Luncheon Panel:
Have We Arrived In the Jetsons' Orbit City?

FAA UAS SYMPOSIUM





- **Moderator: Earl Lawrence,** Director, FAA UAS Integration Office
- **Anil Nanduri**, Vice President, New Technology Group, Intel
- **Charles Bergan,** Vice President, Engineering, Qualcomm Technologies, Inc.
- **Travis Mason,** Vice President of Public Policy & Regulatory Affairs, A³ by Airbus
- **Mark Moore**, Engineering Director of Aviation, Uber

Future sUAS Challenges

Charles Bergan
VP Engineering, Qualcomm Research
Qualcomm Technologies, Inc.
March 28, 2017

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in 3G/4G LTE modem

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in wireless semiconductors

Qualcomm's application processor and communications expertise bring critical technologies to drones

Cellular connectivity

Safety enhancement for autonomous operation

Media sharing and payload status updates

Safety and operational communication for beyond operator's visual line of sight (BLOS)

Redundant link within the operator's visual line of sight

On-board intelligence

Professional videography

Autonomous navigation

Machine Intelligence

Computer vision

High-fidelity sensor processing

Precise localization

Challenges in achieving scale

Can we do onboard obstacle recognition?

Can we do onboard obstacle avoidance?

Can we detect dangerous situations?

Can LTE work at 400 feet AGL?

Thank you

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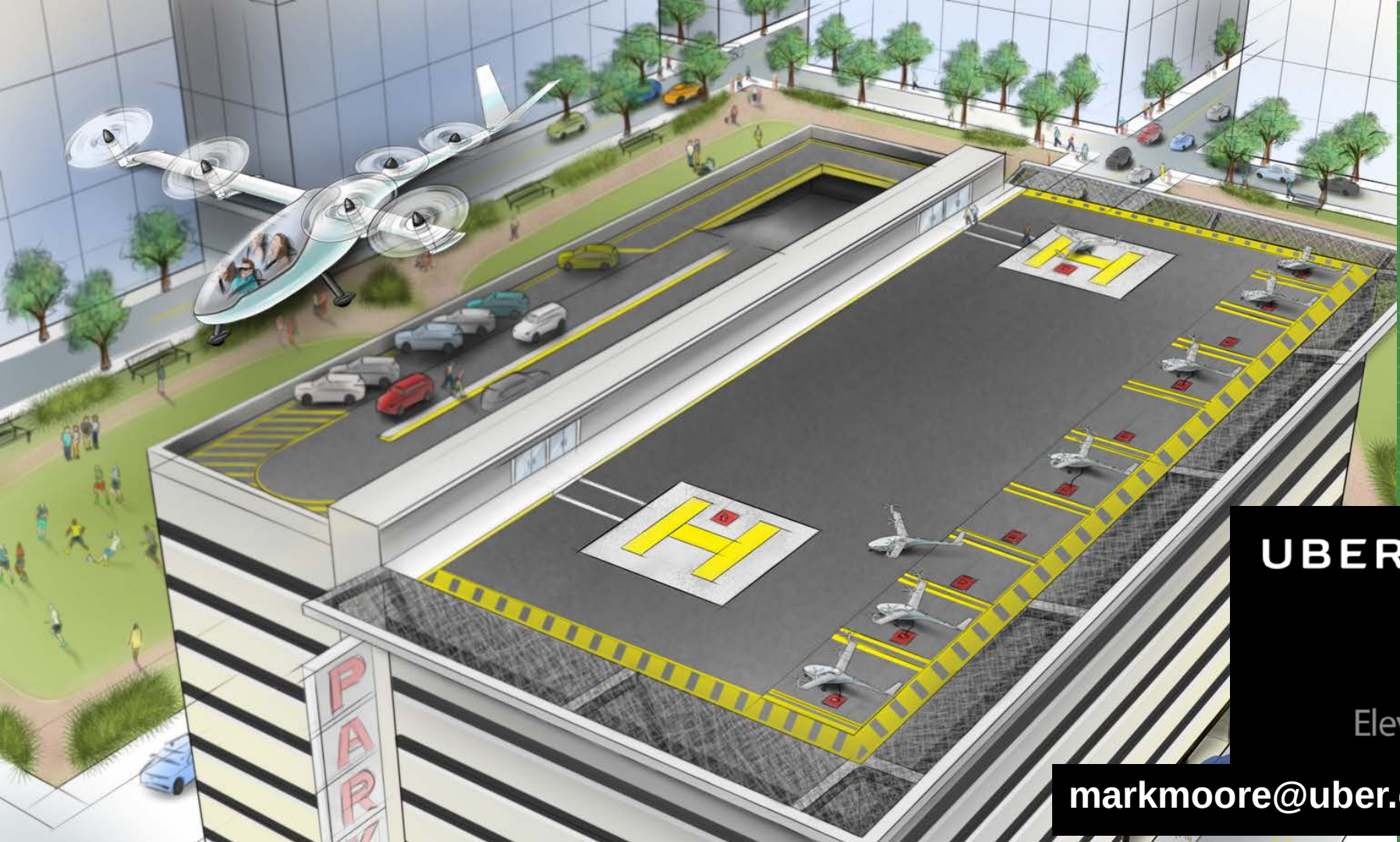

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Elevate

markmoore@uber.com

Helicopters Haven’t Been A Sufficient Solution To Enable Aerial Urban Mobility

Stop The Helipad

San Francisco Residents Opposed to the San Francisco General Hospital Helipad

HOME | SAVE LIVES | SAFETY | HEALTH | FLIGHTS | FAQs | HELP US

San Francisco available Helicopter Landing Sites

In the event of a natural or man-made disaster, helicopters would land in any parking lot or wide intersection. The emergency landing sites shown below, are listed in the SF Emergency Medical Services Agency Manual, Appendix B:

Helipad History in San Francisco

San Francisco residents have successfully battled helicopter danger and noise since the early 1960s. In the past, all heliport and helipad proposals have been

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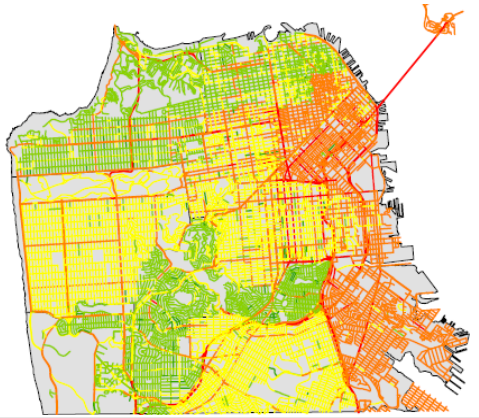
Bay Area Hospital Helipads
San Francisco Helipads
Who will use SFGH helipad?
Environmental Impact
Property Values
Noise
Flight Paths
Helicopter Flight Costs
Fatal Helicopter Crashes
SFGH Neighbors' Comment

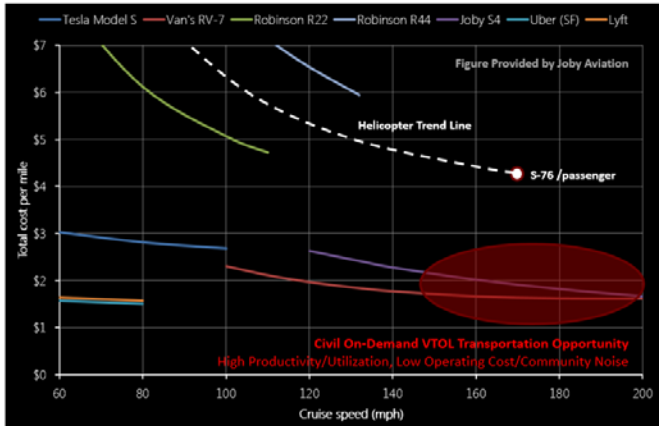
Helicopter Barriers

Community Noise: 15+ dB Above Background Noise
Affordability: High Energy and Maintenance Cost
Safety: ~10x Lower than Autos



Scaled Market Barriers

Infrastructure Availability
Pilot Availability and Proficiency
Airspace for High Volume Urban Operations



Enabling Technologies

Electric Propulsion: Scale-free, Distributed Thrust
  Noise: Match Background Urban Noise Levels
  Safety: Multi-Engine Thrust Redundancy
  Affordability: 3x Higher Lift/Drag, 3.2x Higher Motor Efficiency
Autonomy: Smart Avoinics Linked to Sensors and Network
  Safety: Reduced Pilot Error and Workload, Future Autonomous Ops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MAR/APR 2017
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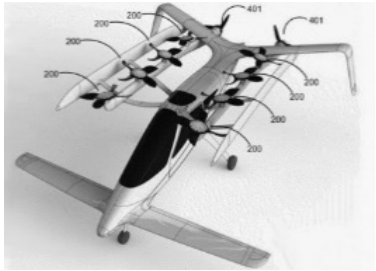
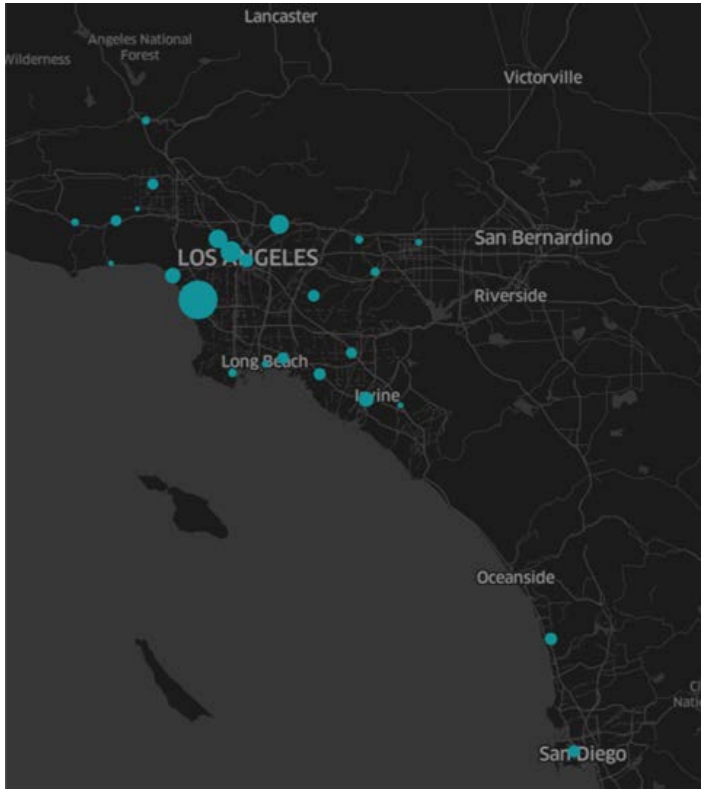
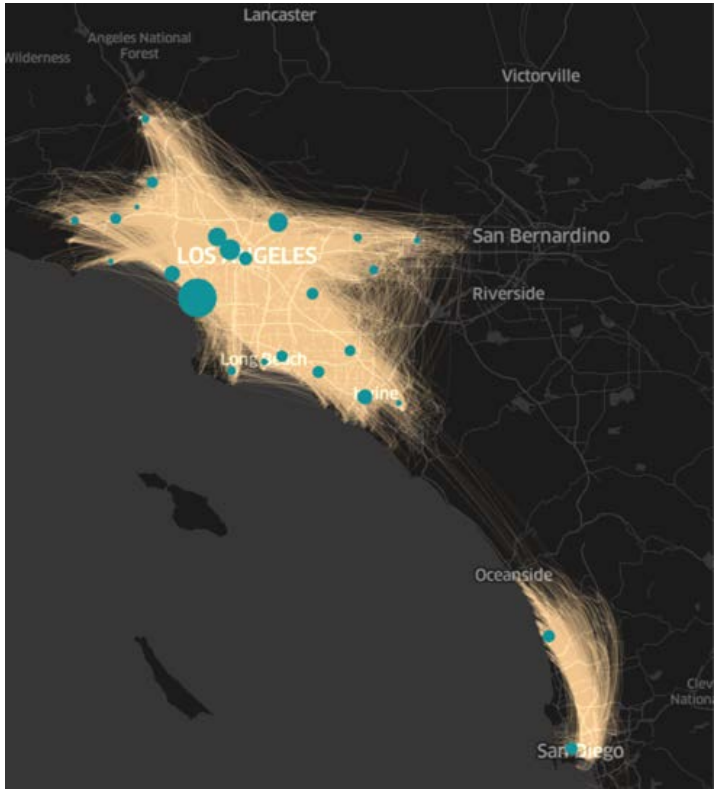
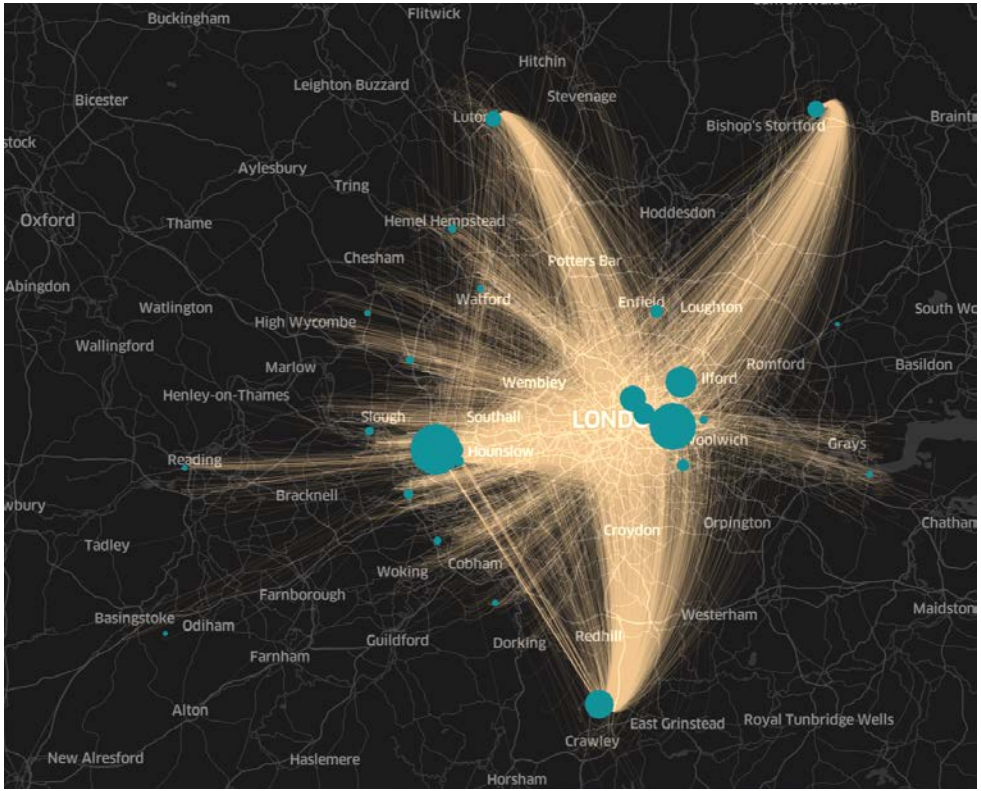


Demand Modeling and Infrastructure

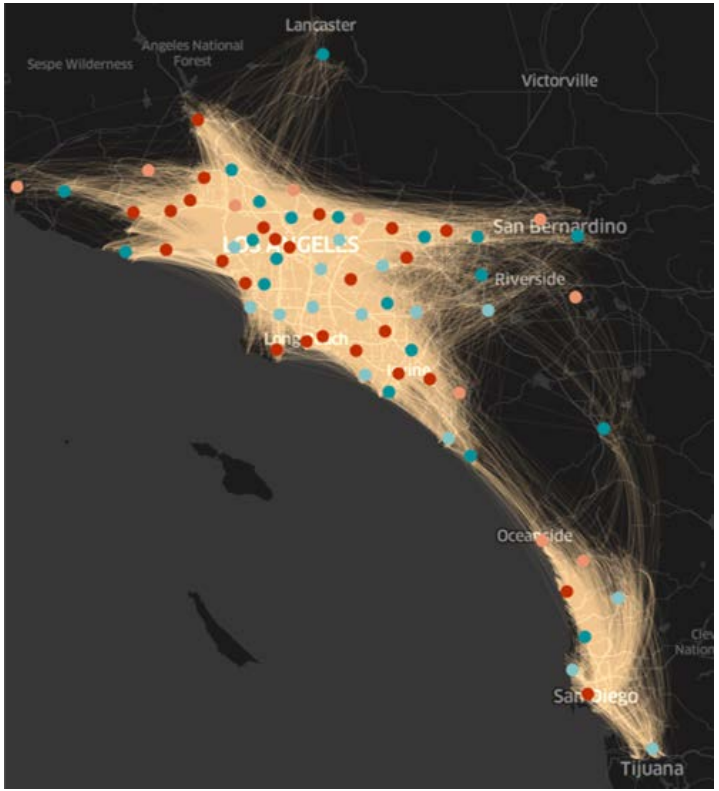


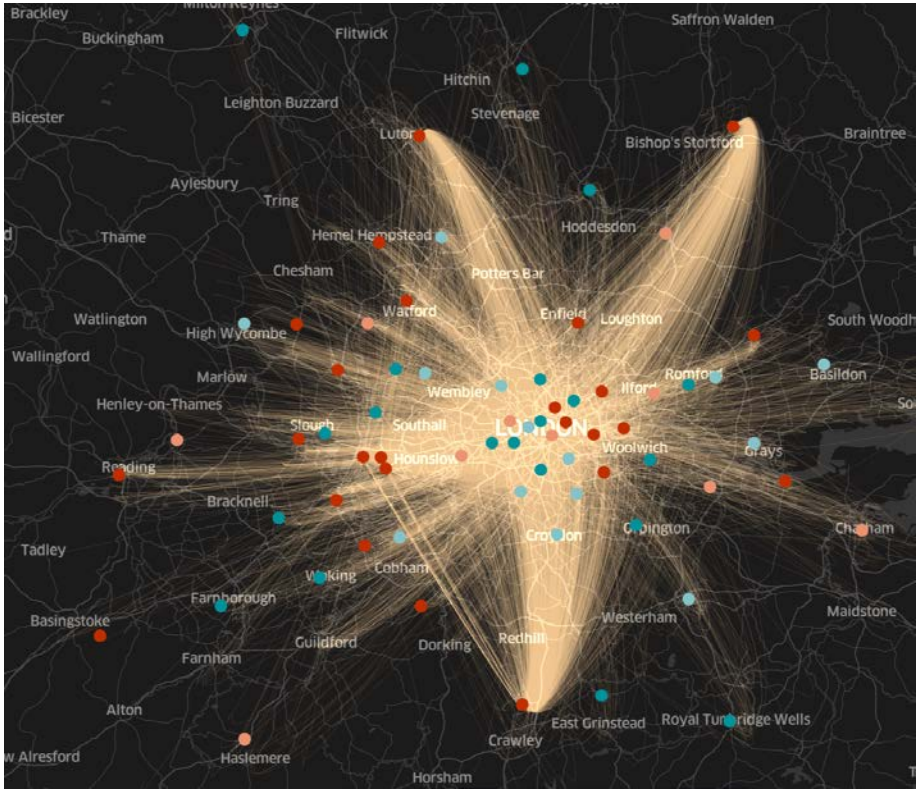
60% of LA’s 20-100 mile Trips Satisfied with 25 Vertiports

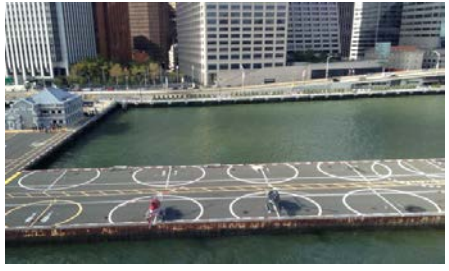




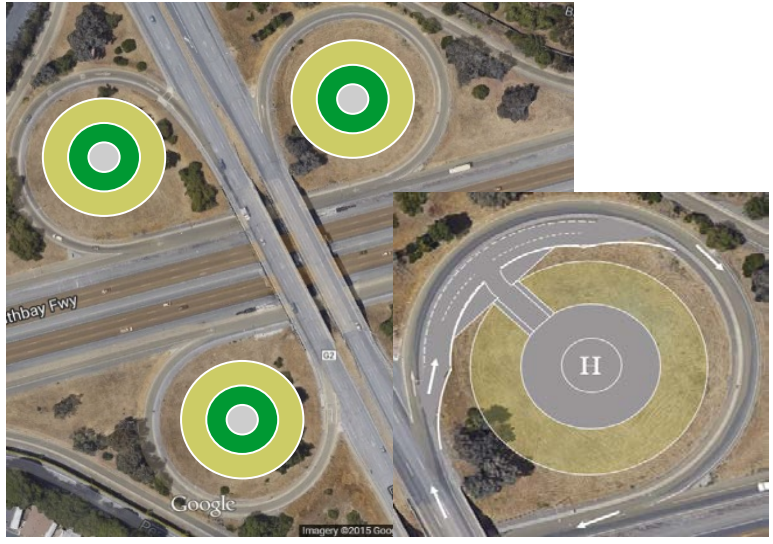
Over Time, Even Greater Time Savings and Accessibility








WATCHTOWER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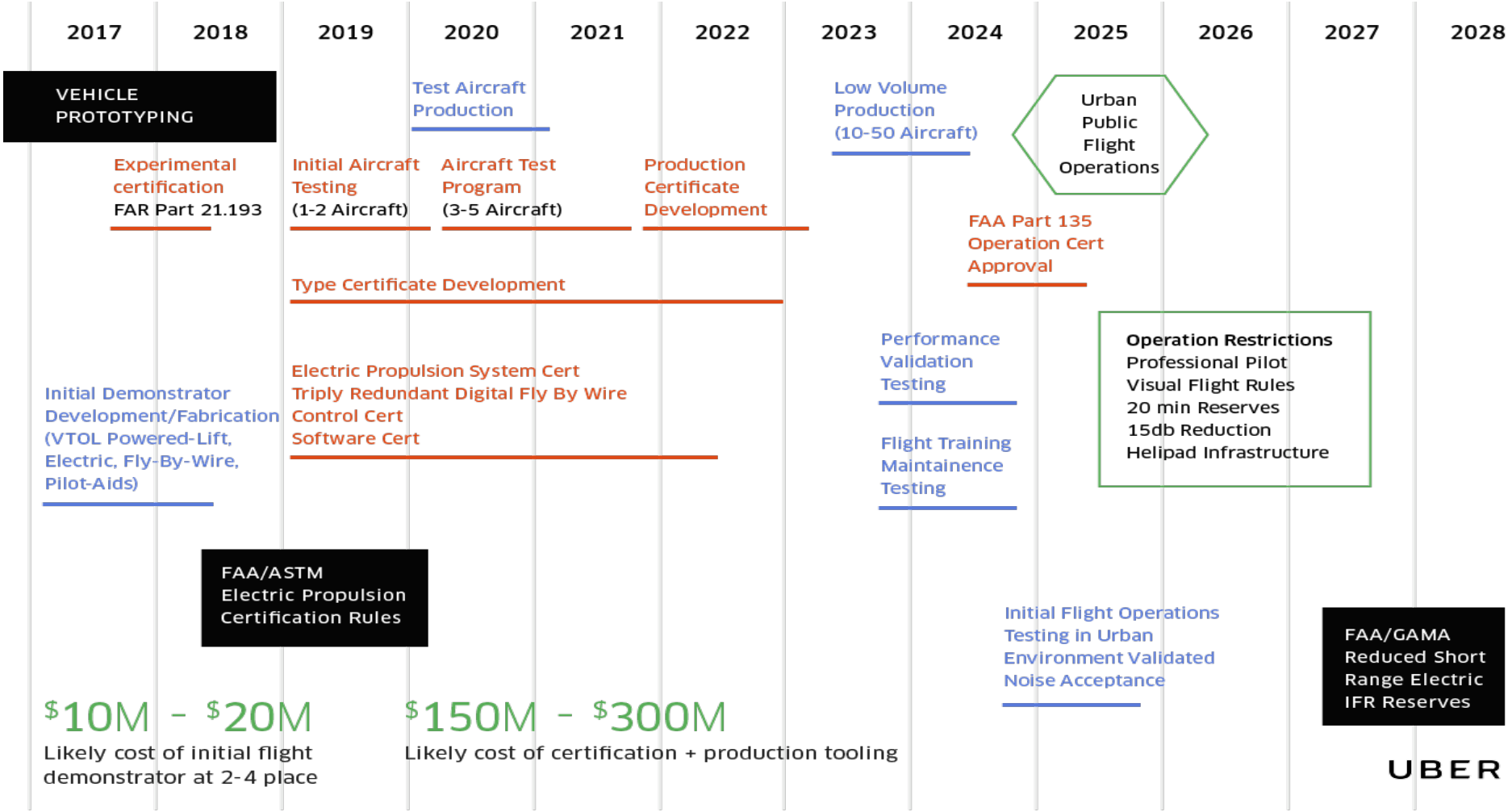
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VEHICLE PROTOTYPING
Test Aircraft Production
Low Volume Production (10-50 Aircraft)
Urban Public Flight Operations
Experimental certification FAR Part 21.193
Initial Aircraft Testing (1-2 Aircraft)
Aircraft Test Program (3-5 Aircraft)
Production Certificate Development
FAA Part 135 Operation Cert Approval
Type Certificate Development
Performance Validation Testing
Operation Restrictions
Professional Pilot
Visual Flight Rules
20 min Reserves
15db Reduction
Helipad Infrastructure
Electric Propulsion System Cert
Triply Redundant Digital Fly By Wire Control Cert
Software Cert
Initial Demonstrator Development/Fabrication (VTOL Powered-Lift, Electric, Fly-By-Wire, Pilot-Aids)
Flight Training Maintainence Testing
FAA/ASTM Electric Propulsion Certification Rules
Initial Flight Operations Testing in Urban Environment Validated Noise Acceptance
FAA/GAMA Reduced Short Range Electric IFR Reserves
$10M - $20M
Likely cost of initial flight demonstrator at 2-4 place
$150M - $300M
Likely cost of certification + production tooling
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Earl Lawrence, Director, FAA UAS Integration Office

Earl Lawrence is the Director of the Unmanned Aircraft Systems (UAS) Integration Office within the Federal Aviation Administration, which is responsible for the facilitation of all regulations, policies, and procedures required to support the FAA's UAS integration efforts. The office serves as a central point of contact for the international aviation community on UAS issues. Mr. Lawrence also represents the FAA on the Senior Steering Group of the UAS Executive Committee (ExCom) focusing on coordination and alignment of efforts among key federal government agencies.

Mr. Lawrence previously served as the Manager of the FAA's Small Airplane Directorate in Kansas City, Missouri, where he managed airworthiness standards, continued operational safety, policy, and guidance for small aircraft, gliders, light sport aircraft, airships, and balloons.

Prior to joining the FAA in 2010, Mr. Lawrence was the vice president of industry and regulatory affairs for the Experimental Aircraft Association (EAA) in Oshkosh, Wisconsin. Mr. Lawrence is a graduate of Northrop University in Los Angeles.

A pilot since 1987, Mr. Lawrence holds a commercial multi-engine pilot certificate as well as an airframe and power plant mechanic certificate with an Inspection Authorization. He currently owns and flies a Piper Twin Comanche.

Anil Nanduri, Vice President, New Technology Group, Intel

Anil V. Nanduri is Vice President in the New Technology Group and General Manager of Unmanned Aviation Systems for the Perceptual Computing Group at Intel Corporation. He is responsible for Intel's unmanned aviation systems business and pursuing opportunities for growth in this segment. Prior to his current role, he was most recently responsible for new business opportunities for Intel® RealSense™ technology and building awareness.

During his Intel career, Mr. Nanduri has held roles encompassing chip design, platform enabling, and technical and product marketing. He served as chief of staff and technical assistant to the general manager of Intel's PC Client Group. From 2008 to 2010, Mr. Nanduri led netbook marketing at Intel, a role that included establishing the category and promoting its growth through marketing strategies and design wins. Earlier in his Intel career, he managed platform strategy and marketing for Intel's next-generation mobile platform.

Mr. Nanduri initially joined Intel in 1997 as a chipset design engineer. In 2007, he left to serve as director of marketing at Powercast Corporation, then rejoined Intel in 2008. His contributions to Intel's mobile platforms have earned him three Intel Achievement Awards.

Mr. Nanduri received his bachelor's degree in electrical and electronics engineering from the College of Engineering, Trivandrum, in India; and his master's degree in electrical engineering from Pennsylvania State University. He holds one U.S patent, with another patent pending.

Charles Bergan, Vice President, Engineering, Qualcomm Technologies, Inc.

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Charles Bergan leads the software department for Qualcomm Research. He also oversees Qualcomm Research's robotics program. While at Qualcomm, he has been involved in the research and development of most of the modern cellular radio standards, including CDMA, UMTS, UMB and LTE.

Previously, Mr. Bergan led the software development team at Ensemble Communications, a start-up company which pioneered the development of LMDS point-to-multipoint wireless backhaul systems.

Mr. Bergan has a B.S. in computer engineering, and an M.S. in computer science, both from the University of California, San Diego.

Travis Mason, Vice President of Public Policy & Regulatory Affairs, A^3 by Airbus

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Travis G. Mason is the Vice-President of Public Policy and Government Affairs at A^3 by Airbus managing public policy across the A3 project teams, Airbus' new commercial UAS business and the Airbus Corporate Technology Office (CTO) urban air mobility group. Mr. Mason joins A^3 after six years at Alphabet and Google focused on public policy issues facing the company's advanced technology efforts in aviation, renewable energy and life sciences. Before Google, Mr. Mason worked at Booz Allen Hamilton designing collaborative technology solutions across the Departments of Homeland Security, Defense and State.

Graduating from the Maxwell School of Citizenship at Syracuse University, Mr. Mason was recognized as a Harry S. Truman Scholar, one of the country's most prestigious undergraduate awards. He earned his master's from the University of Michigan and has also studied at Princeton University's Woodrow Wilson School of Public Policy and Harvard University's Kennedy School of Government as a Galbraith Scholar.

Mark Moore, Engineering Director of Aviation, Uber

Mark Moore worked for NASA for 32 years before becoming the Uber Engineering Director of Aviation. Uber has developed a transformative vision for urban mobility called Elevate to implement short-range aerial ridesharing to provide a low infrastructure alternative to ground highway gridlock.

Throughout his entire career, Mr. Moore has performed conceptual design studies of advanced aircraft, with a focus on small powered-lift vehicles. Over the past decade, he has focused his attention on the development of Distributed Electric Propulsion (DEP) and autonomy technologies as enablers of new types of vertical flight aircraft. He led three rapid concept to flight demonstrator teams that resulted in the NASA GL-10 VTOL UAV, the LEAPTech Mobile Ground Rig full-scale DEP wing, and the SCEPTOR X-57 (the first NASA X-plane in over a decade). His research focuses on understanding how to best integrate emerging technologies to achieve ultra-low noise, redundant propulsion, robust control and low operating cost ESTOL and VTOL aircraft. He has authored many technical publications promoting a future vision of large-scale distributed and on-demand aviation.

Mr. Moore received his master's degree in aeronautical engineering from Stanford University and is currently completing his PhD at Georgia Tech.

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