



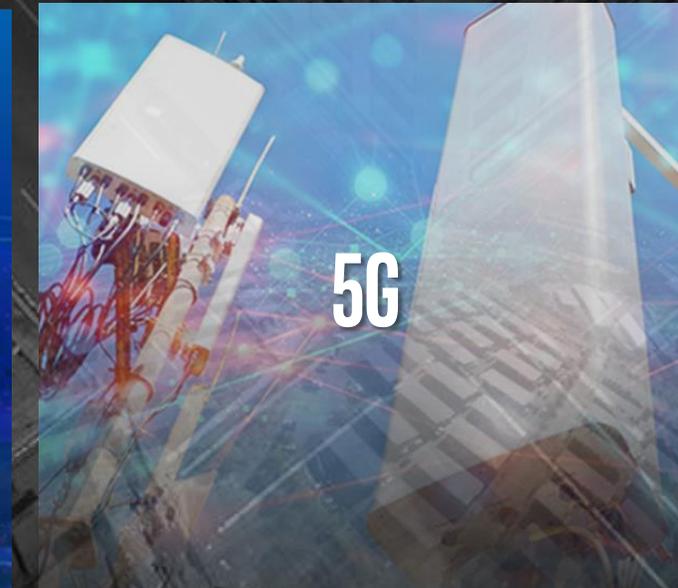
# BUILDING THE AUTONOMOUS FUTURE

**Anil Nanduri**

VP and GM, Drone Group



# TECHNOLOGY INFLECTIONS



# UAV MARKET SEGMENTS



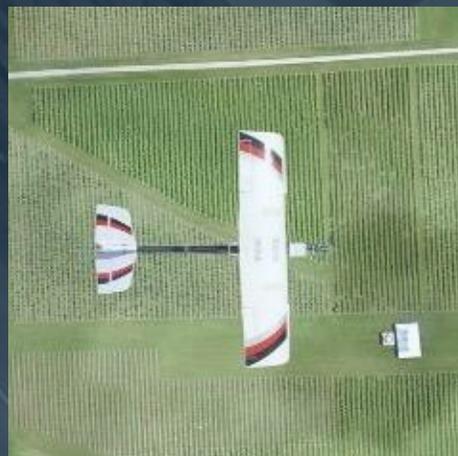
## MILITARY / DEFENSE

ISR  
Targeting  
Search & Rescue  
Communications  
Relay



## CIVIL

Search & Rescue  
Environment and  
Wildlife  
Management  
Law Enforcement &  
Public Safety



## COMMERCIAL

Construction  
Inspection  
Agriculture  
Oil & Gas  
Insurance  
Deliveries



## PROSUMER/HOBBYIST

Film and media  
Real estate  
Professional  
entertainment  
Private Security  
Marketing/sales



## CONSUMER/TOY

Recreational photo  
and videography  
Personal entertainment/  
FP flying Drone Racing  
Action sports



# DRONE WORKFLOWS IMPROVE EFFICIENCY AND REDUCE COSTS

## CONSTRUCTION



Bridges and Infrastructure



Buildings



City Planning



Surveying

## UTILITIES



Power Lines



Wind Turbines



Cell Towers



Solar

## INSURANCE



Underwriting



Risk Management



Claim Management



Disaster Assessment

## OIL AND GAS



Refinery



Drilling



Pipelines



Storage Tanks

# INSPECTING SITES, ASSETS, AND INFRASTRUCTURE



## UNESCO WORLD HERITAGE SITE

Hwahongmun Gate of Suwon  
Hwaseong Fortress built in 1796,  
South Korea  
2,200 images, 20GB of Data



## BRIDGE INSPECTIONS

Daniel Carter Beard Bridge  
640m in length crossing Ohio River  
2,500 images, 22GB of Data



## OIL & GAS PLANT

Cooper Basin in South Australia  
4 flare tips, 9 flights, 600 images  
total (RGB & thermal)

# NASA AMES WIND TUNNEL INSPECTION, JULY 20, 2019

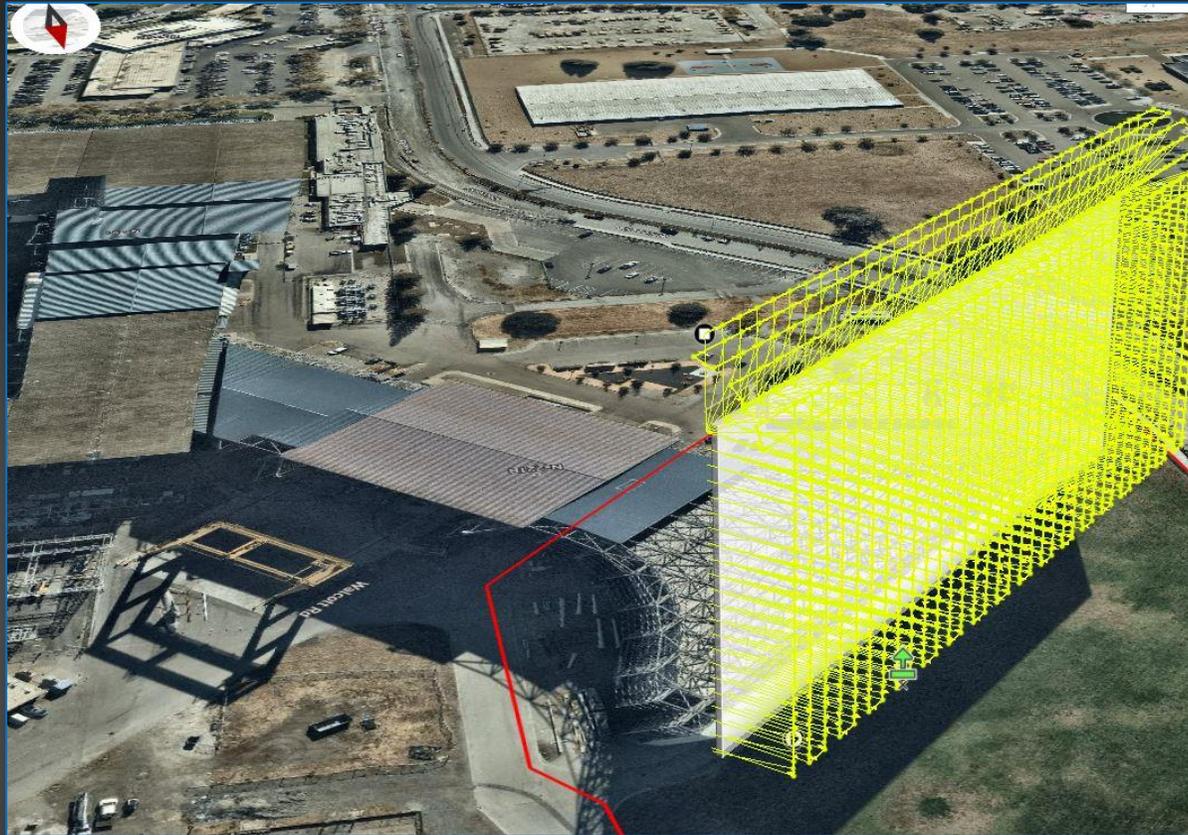
9 automated flights,  
1,704 images, 26GB Data

One Intel® Falcon 8+ Drone

Permission to fly under Wide  
Area Airspace Authorization and  
coordination with Moffett ATC



# FAÇADE FLIGHT PLAN WITH INTEL<sup>®</sup> MISSION CONTROL SOFTWARE, HIGH RES INSPECTION PHOTOS



# THE DATA-CENTRIC WORLD

OVER

**HALF** OF THE  
WORLD'S  
DATA

WAS CREATED IN THE LAST

**2 YEARS**

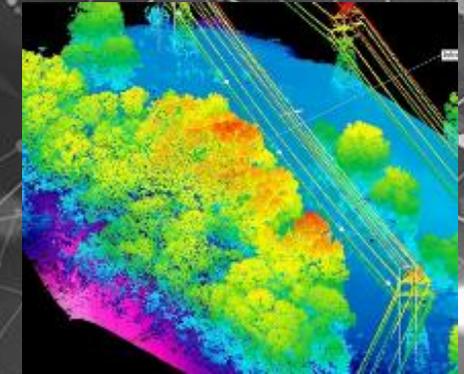
LESS THAN

**2%** HAS  
BEEN  
ANALYZED

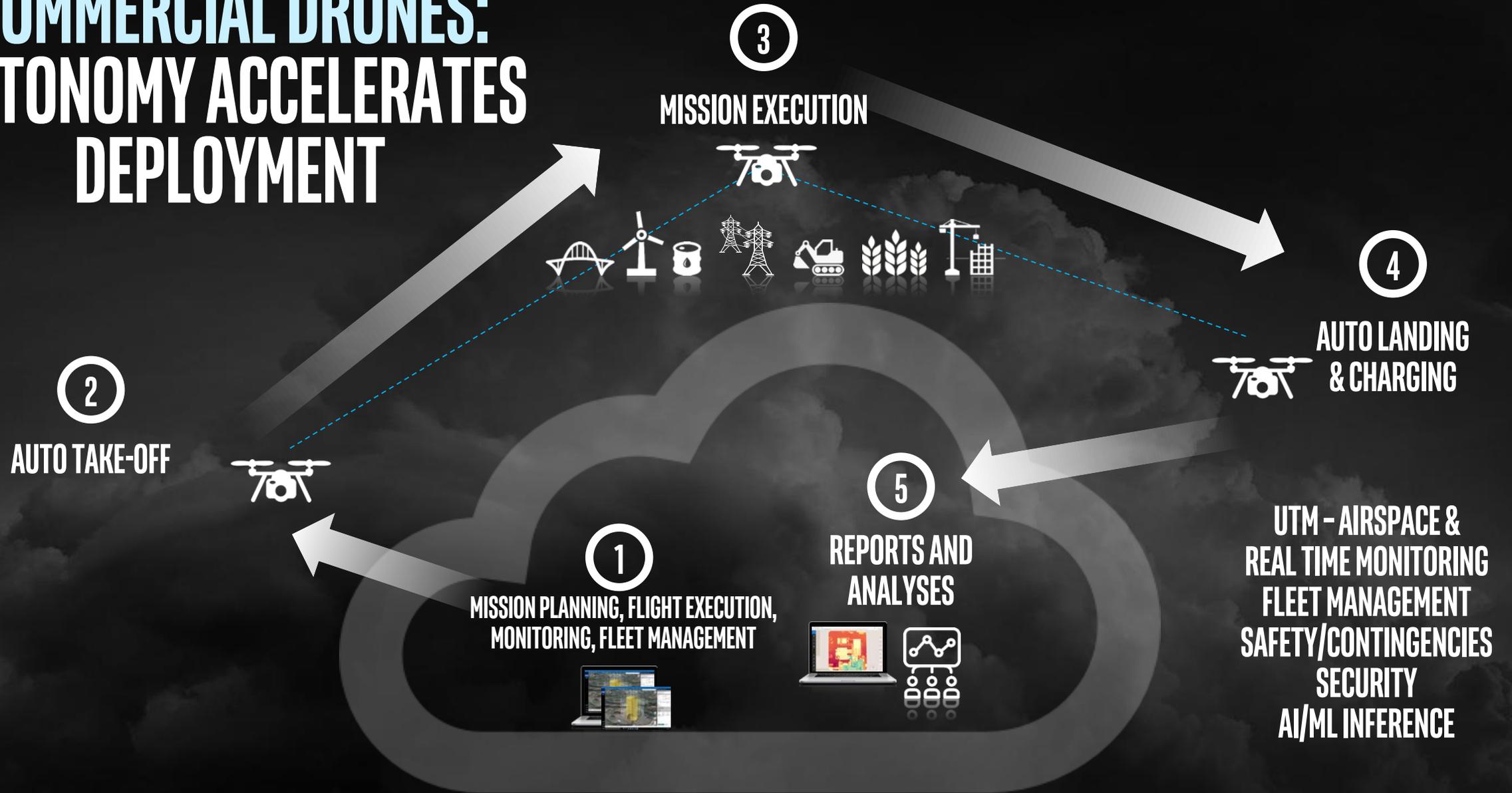


# THE POWER OF DATA

ASSET INSPECTION  
AND MONITORING  
CHANGE DETECTION  
PREDICTIVE MODELS



# COMMERCIAL DRONES: AUTONOMY ACCELERATES DEPLOYMENT



# ACHIEVING AUTONOMY



# ACHIEVING AUTONOMY

Level 0 No Automation	Level 1 Human Assisted	Level 2 Partial Automation	Level 3 Conditional Automation	Level 4 High Automation	Level 5 Full Automation
<p>Manual flight and operation</p> <p>Visual line of sight</p> <p>No onboard flight safety</p> <p>Operator knowledge &amp; adherence to restrictions, conditions, weather</p>	<p>Manual flight and operation</p> <p>Autopilot assist - GPS and navigation aids</p> <p>Safer VLOS</p> <p>Adherence to altitude restrictions and geo-fence</p>	<p>Routine flights automated</p> <p>Pre-defined waypoint flying BVLOS capable</p> <p>Pilot supervision and control when necessary</p> <p>Automated airspace authorization</p>	<p>Automated flight and operation – human in the loop</p> <p>Waypoint flying with adaptive safety systems</p> <p>Safe integration of BVLOS in controlled airspace</p> <p>Low density UAV coordination</p>	<p>Automated flight and operation</p> <p>Multi-drone operations at moderate scale</p> <p>'Nest' automated to support takeoff/landing/charging</p> <p>UA traffic mgmt system integrated</p>	<p>Self-managed automated flight and operation</p> <p>Operation in dynamic &amp; high density airspace</p> <p>Integration of weather services</p> <p>ATM integration for congestion avoidance</p>
Human Dependency					
<p>TRAINED &amp; SKILLED PILOT</p> 	<p>TRAINED PILOT</p> 	<p>BASIC PILOT</p> 	<p>OPERATOR MONITORING ONSITE</p> 	<p>REMOTE OPERATOR MONITORING</p> 	<p>NO OPERATOR</p> 

# REGULATION AND POLICY CRITICAL TO FURTHER AUTONOMY OF UAV SYSTEMS

Adoption and standardization of UTM system to enable safe low-altitude airspace

Decision on a UAS Remote Identification and tracking to further enhance safety and ATM

Standards and regulations for BVLOS operations

COMMERCIAL JETS AND AIRLINERS



GENERAL AVIATION



CARGO DRONES  
(LARGE PAYLOAD, LONG RANGE)



SURVEILLANCE, MAPPING, SECURITY



GEOFENCE



# INTEL DRONE LIGHT SHOW

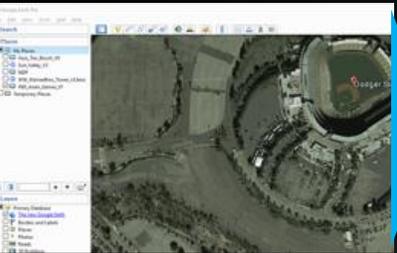
A new form of art and storytelling – allowing creativity to come to life - with the sky as our canvas, and flying lights as ink

A **spectacular experience** where the night-sky is illuminated with **3D shapes and dynamic formations** choreographed to music

A **smoke-free and noise-free** way for audiences to enjoy a night-sky entertainment

100s/ 1000s of preprogrammed drones flying in unison – **all controlled by one pilot**

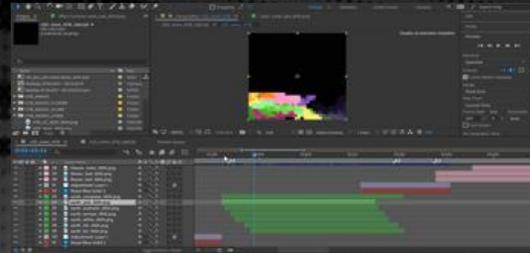
# LIGHT SHOWS **WORKFLOW**



**Site  
Planning**



**Concept and  
Design**



**Animation, Testing,  
and Validation**



**Show  
Setup**



**Execution**

# INTEL DRONES SHOOT FOR THE MOON

## HONORING THE 50TH ANNIVERSARY OF THE APOLLO 11 MOON LANDING



300 Intel®  
Shooting Star™ drones

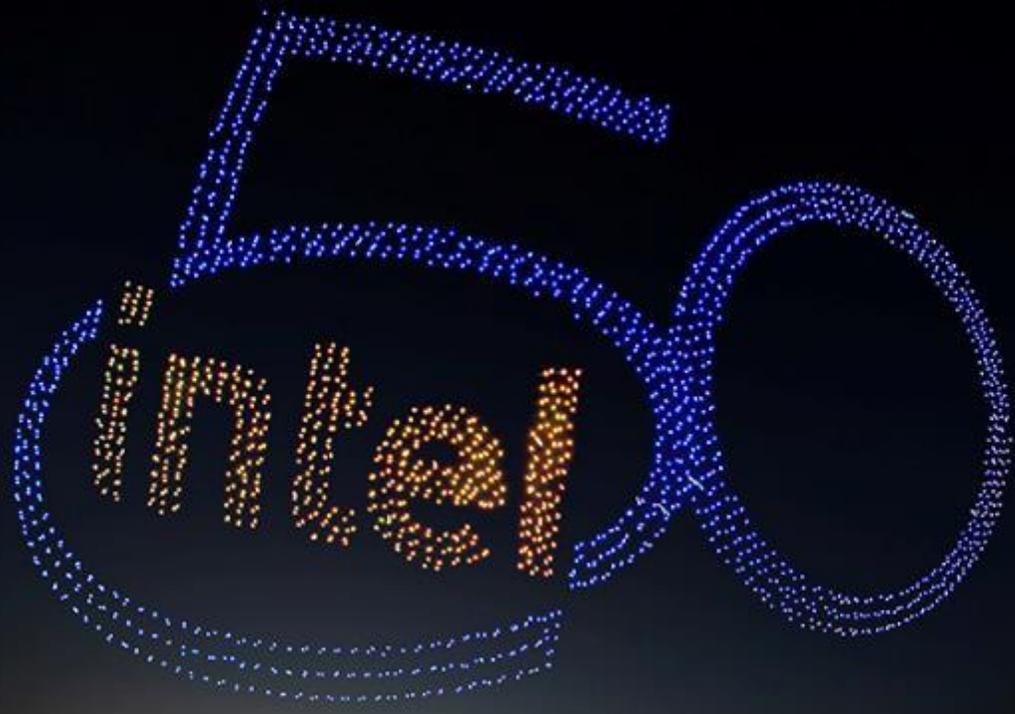
Permission to fly over NASA  
controlled airspace!

In partnership with Studio Drift,  
and to music performed live by  
Duran Duran

# INTEL DRONES SHOOT FOR THE MOON



# INTEL'S 50TH ANNIVERSARY & A CURRENT GUINNESS WORLD RECORD: 2,066



JULY 2018

# LIGHT SHOW FLEET EVOLUTION

2015

2016

2017

2018



100

500

>1000

>2000

## AUTONOMY MANAGING INCREASED COMPLEXITY

19

A large Saturn V rocket is the central focus, displayed on a metal support structure. The rocket is illuminated with blue light, and the words "UNITED STATES" are visible on its side. The background is a dark night sky filled with numerous small, bright blue stars. Other rockets are visible in the background, including one with "NASA" written on it. The overall scene is a tribute to space exploration.

**THANK YOU**