The Self-Driving Network™: How to Realize It

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The Self-Driving Network™

In March 2016, I presented the vision of a Self-Driving Network – an automated, fully autonomous network

I drew an analogy with the vision of a self-driving car

- **It took 10 years from vision to prototype**
- **The first attempt (in 2004) failed!**

What will it take to realize the Self-Driving Network?

The Self-Driving Car Journey

2004

2014

DARPA Grand Challenge:
build a self-driving car

The Self-Driving Network: What It Does

A self-driving network would

- Accept “guidance” from a network operator
- Self-discover its constituent parts
- Self-organize and self-configure
- Self-monitor using probes and other techniques
- Auto-detect and auto-enable new customers
- Automatically monitor and update service delivery
- Self-diagnose using machine learning and self-heal
- Self-report periodically

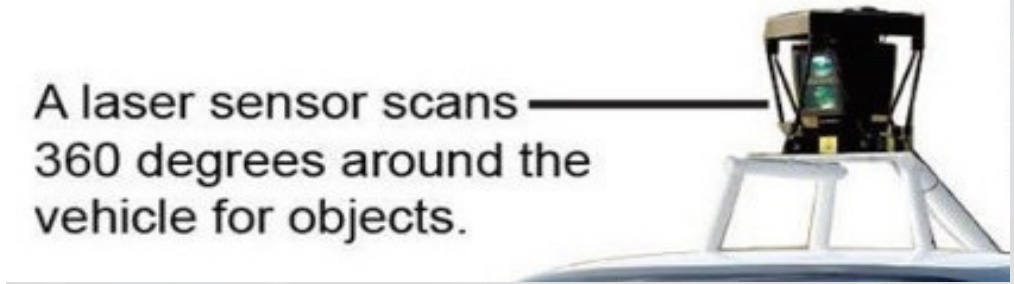
FIVE TECHNOLOGIES FOR SELF DRIVING

1. TELEMETRY
2. MULTIDIMENSIONAL VIEWS
3. AUTOMATION
4. DECLARATIVE INTENT
5. DECISION MAKING
   A. RULE-BASED
   B. MACHINE LEARNING

1. TELEMETRY—CARS

The usual: speedometer, gas gauge, tire pressure sensors

More recent: radar (for ACC), sonar (for parking assist), cameras



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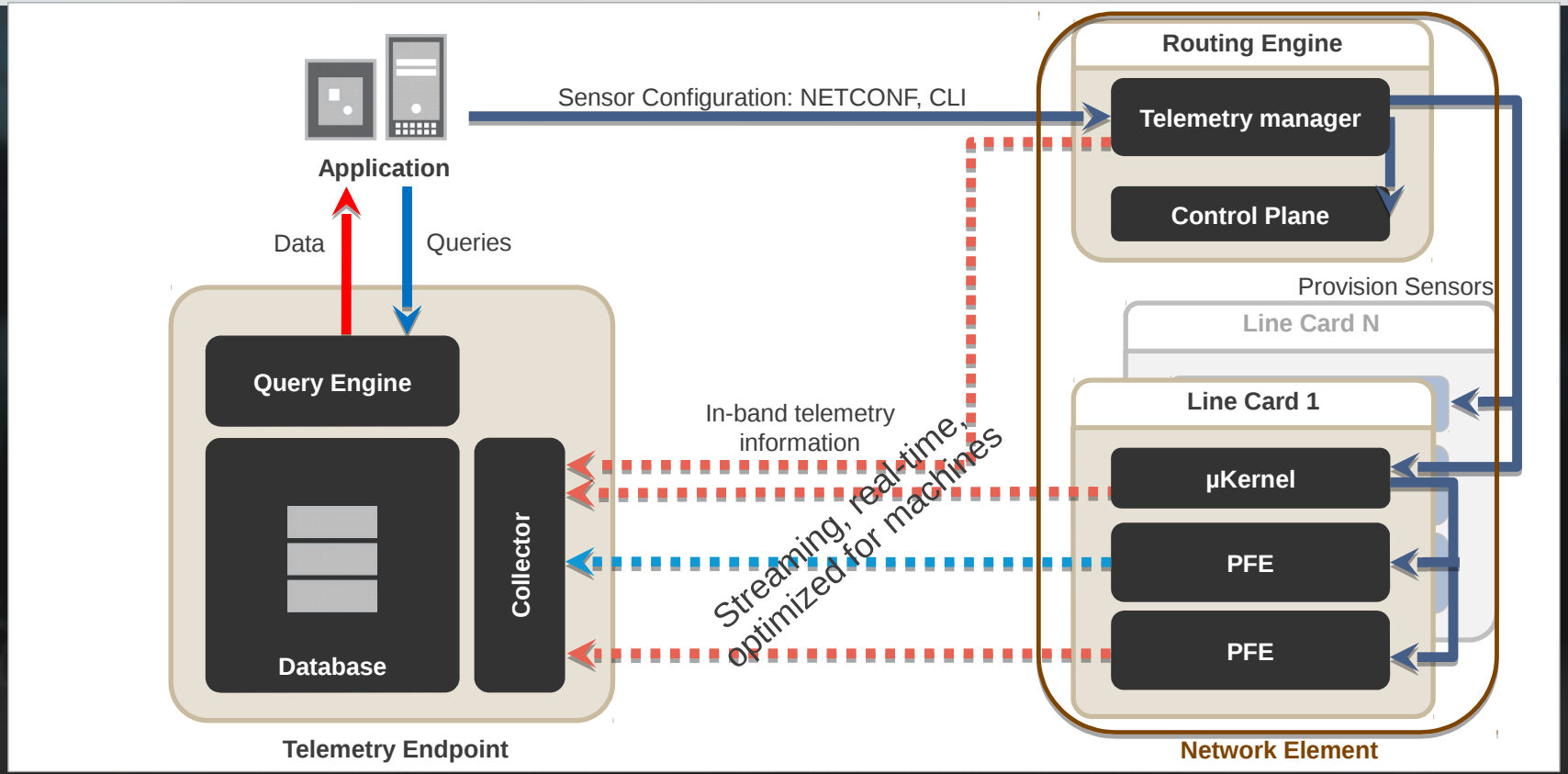
1. TELEMETRY—NETWORKS: where we are today



2. MULTIDIMENSIONAL, MULTI-MODAL VIEWS

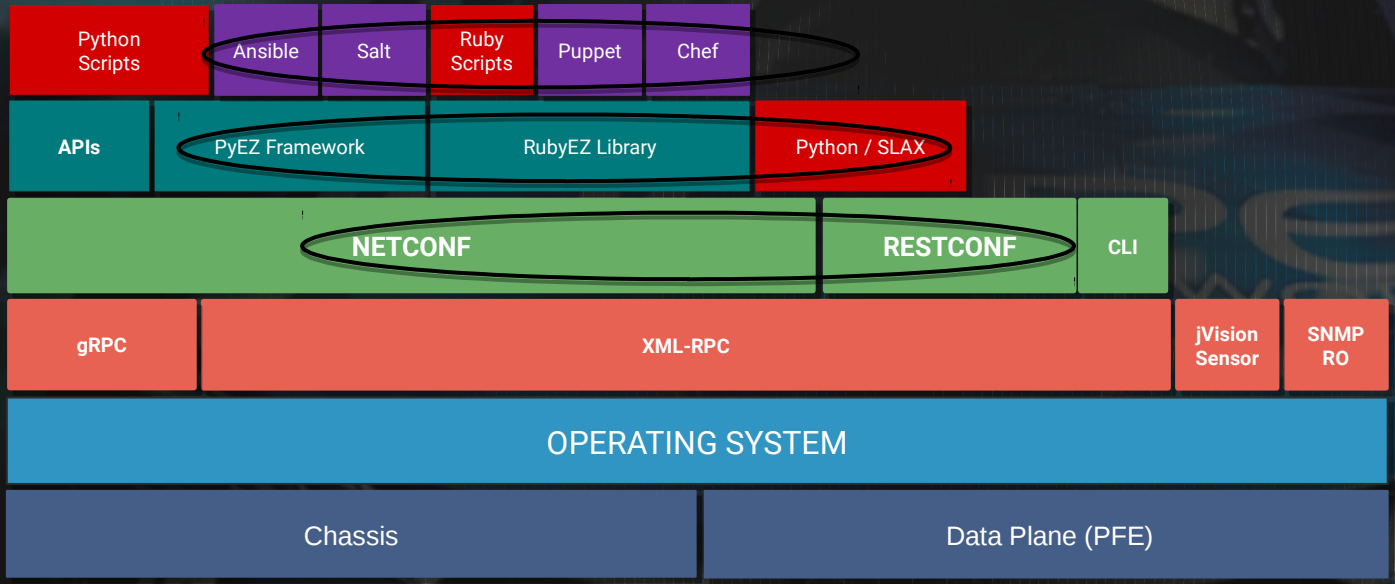
NETWORK TODAY

- Neighbors, links
- Exit points, peers
- L0-1 devices
- Middle-boxes
- Global topology, traffic, flows
- Server and application performance
- Hackers, flash crowds, DDoS

NETWORK (FUTURE)

- Correlation of information across geographies, layers, peers, clouds
- Root cause analysis via supervised learning
- Time-based trending to establish and adapt baselines
- Optimal local decisions based on global state

3. AUTOMATION—NETWORKS: where we are today



4. DECLARATIVE STATEMENT OF INTENT—CARS

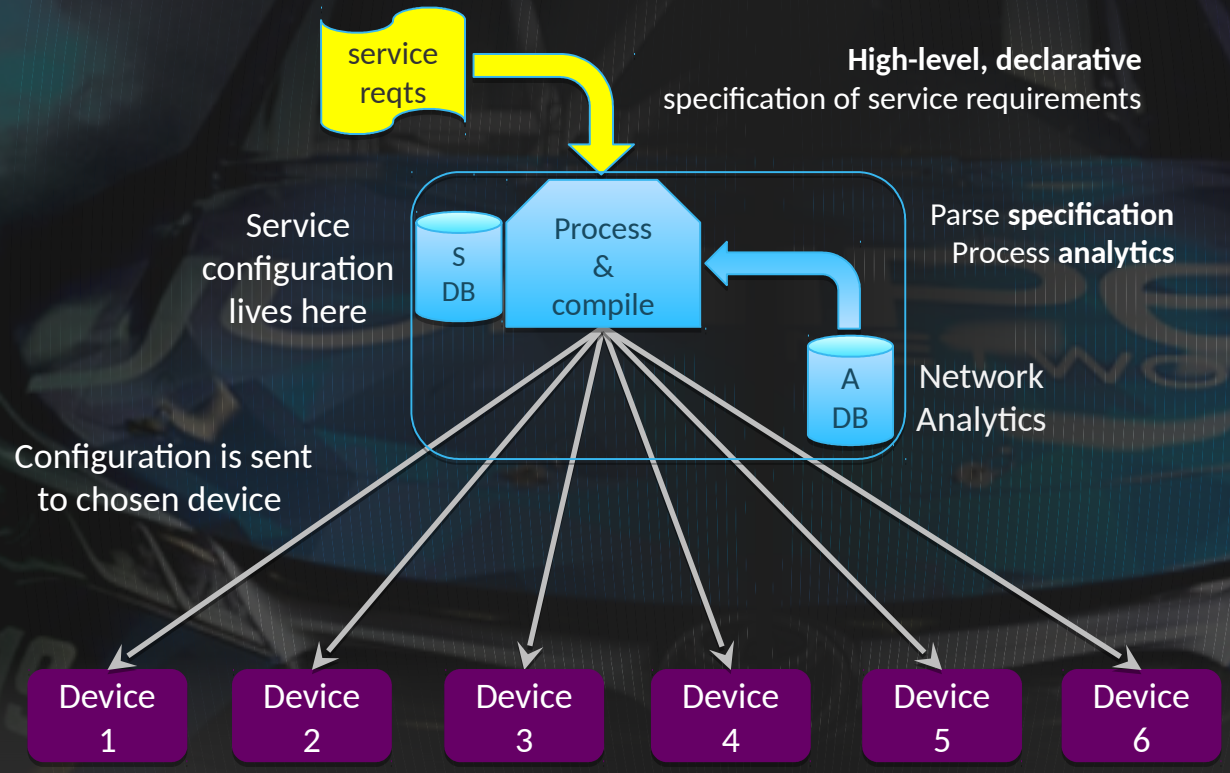
SAY WHERE YOU WANT TO GO…

Hints:

- Fastest time
- Lease distance
- Most efficient use of battery

Even better, the car can simply talk to your phone, figure out where you need to be, and take you there

4. INTENT: “Say *What* You Want, Not How” – where we are today



5. DECISION MAKING—RULE-BASED VS. MACHINE LEARNING

RULE-BASED LEARNING

If X happens, do Y: “avoid big rocks”

—“If this then that”

+Straightforward programming

+Easy to predict and refine

- Slow, painstaking work
- At scale, hard to manage

MACHINE LEARNING

“Essence of artificial intelligence”

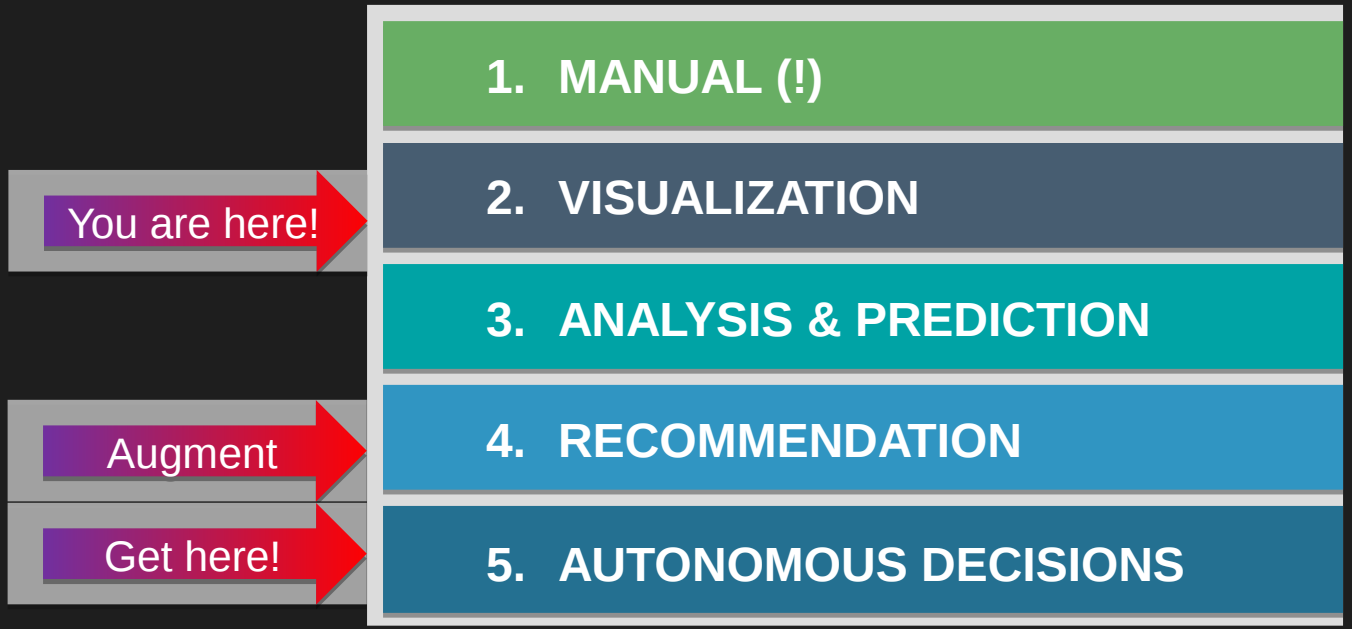
—Alan Turing

+Can become “creative”

+Fastest way to learn complex behavior

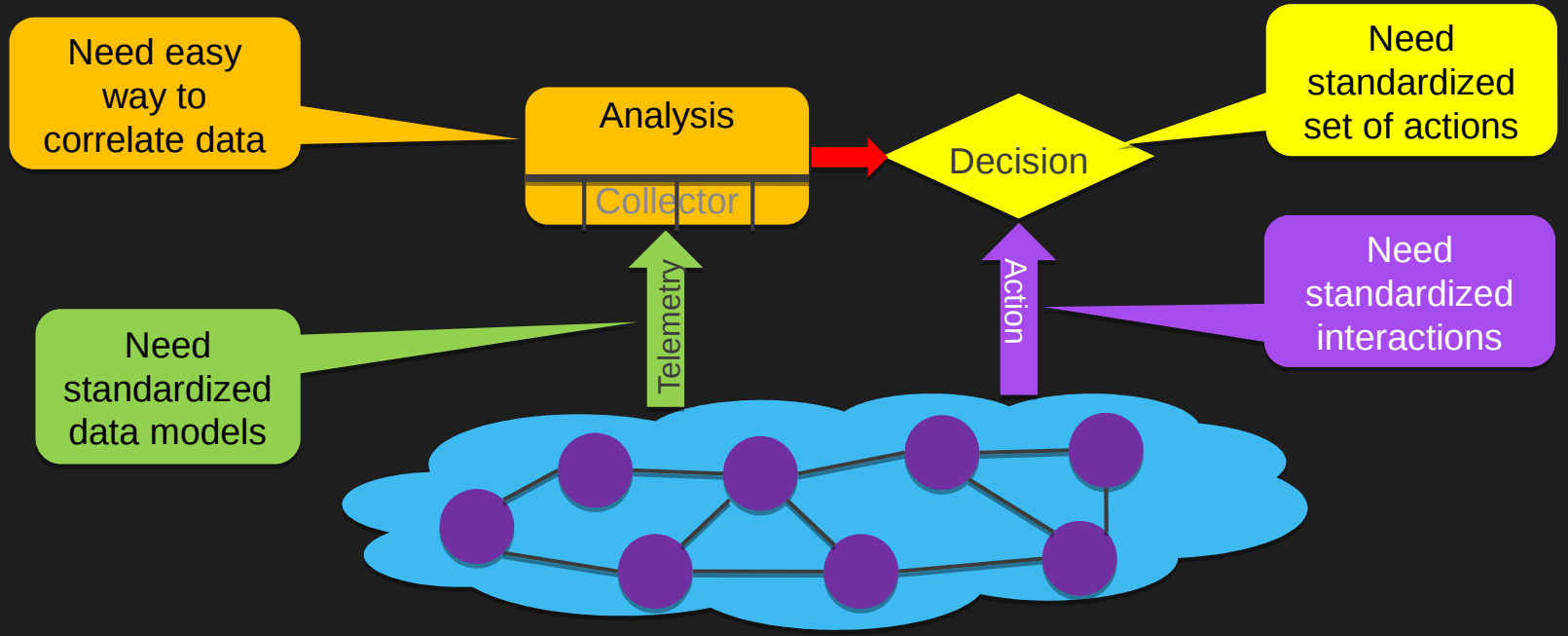
- Can come to strange conclusions
- Hard to know what it knows

FIVE STAGES OF SELF-DRIVING



How Do We Get This Kicked Off?

HIGH-LEVEL ARCHITECTURE



THE NETWORKING **GRAND CHALLENGE**

BUILD A SELF-DRIVING NETWORK

GOAL

- Self-Discover—Self-Configure—Self-Monitor—Self-Correct—Auto-Detect Customers—Auto-Provision—Self-Analyze—Self-Optimize—Self-Report

PRIZE

- TBD

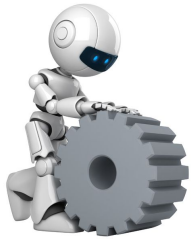
RESULT

- Free up people to work at a higher-level: new service design
- Agile, even anticipatory service creation
- Fast, intelligent response to security breaches

CHALLENGE

- Run a datacenter for six months with no human intervention (not even from afar) with no reduction or compromise in functionality

IMPACT:



POSSIBILITIES

THE SELF-DRIVING NETWORK: **GRAND IMPACT**

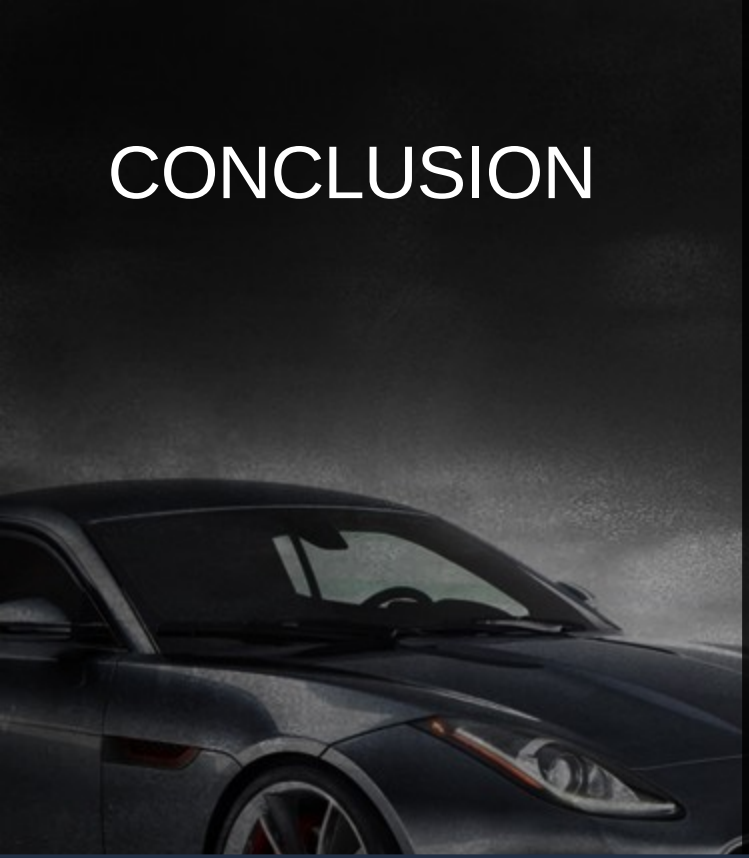
- Skill set change:
  1. Network geeks ⊔ service designers
  2. Network knowhow ⊔ algorithmic tweaking
- The network gets out of the way!
  - SLAs are automatically met
- Networks adapt, react, anticipate
- Security becomes Good Guy ‘Bot versus Bad Guy ‘Bot

THE SELF-DRIVING NETWORK: **GRAND POSSIBILITIES**

Super Bowl LX in 10 years

IT infrastructure orders and delivers itself, then self-organizes on-site

CONCLUSION



We have before us a compelling vision in networking, both meaningful and realizable

- Economic imperative: attack the biggest cost in networking – operations
- Efficiency imperative: spin up resources as needed and optimize their use
- Agility imperative: bring up new services quickly; predict, anticipate and adapt
- Security imperative: quickly diagnose, isolate and remove or mitigate threats

… and do this all with no human intervention

Let’s get to work: study, share data, research, prototype, standardize, iterate