Empowering cities with connected lighting

Lessons from Los Angeles

innovation you

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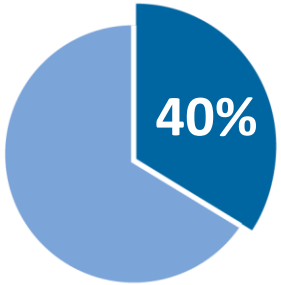
Public lighting is everywhere

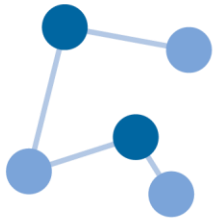
but connectivity is not

~215k
street lights in LA



Lighting can account for up to 40% of a city's total energy consumption[2]

On average, public lighting is more than 20 years old[3]



2% of installed systems are connected globally, expected to reach 35% by 2025[3]

[1] Northeast Group, *Global LED and Smart Street Lighting Forecast* 2015-2025
[2] European PPP Expertise Centre (EPEC), European Commission, *Energy Efficient Street Lighting*, 2013
[3] Philips market analysis

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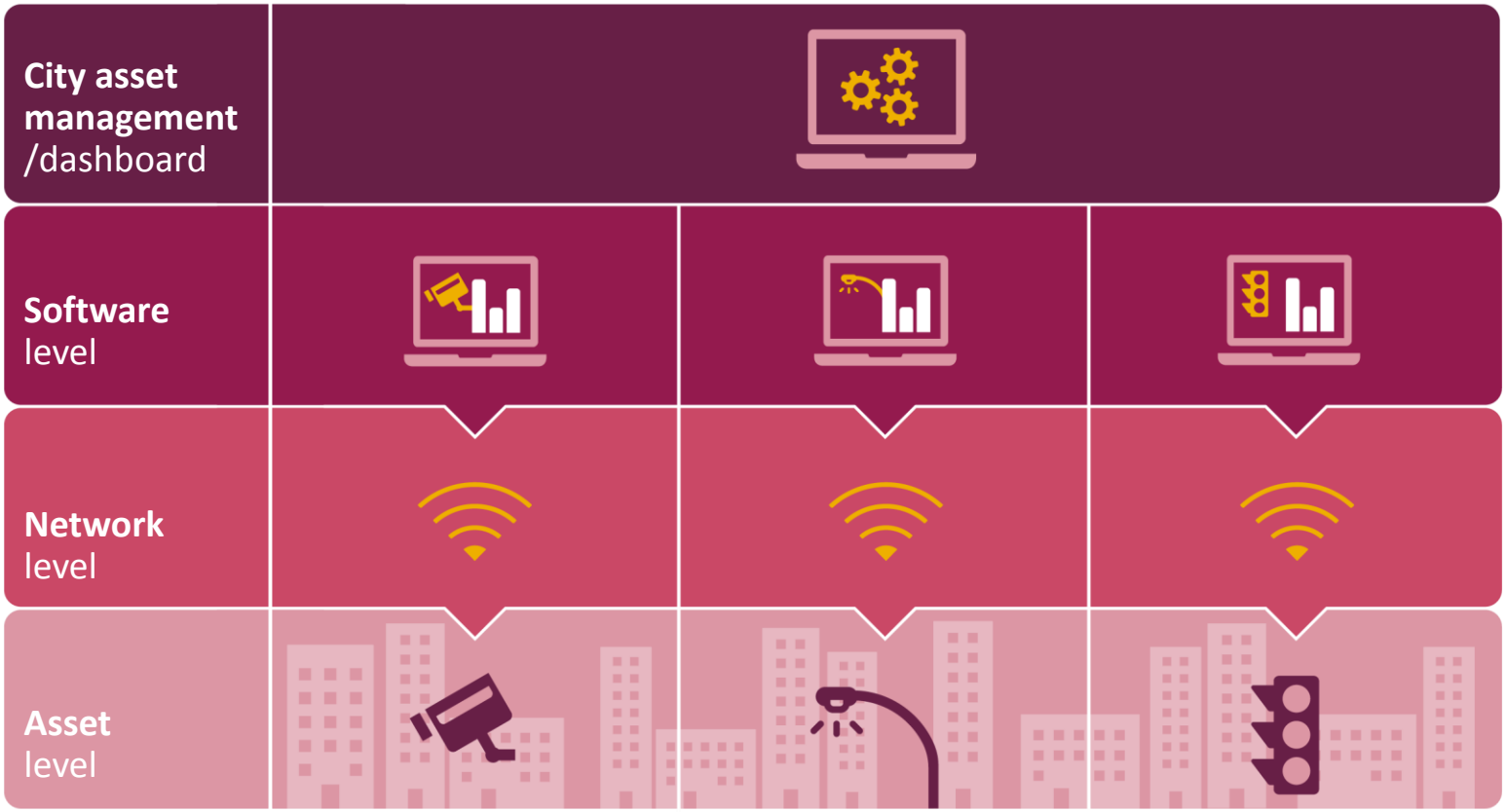
Public infrastructure should be
as connected as we are

Expanding into smart city

use cases that provide new value



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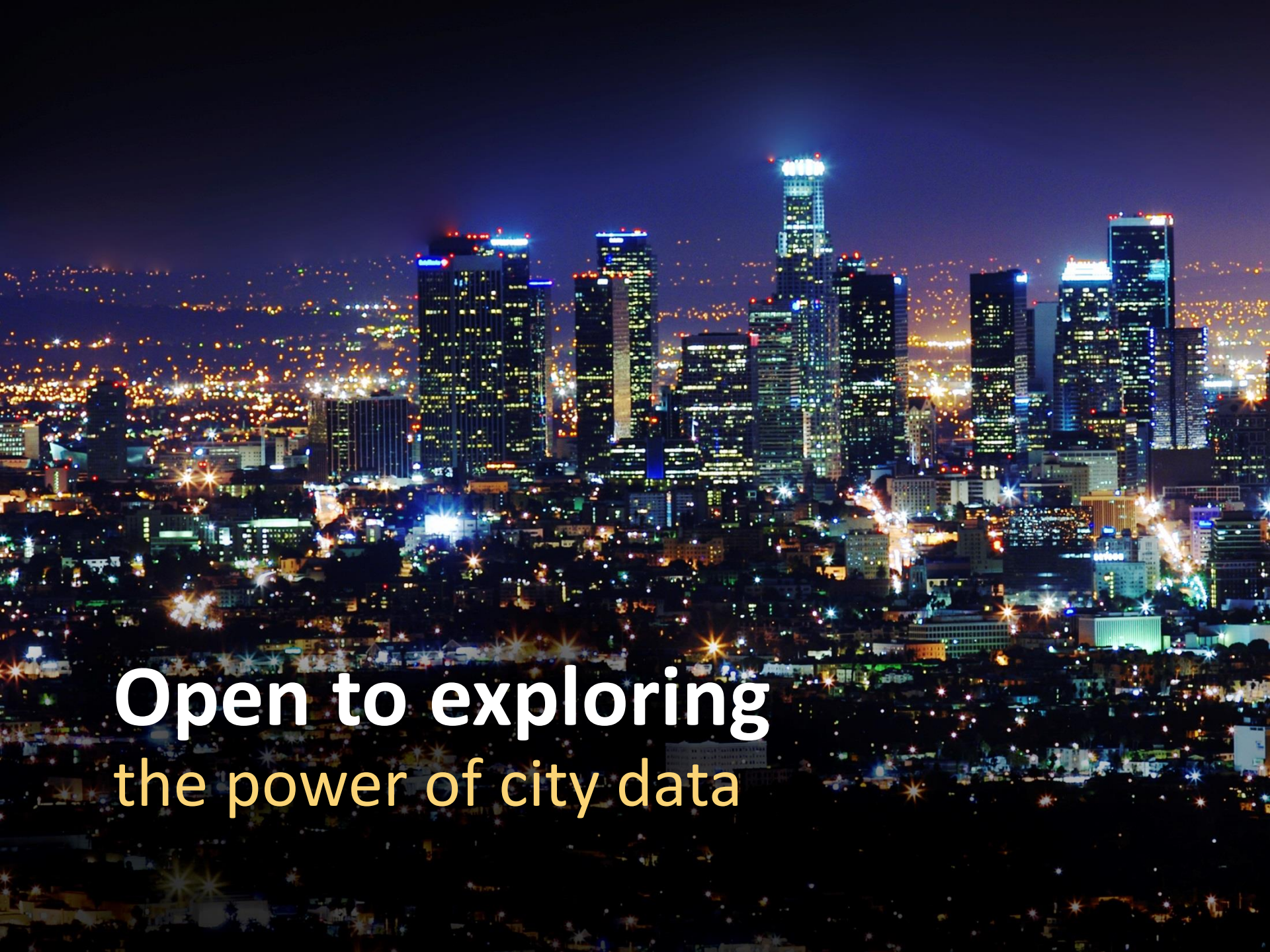
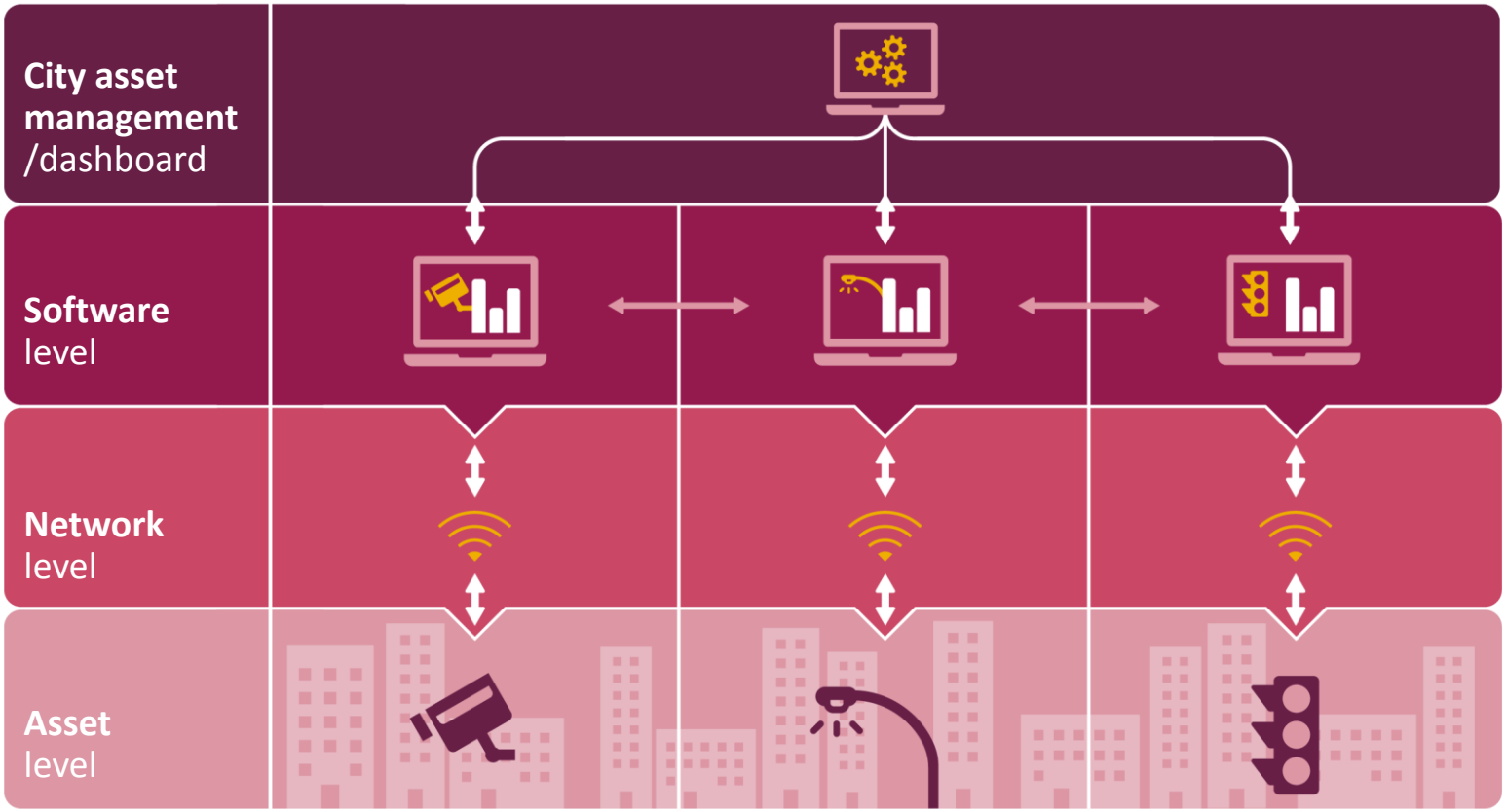

Open to exploring
the power of city data

Enable new opportunities

via open, well-defined interfaces



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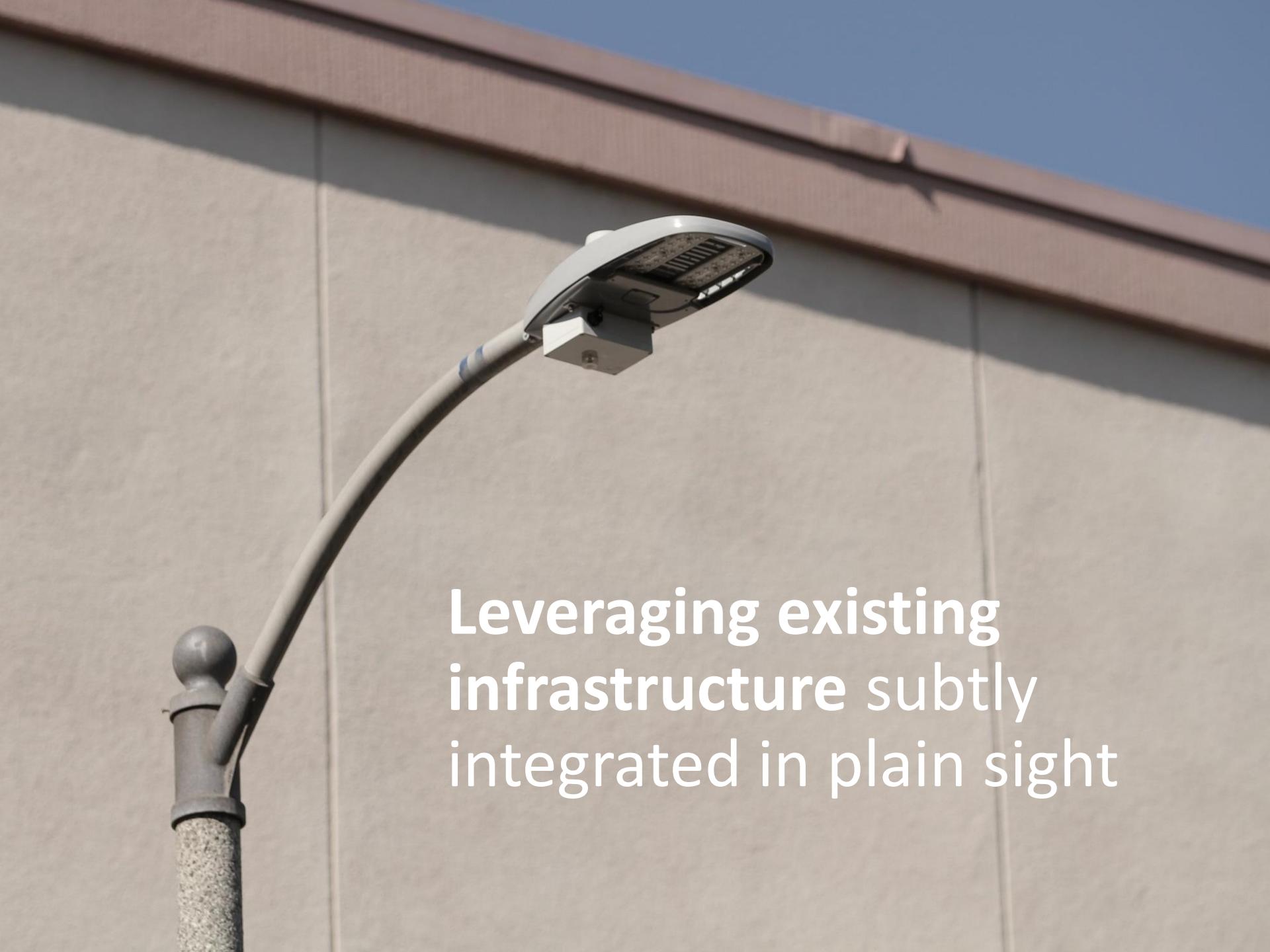
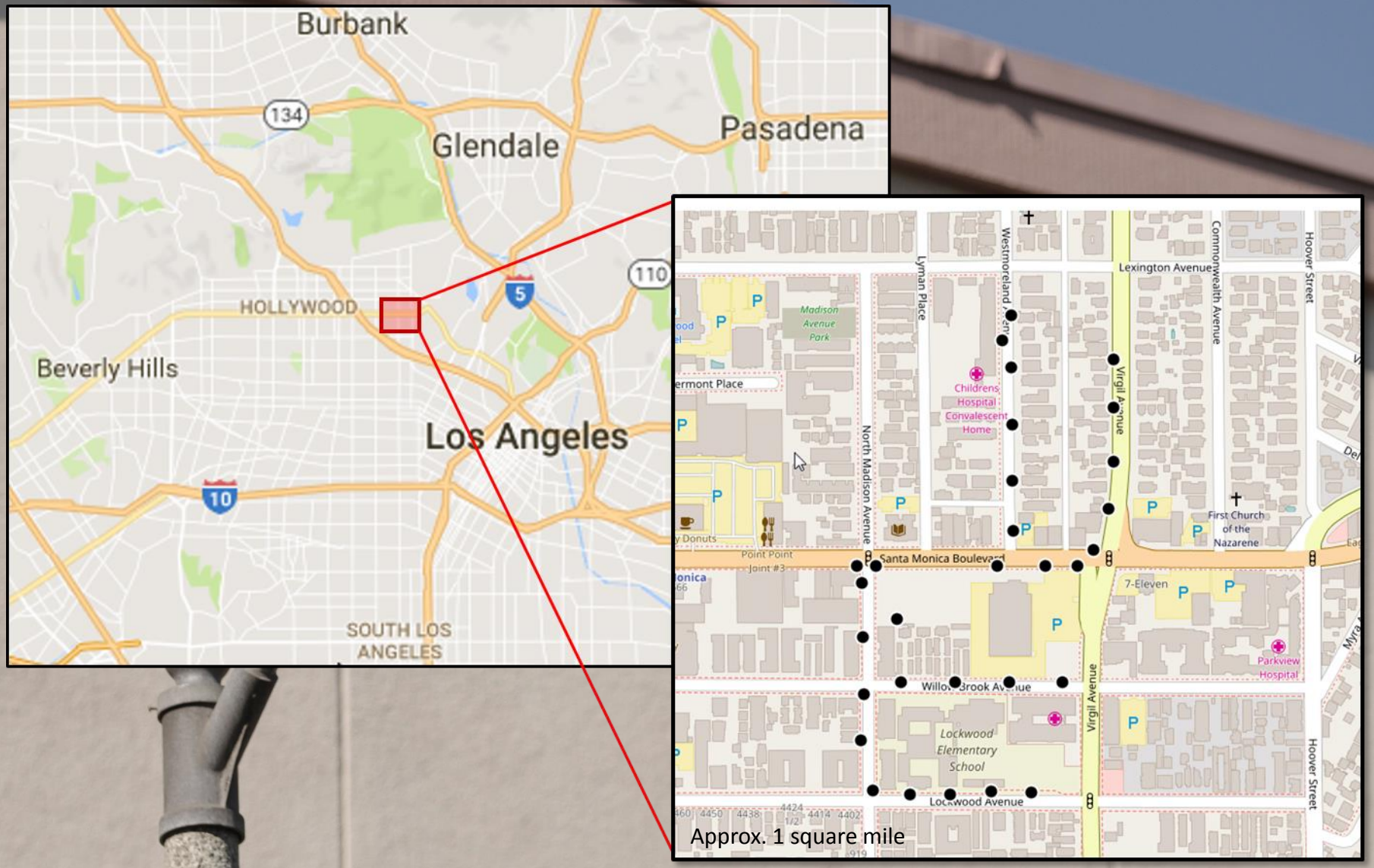
Los Angeles is leading the way

by deploying connected lighting today


Leveraging existing infrastructure subtly integrated in plain sight

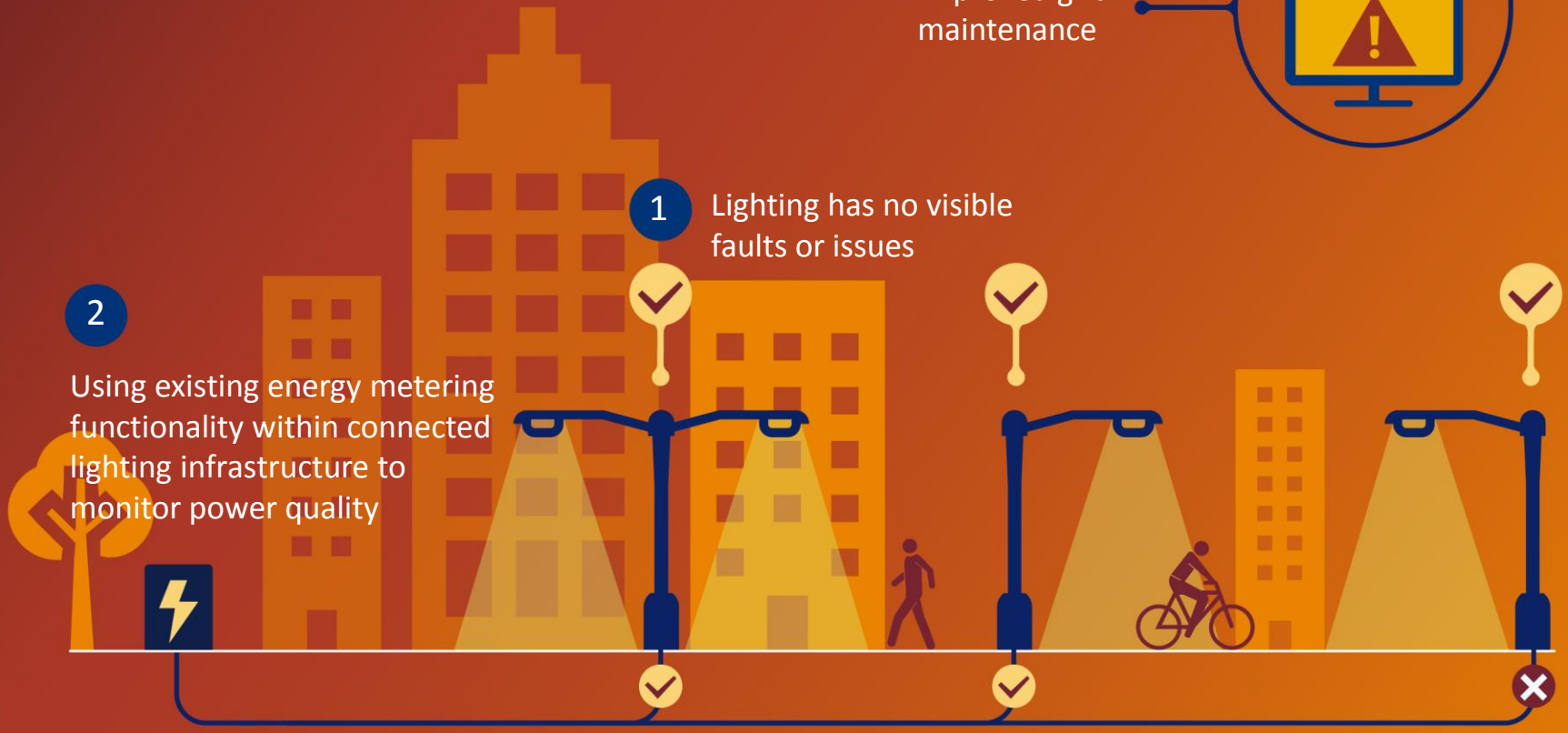

Burbank
134
Glendale
Pasadena
110
5
HOLLYWOOD
Beverly Hills
Los Angeles
10
SOUTH LOS ANGELES
Madison Avenue Park
Lyman Place
Westmoreland Place
Lexington Avenue
Commonwealth Avenue
Hoover Street
Childrens Hospital Convalescent Home
Virgil Avenue
North Madison Avenue
First Church of the Nazarene
Point Point Joint #3
Santa Monica Boulevard
7-Eleven
Parkview Hospital
Willoughby Avenue
Lockwood Elementary School
Lockwood Avenue
Approx. 1 square mile

Lighting network health monitoring

3 Improved grid maintenance

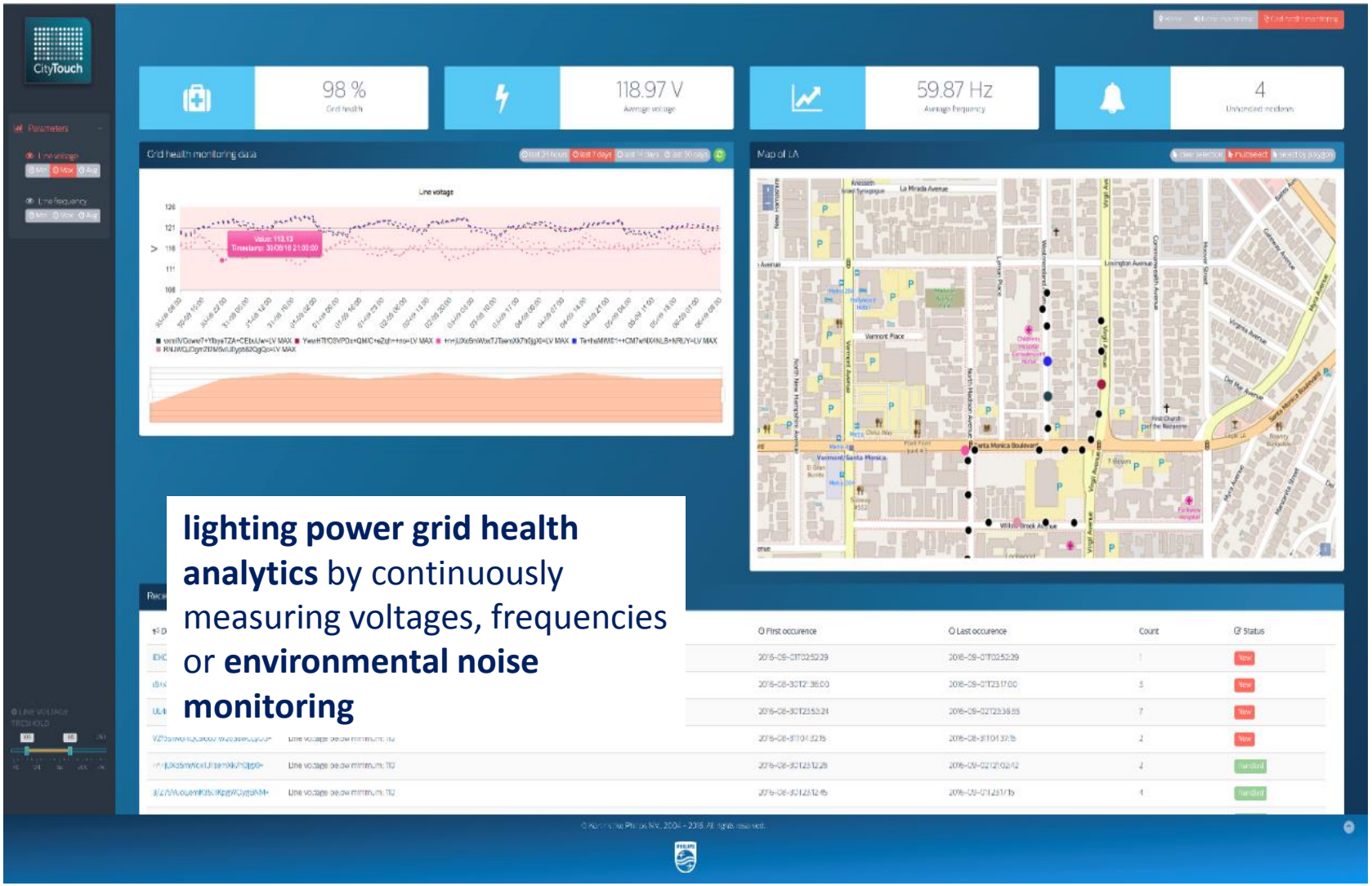
1 Lighting has no visible faults or issues

2 Using existing energy metering functionality within connected lighting infrastructure to monitor power quality



Network health monitoring

to ensure lights never go out



lighting power grid health analytics by continuously measuring voltages, frequencies or **environmental noise monitoring**

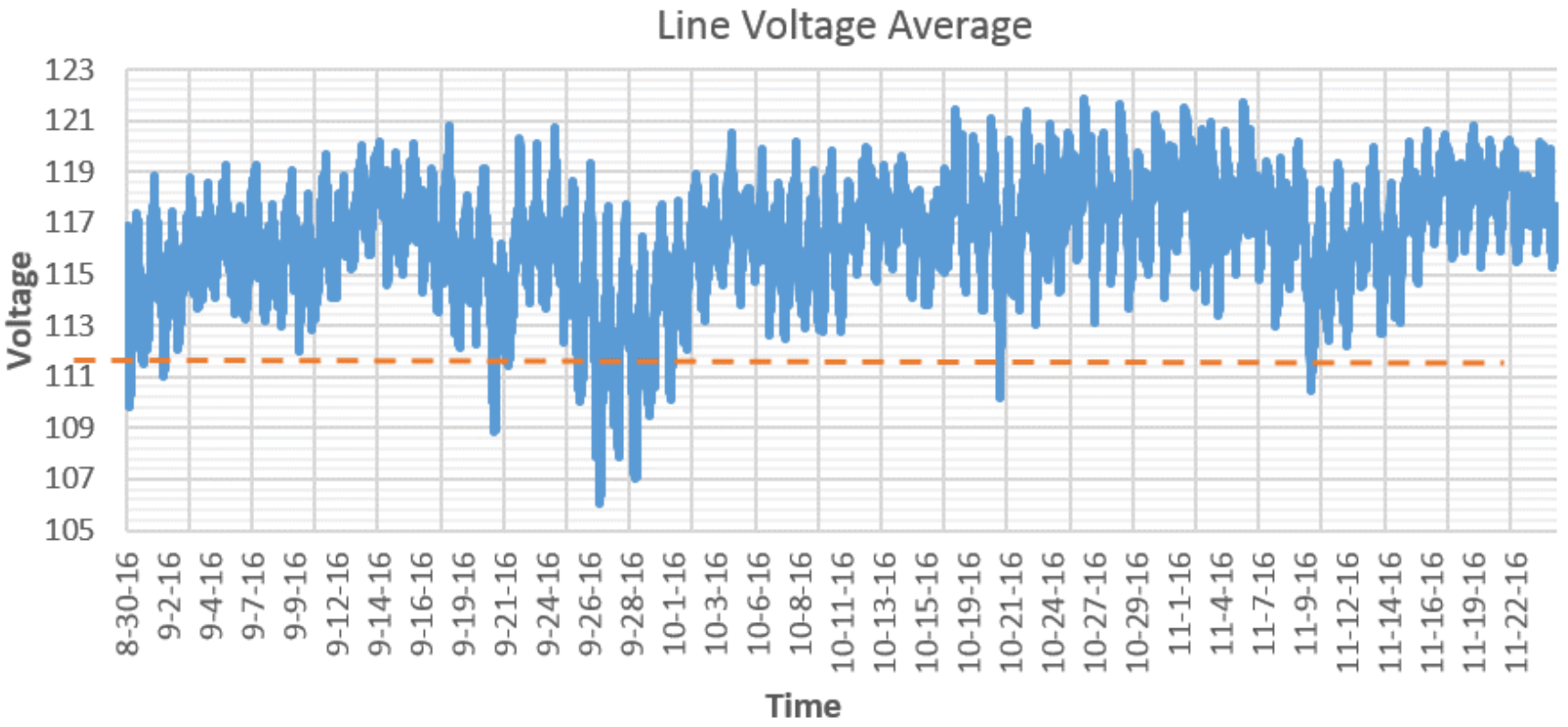
Network health monitoring

to ensure lights never go out

- **Average line voltage** over the test period **118.45V** (SD 28.56V) → Meets ANSI C84.1 standard (110-125V)
- Overall **Max. 125.8V**; overall **Min. 105.5V**
- Clearly **visible daily patterns** (e.g. voltage peaks between 2-3am daily)
- Average **line frequency 60Hz** (SD 2.52Hz) → Meets DOE requirements and FNET/GridEye Consortium
- Individual fixtures experienced some **extremes** (1% of total measurements) → Potential for advanced predictive maintenance models

Network health monitoring

to ensure lights never go out



Average voltage fluctuation of a particular fixture throughout duration of the pilot (August 30th – November 22nd, 2016.

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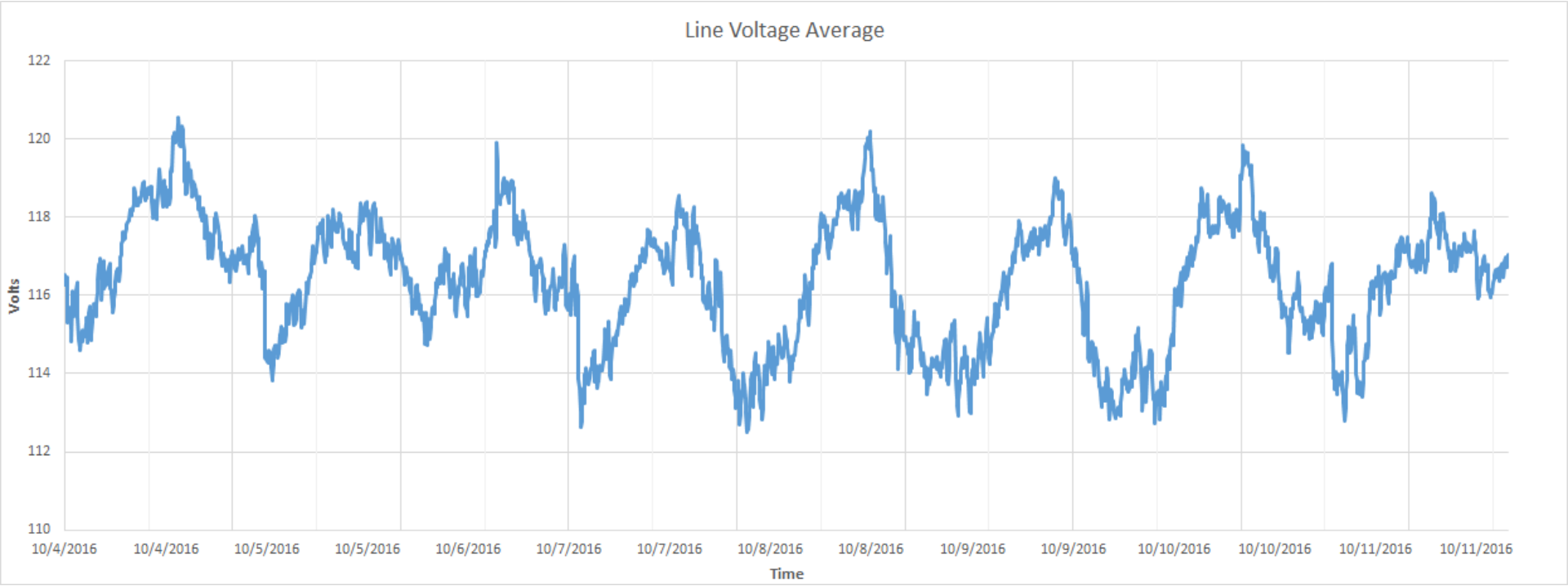
Network health monitoring

to ensure lights never go out



Zooming in on cyclical patterns during the week of October 4th, 2016.

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Connected lighting
and city monitoring

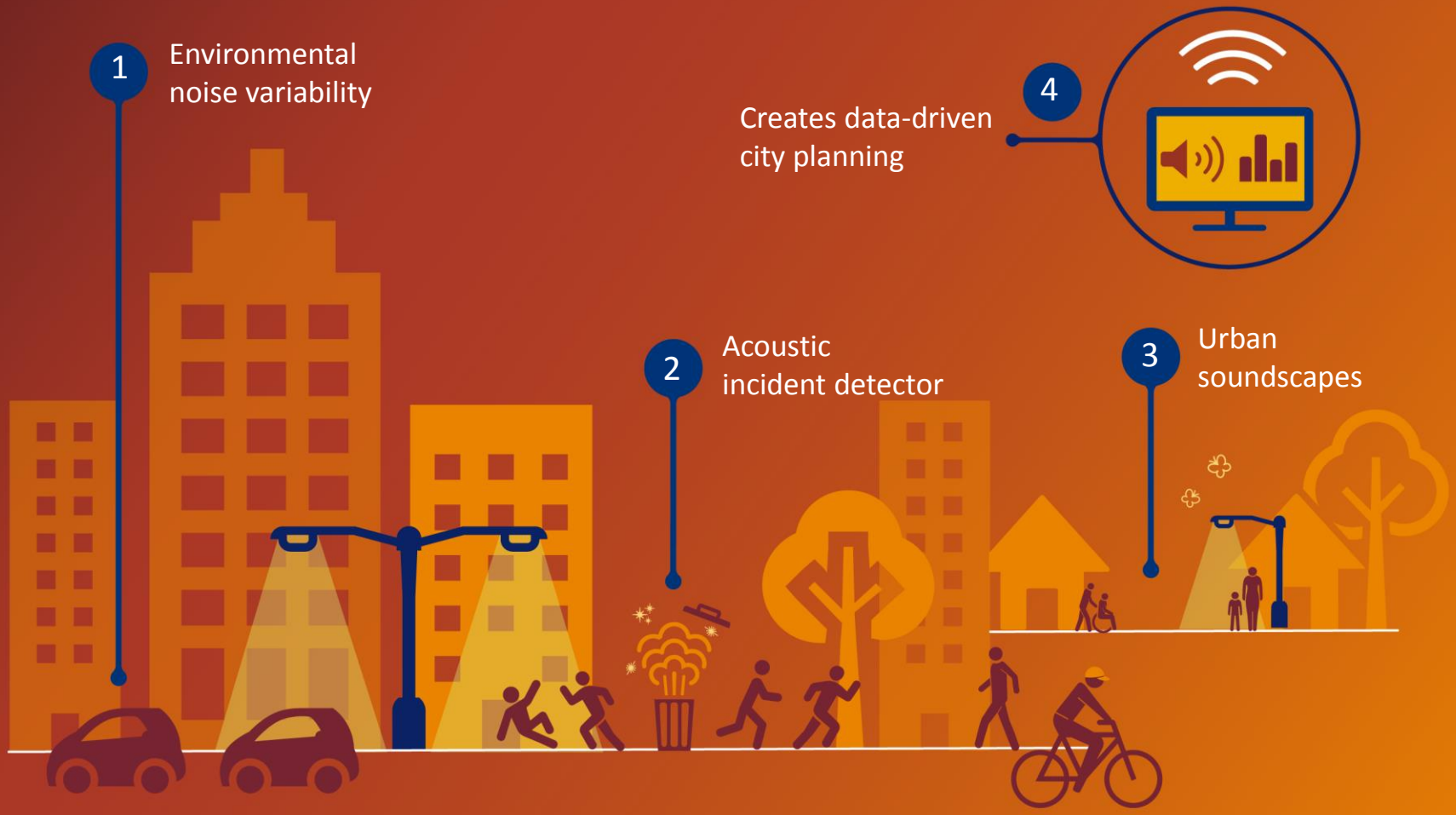
Acoustic monitoring

1 Environmental noise variability

2 Acoustic incident detector

3 Urban soundscapes

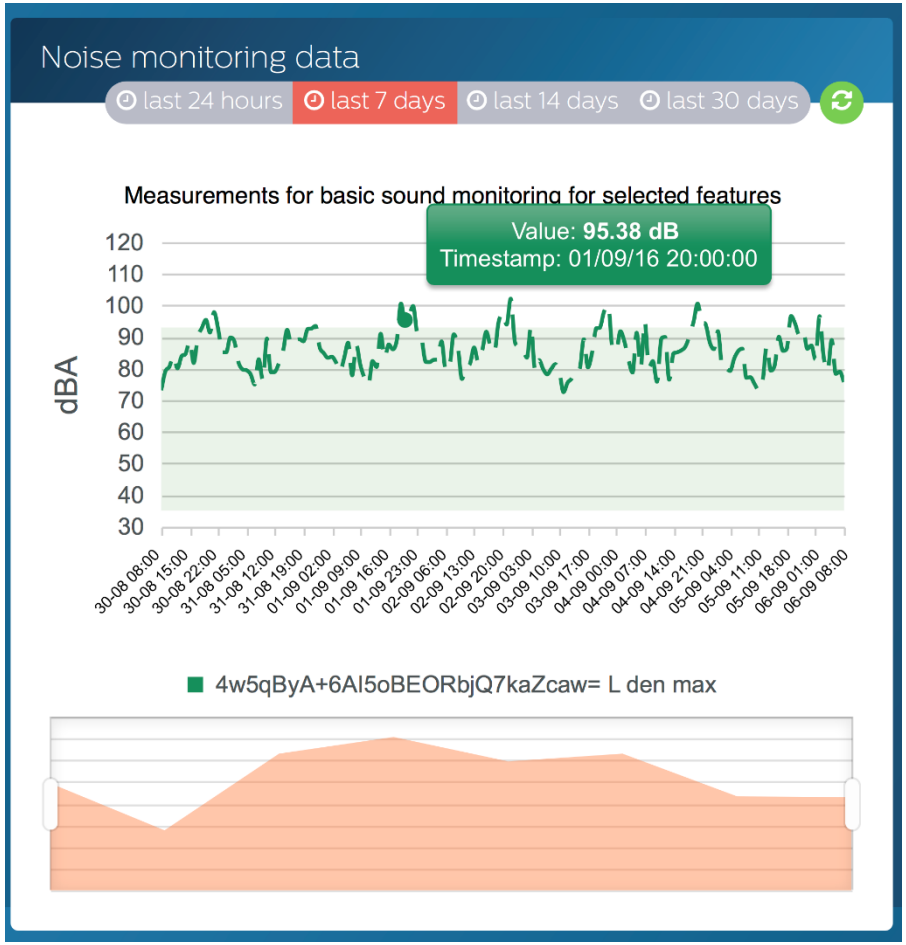
4 Creates data-driven city planning



Environmental noise monitoring

provides continuous, dense data

- Generate continuous and dense data on urban noise
- Support city-wide planning decisions like traffic planning or school placement
- Inform and monitor public health initiatives related to environmental conditions



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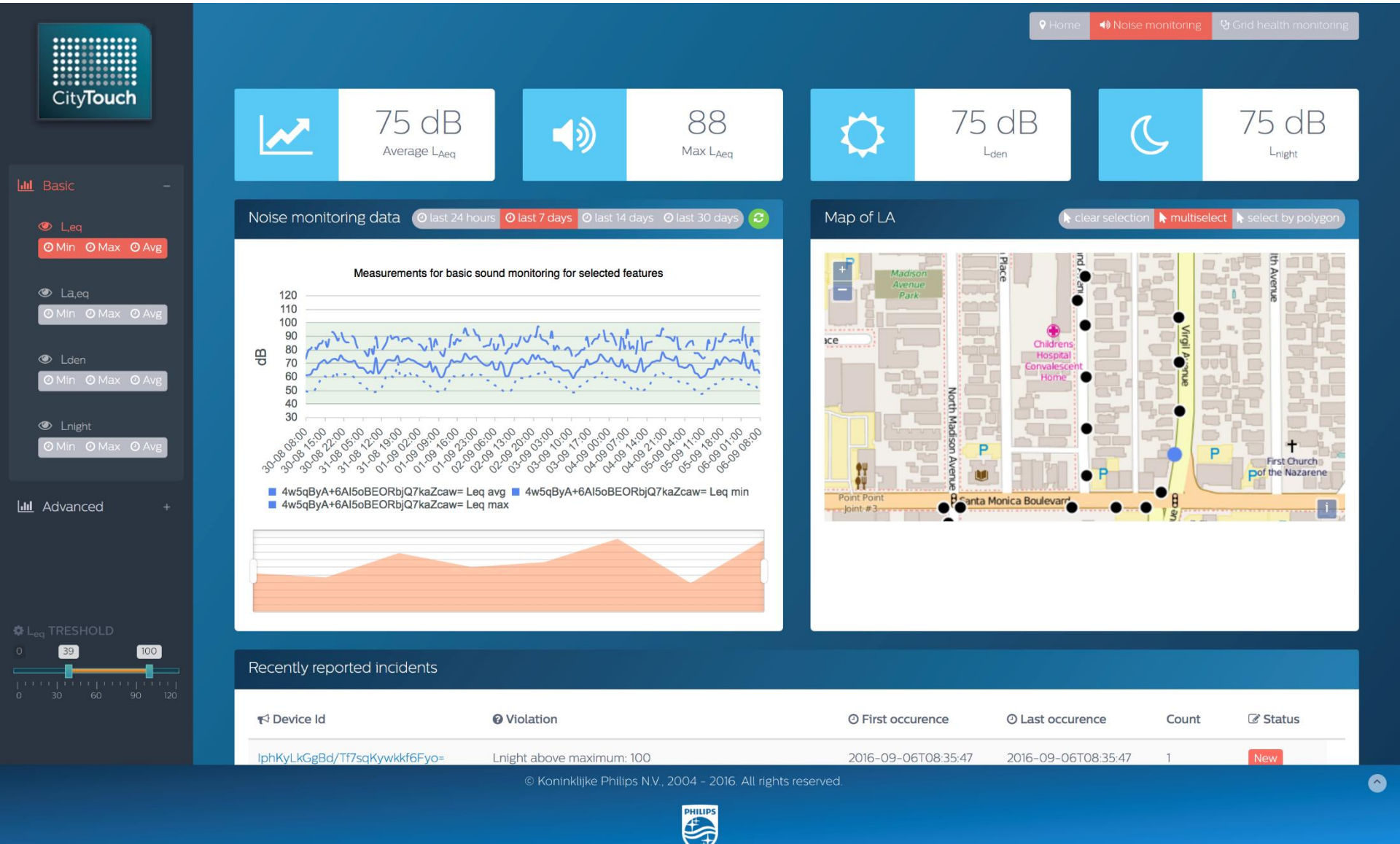
Environmental noise monitoring

provides continuous, dense data



Environmental noise monitoring

provides continuous, dense data

- Average A-weighted loudness was 60 dB(a) (typical for moderate commercial area)
- Averages vary substantially by street (e.g. main streets 10 dB(a) higher than residential streets which are about 10 dB(a) lower)
- Rush hour peaks in the morning (6-7am) and afternoon (2-3pm) are visible
- Weekends are relatively consistent with weekdays however less variation

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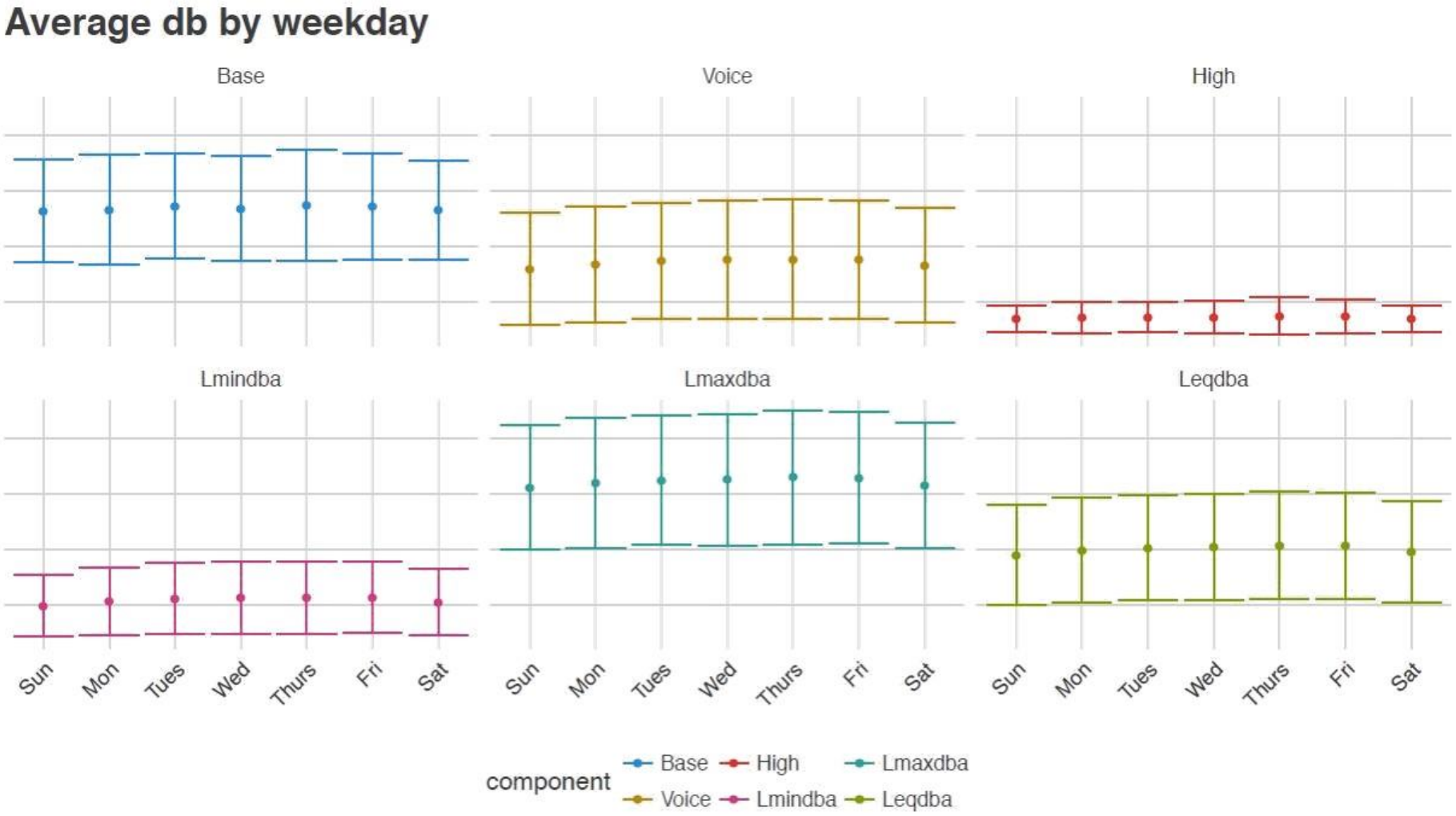
Environmental noise monitoring

provides continuous, dense data



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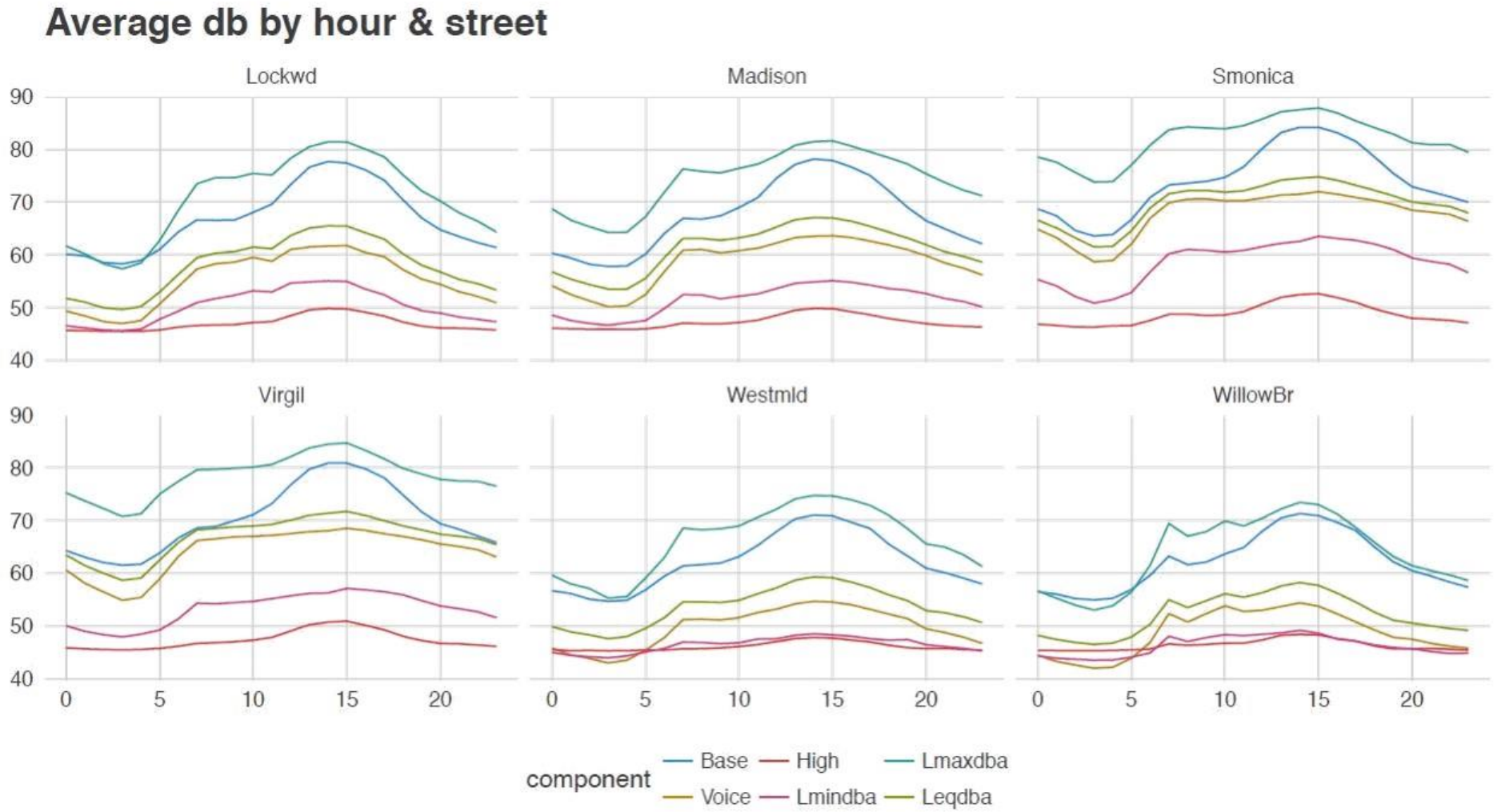
Environmental noise monitoring

provides continuous, dense data



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Urban soundscape monitoring
takes insights to the next level

- Monitoring and **alerts of sound levels** to track **compliance** with regulatory limits
- Handle **noise nuisance** complaints (e.g. local councils, housing associations and environmental health officers)
- Noise maps for **urban planning**
- Data: (A-weighted) sound pressure (min/max/av) (advanced use cases look at more frequency bands to extract more activity information)

Examples of urban sound maps

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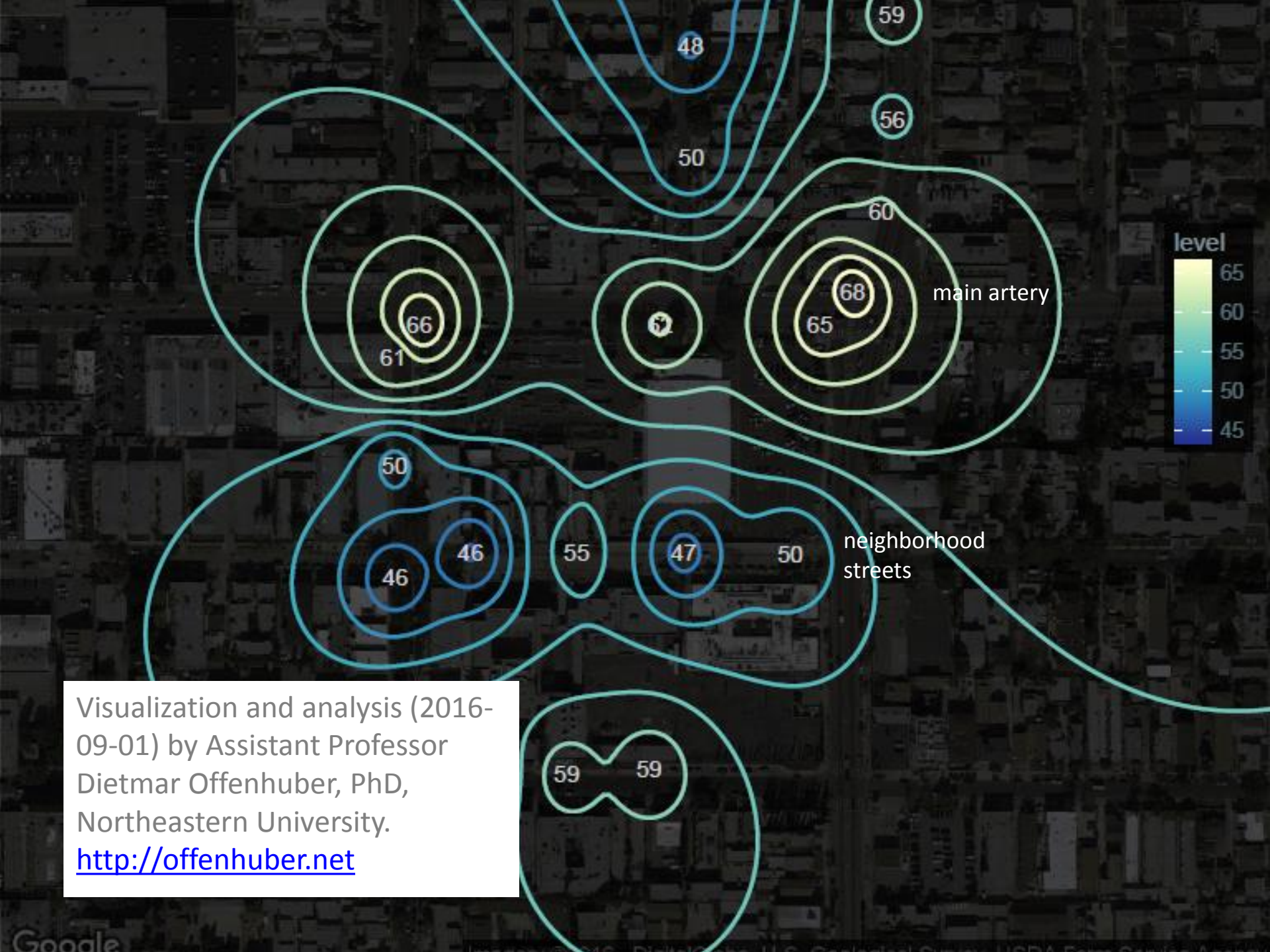
59
48
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level
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60
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main artery
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66
61
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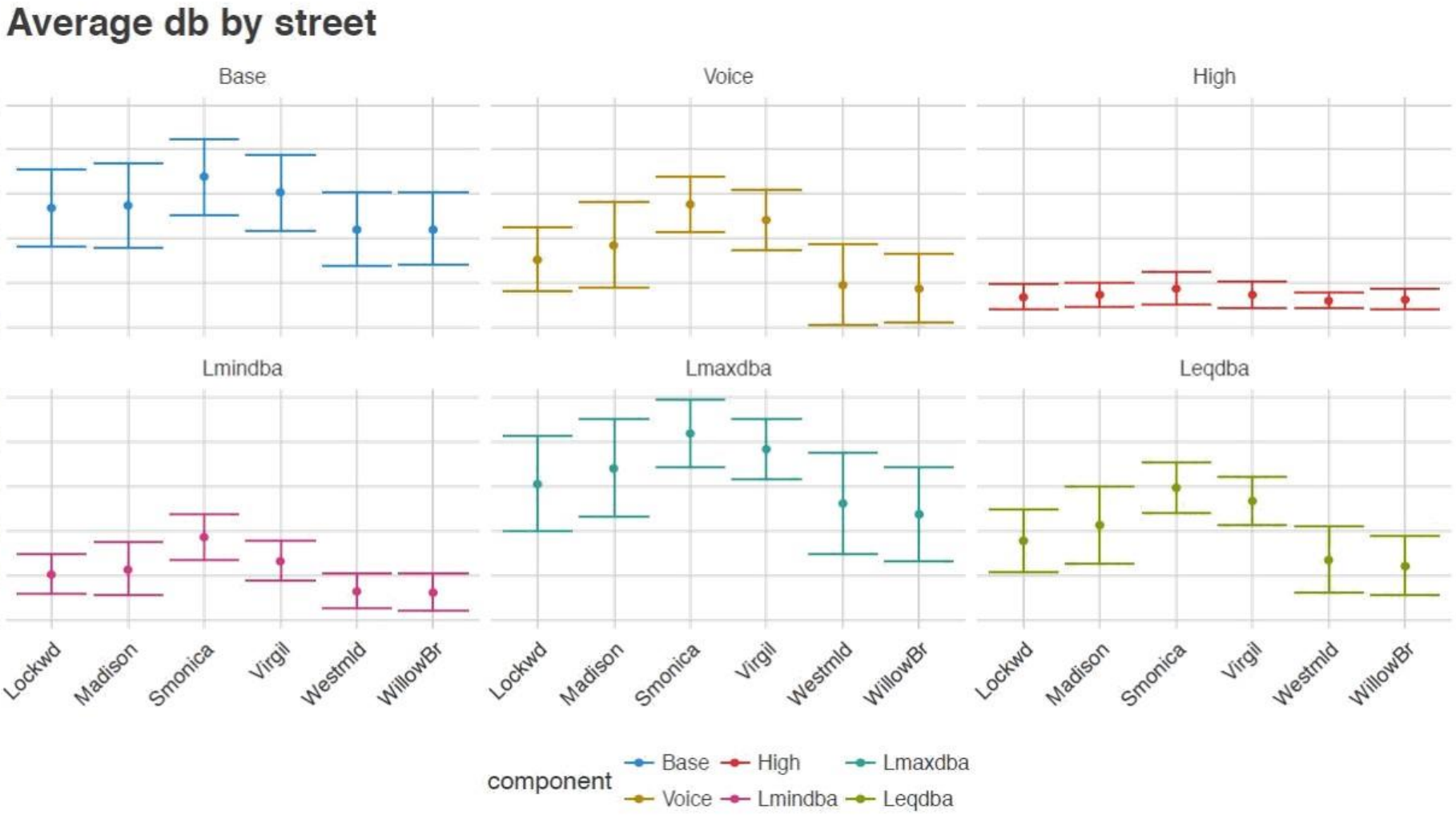
46
46
55
47
50
neighborhood
streets
59
59
Visualization and analysis (2016-09-01) by Assistant Professor Dietmar Offenhuber, PhD, Northeastern University.
http://offenhuber.net
Google

Urban soundscape monitoring

takes insights to the next level



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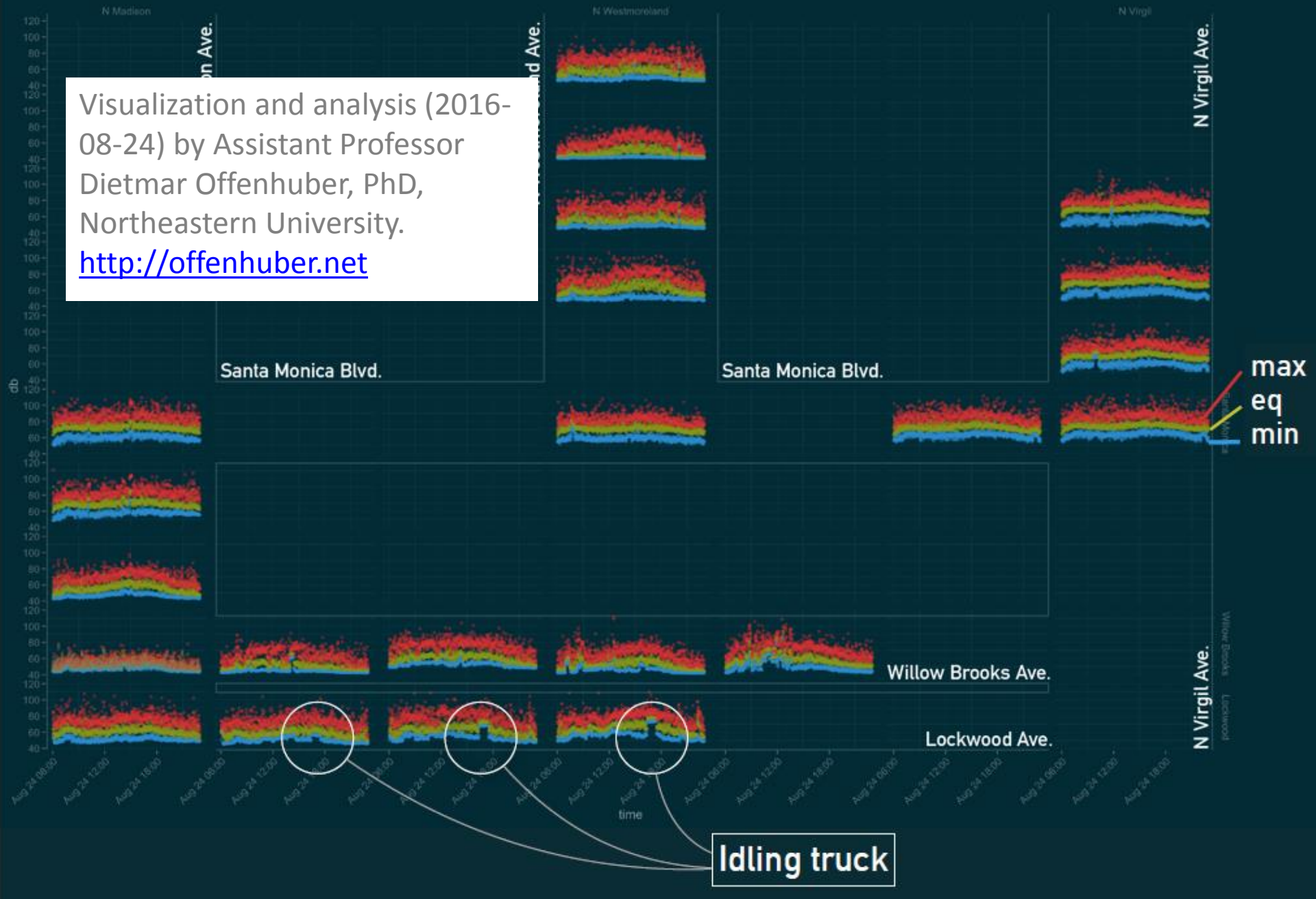
Loudness dB(A) values, August 24, 6am-11pm



Loudness dB(A) values, August 24, 6am-11pm

Visualization and analysis (2016-08-24) by Assistant Professor Dietmar Offenhuber, PhD, Northeastern University.
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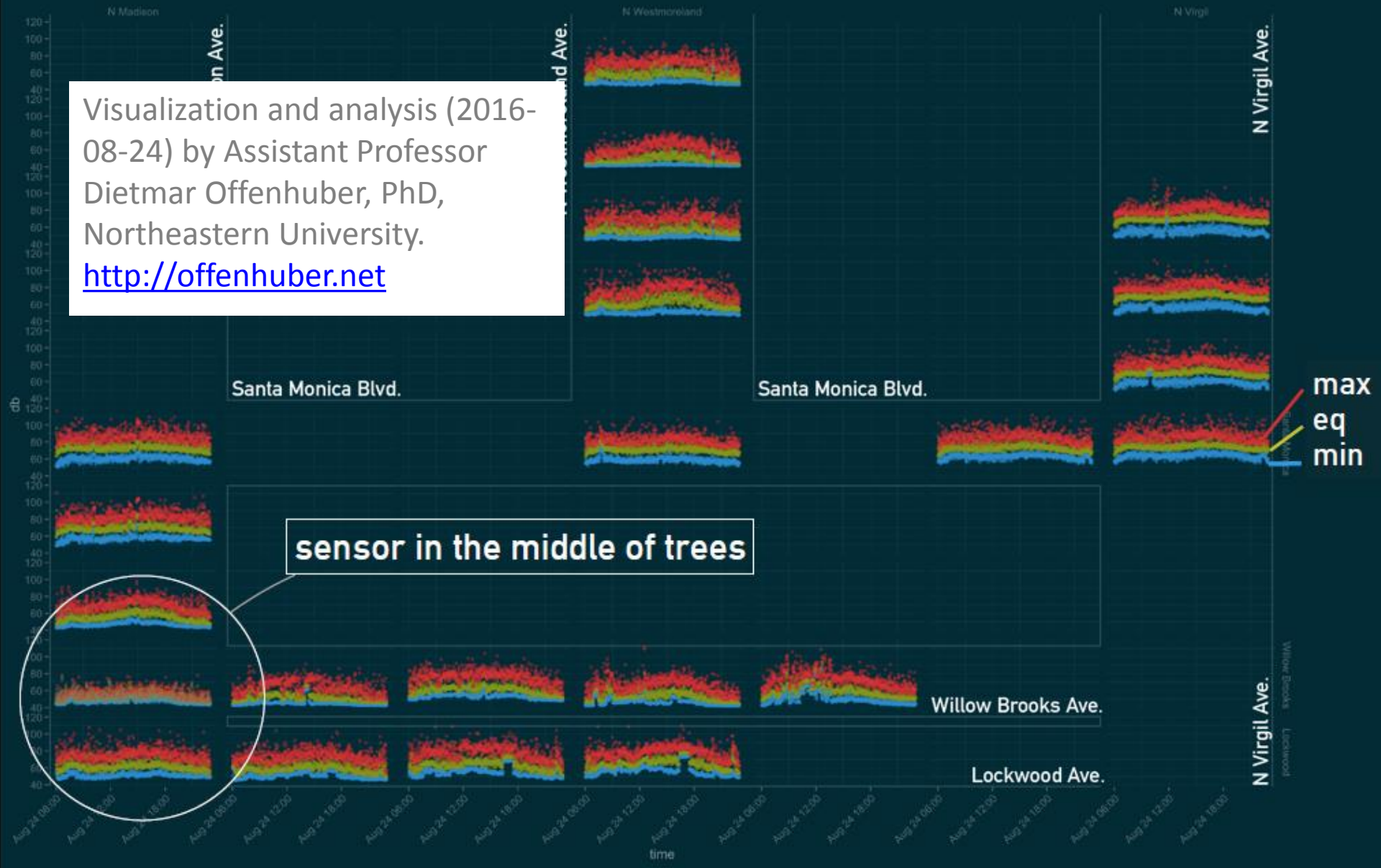
Loudness dB(A) values, August 24, 6am-11pm



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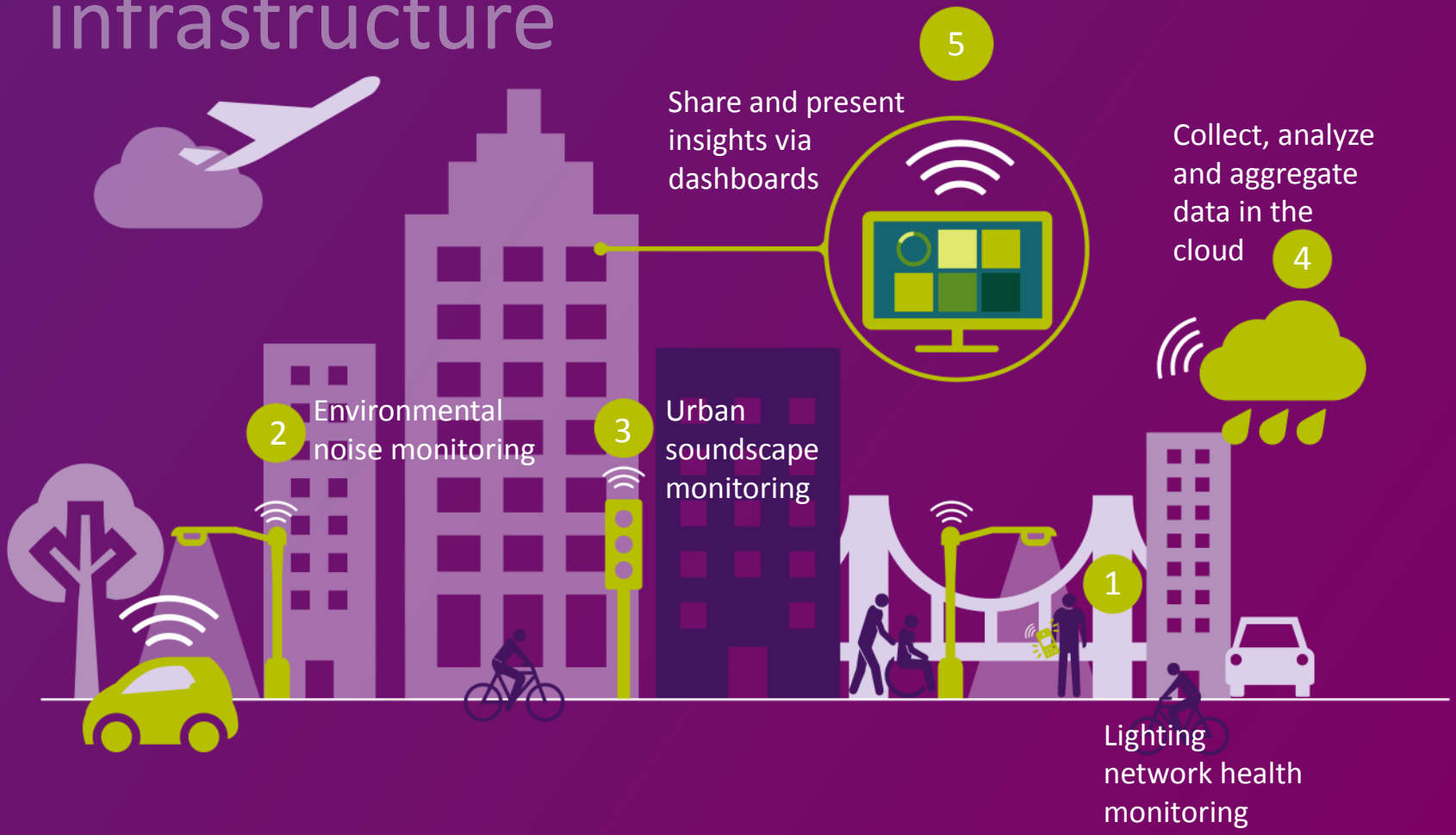
Exploring new value by leveraging existing, ubiquitous infrastructure



Lessons learned
on next steps towards smart cities

Architectures:
- Extensible architectures
- Edge-computing benefits
- Cloud architecture for flexibility

Applications:
- Dense temporal and spatial diagnostic data provides new insights
- Sound data presents many opportunities

Governance:
- Data policies needed (e.g. LA Open Data Policy and Playbook)
- Frameworks for pilots drive innovation

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