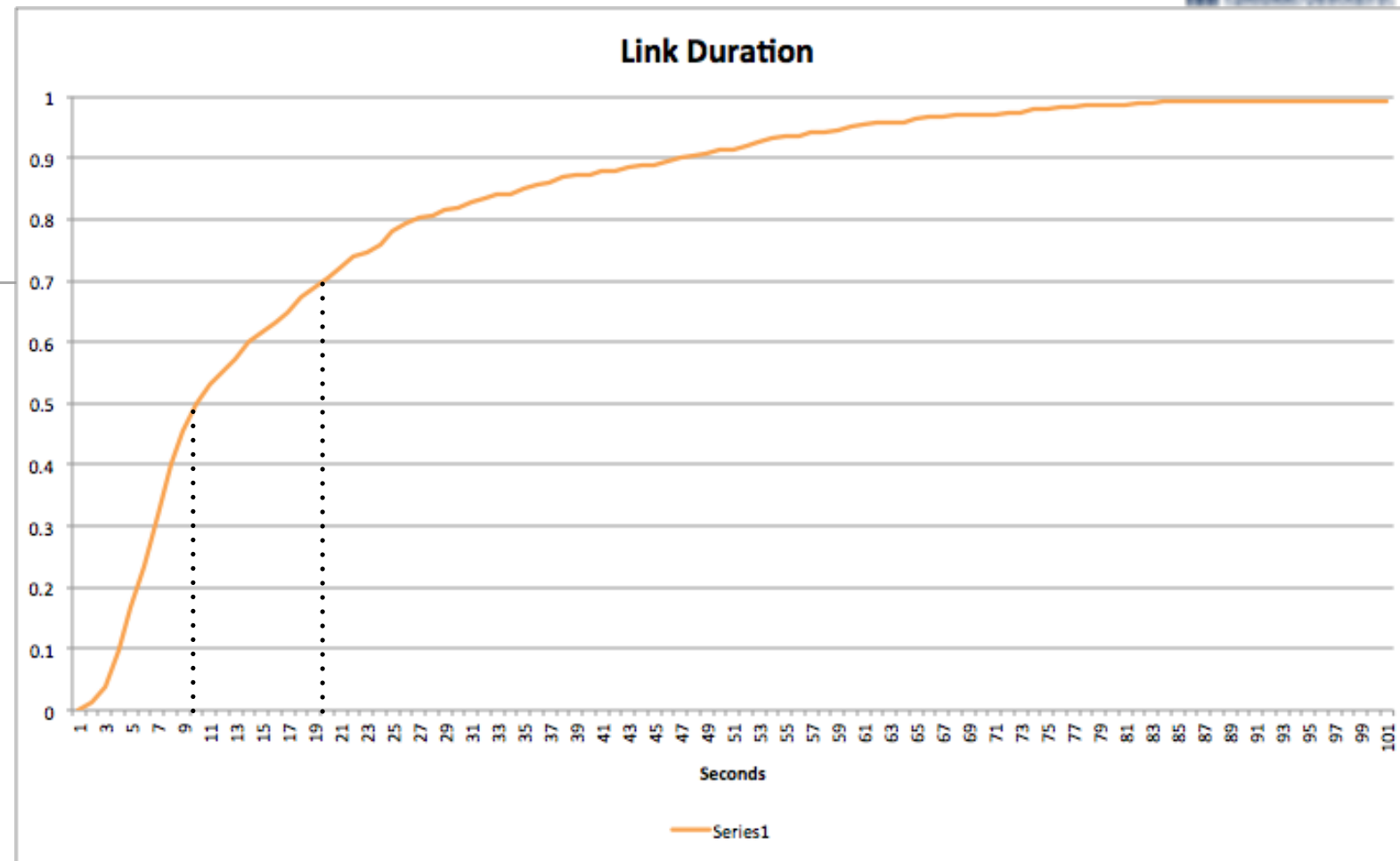- we expect this to be further reduced by further optimizing the Scan.

How it looks like?

Car-FI
Opportunistic WiFi on the Go

UPMC - Paris, Nov 2014
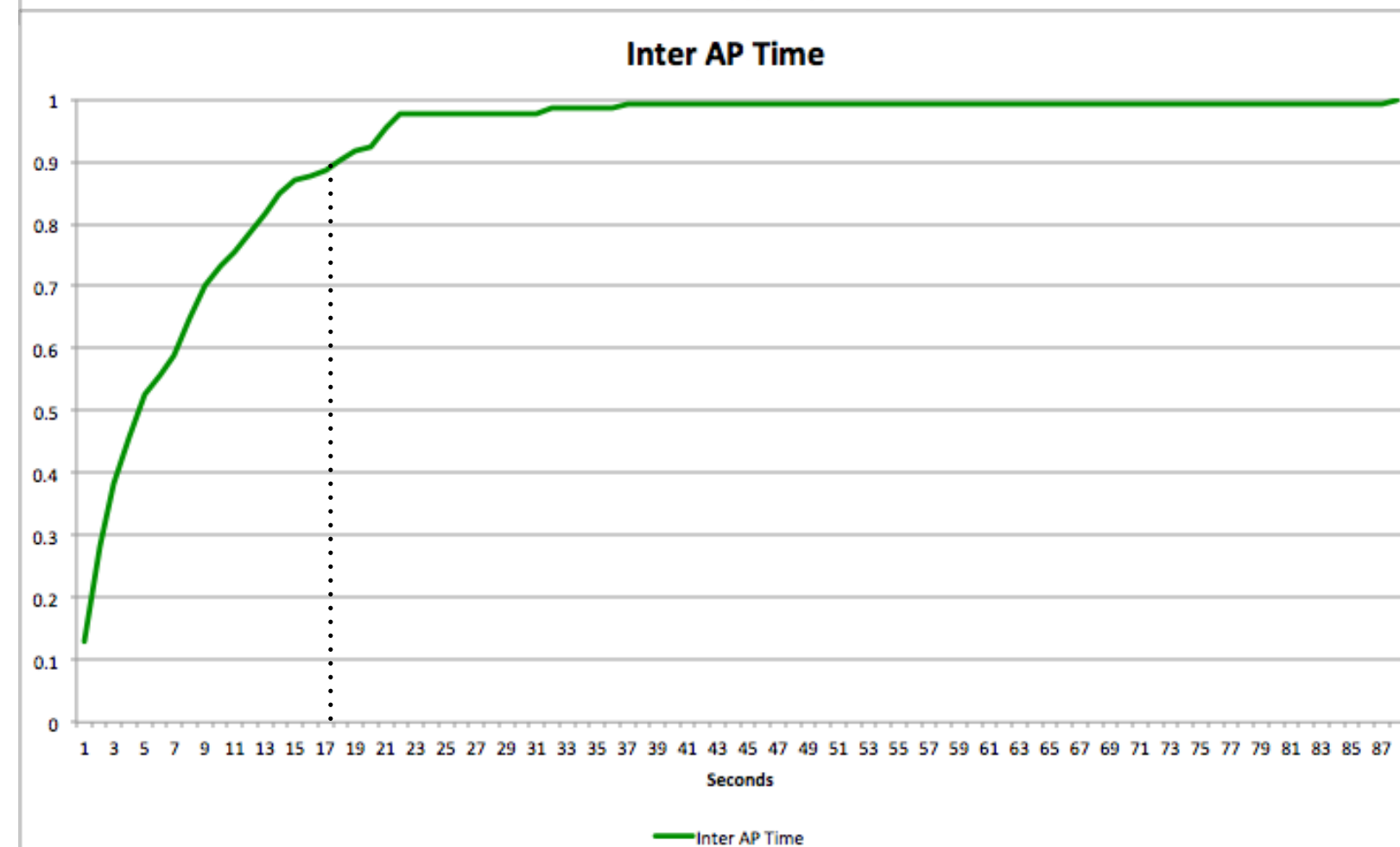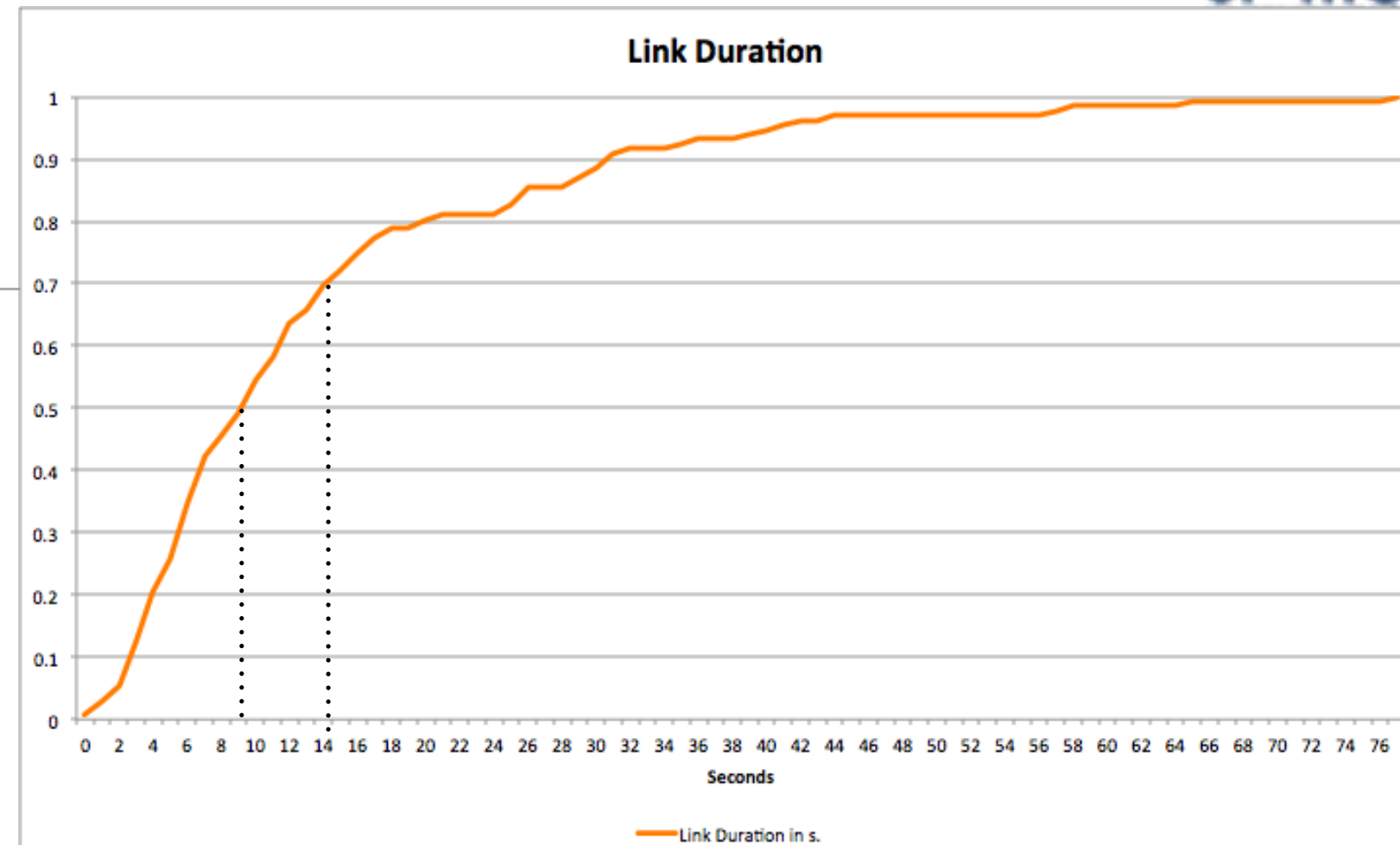
OK; but how dense is the Deployment???

Paris, 2015-02-21, 5pm-9.30pm

- 50th Percentile of Link Duration is about 9s and 70th percentile is 19s

- The coverage in Paris is fairly good the 90th percentile of Inter-AP-Time is 29 seconds
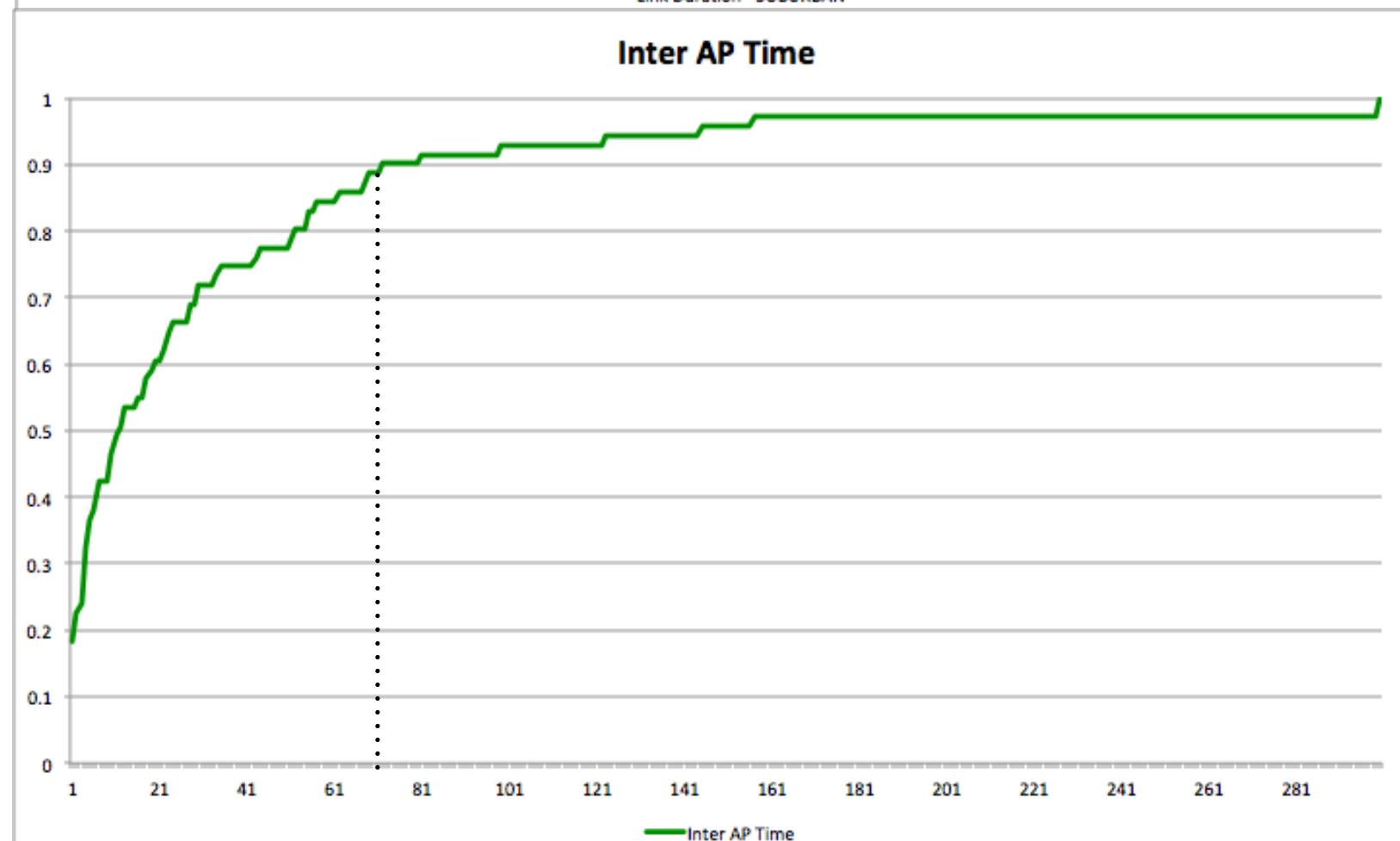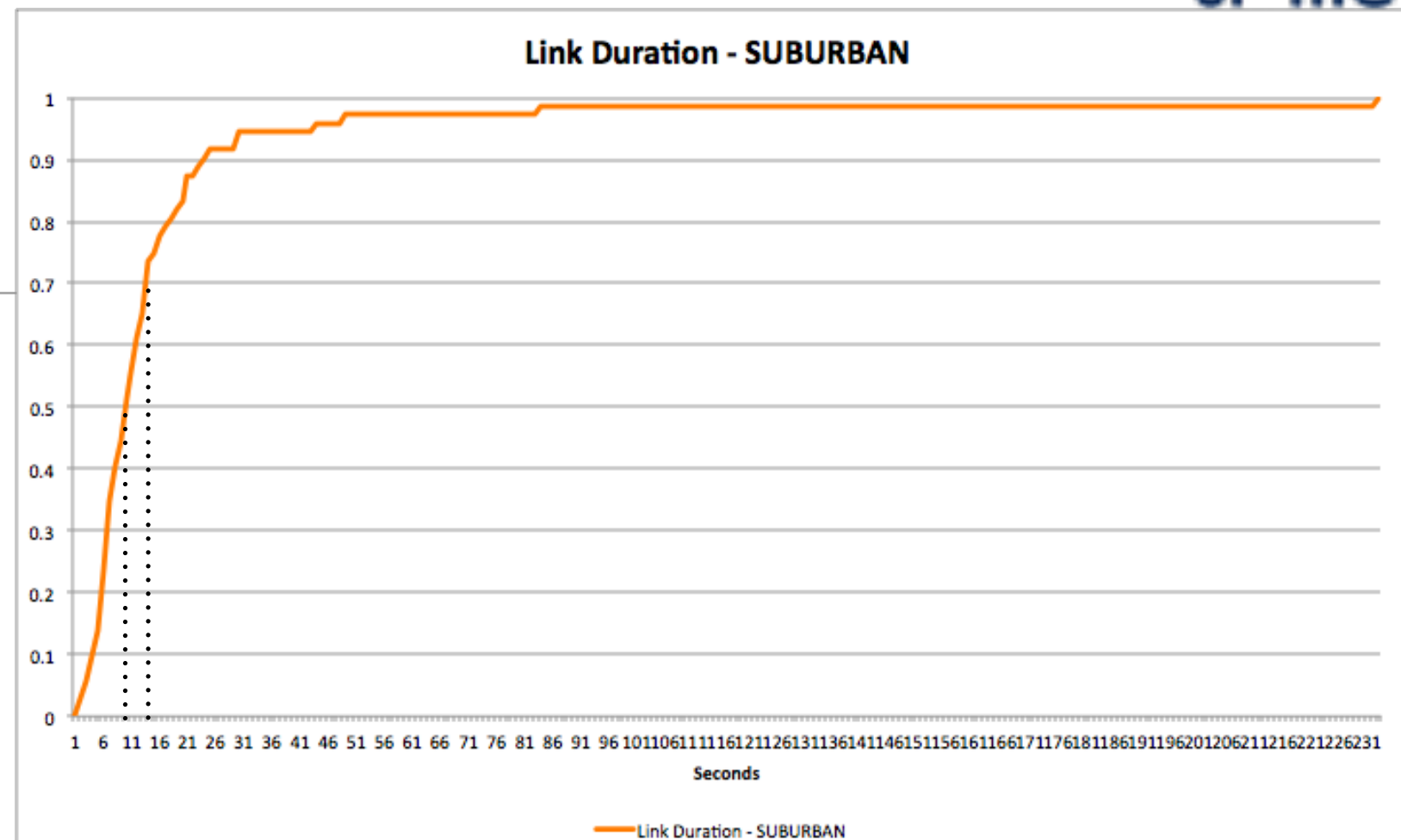
Paris, 2015-02-21, 11pm-01am

- 50th Percentile of Link Duration is about 9s and 70th percentile is 15s

- The coverage in Paris is fairly good the 90th percentile of Inter-AP-Time is 17 seconds
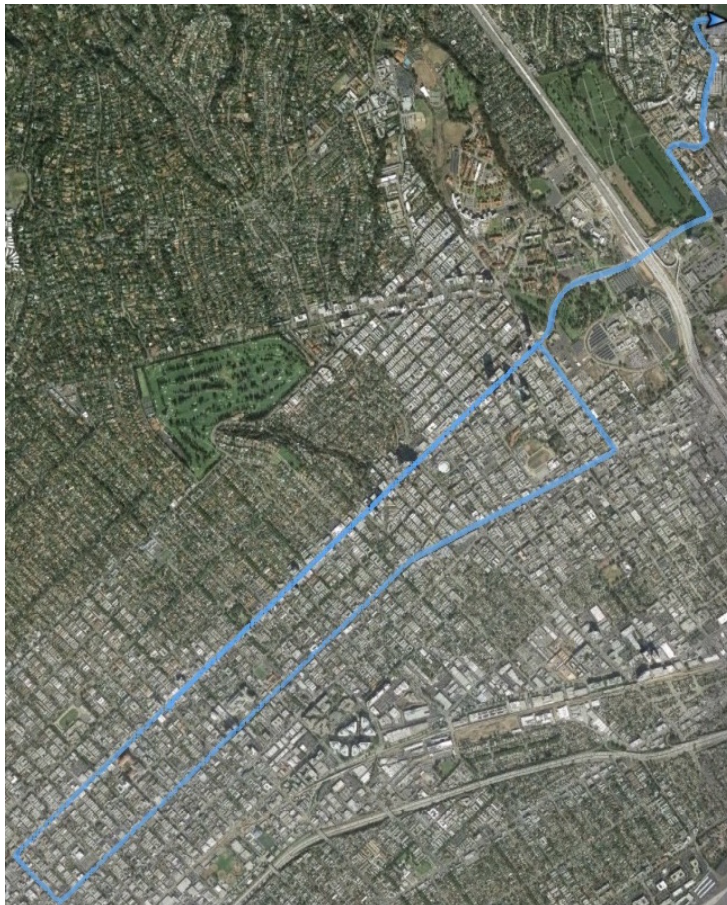
Suburban Paris, 2015-03-05, 4.30PM

- 50th Percentile of Link Duration is about 9s and 70th percentile is 14s

- The coverage in Suburban Paris is fairly good the 90th percentile of Inter-AP-Time is 80 seconds
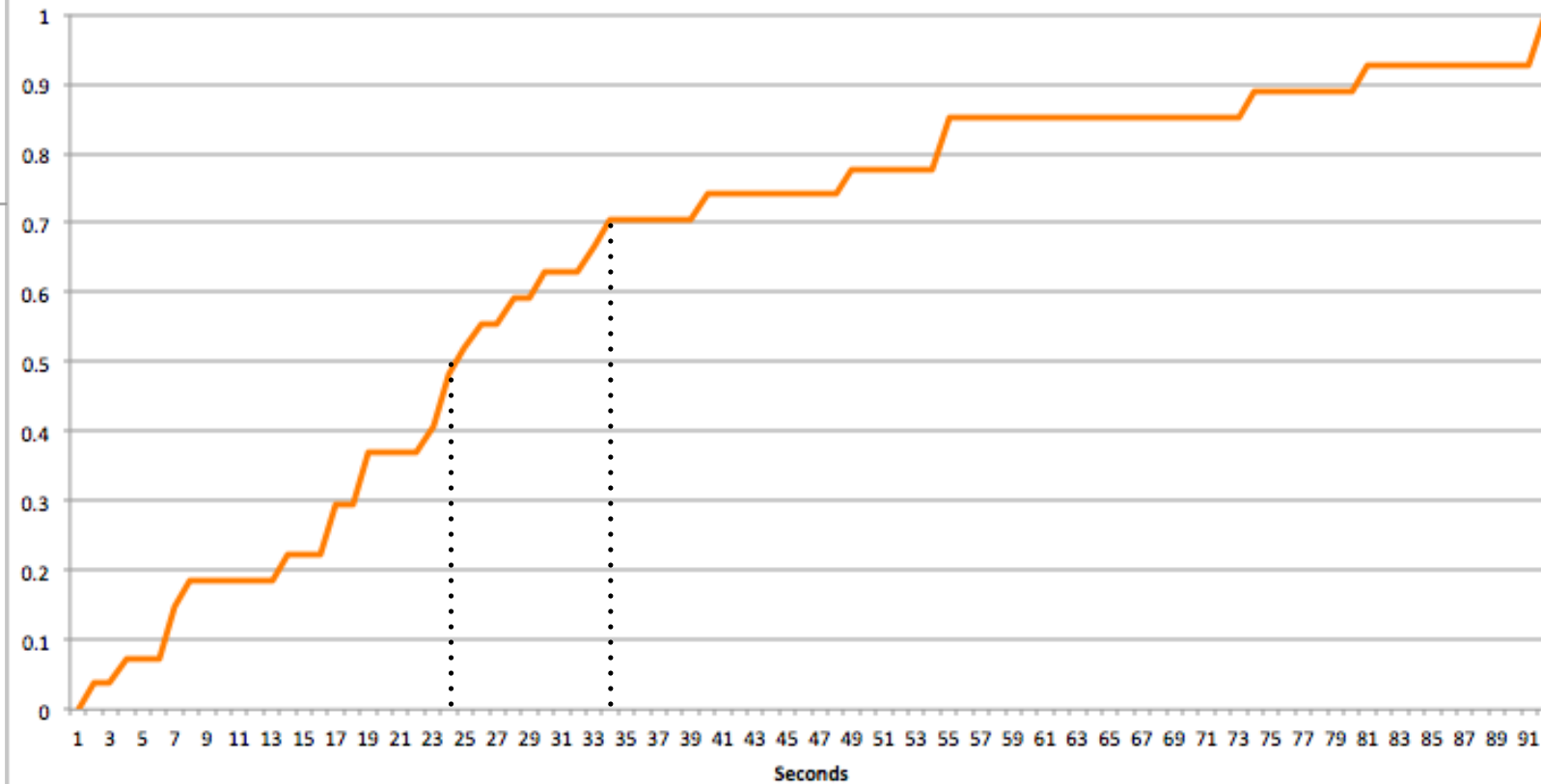

Link Duration - SUBURBAN
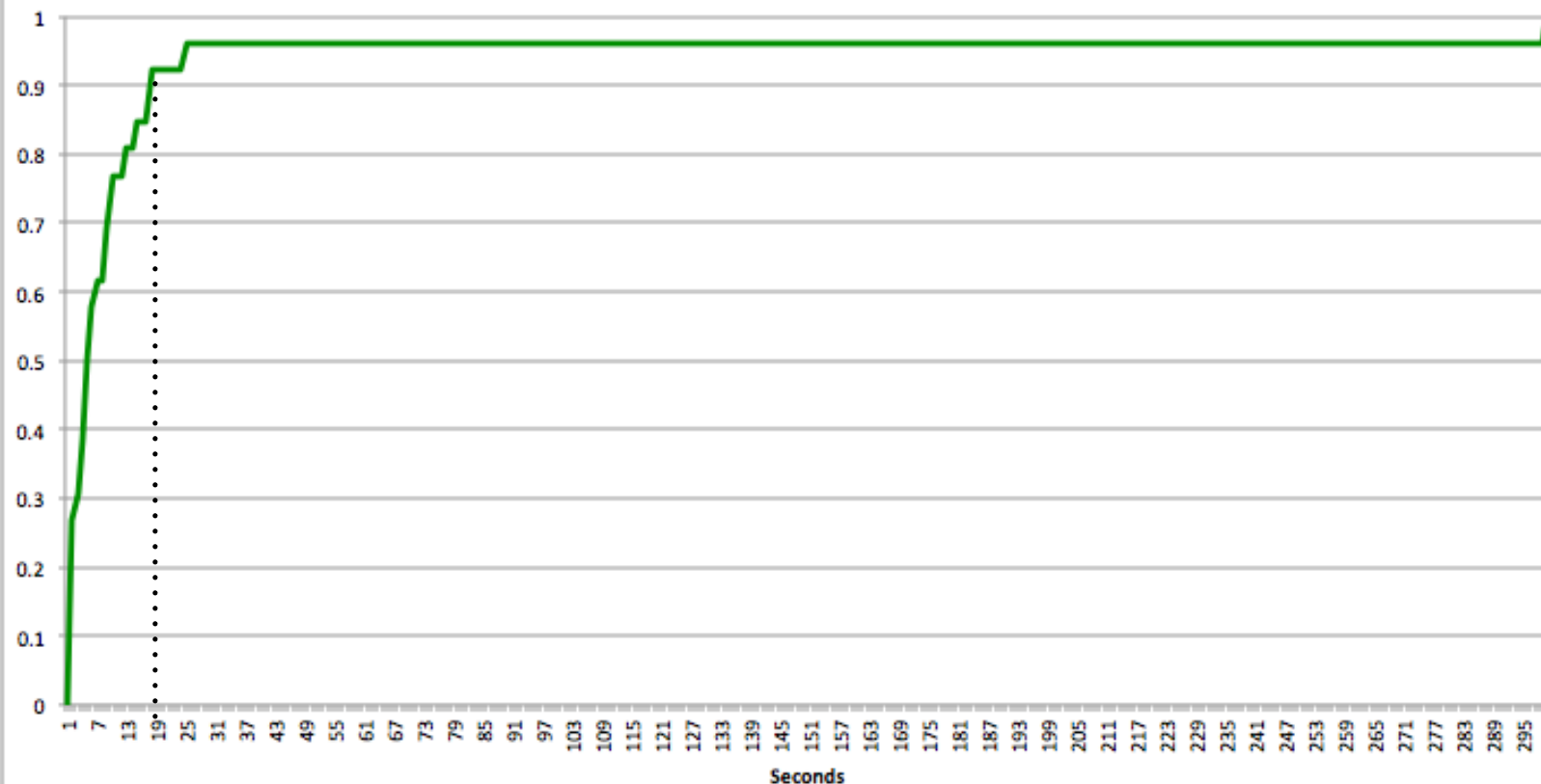

Inter AP Time

Los Angeles, 2015-02-11-8PM

- 50th Percentile of Link Duration is about 23s and 70th percentile is 34s

- The coverage in LA is generally fairly sparse however **covered areas** are highly dense the 90th percentile of Inter-AP-Time is **15** seconds

Link Duration - LOS ANGELES- TIME WARNER CABLE

Inter Access Point Time - LOS ANGELES- TWC

Questions??