The Internet of Cars

A Catalyst to Unlock Societal Benefits of Transportation

Andreas Mai
Director Product Management Smart Connected Vehicles

March 2013

Disruptive Innovation?

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A History of Connections

170 Years Ago:
Invention of the Telegraph

100 Years Ago:
Invention of the Radio

70 Years Ago:
First general purpose electronic computer

40 Years Ago:
First Internet connection

20 Years Ago:
World Wide Web

Intelligently Connecting People, Process, Data, and Things

2003:
0.5B Connected Devices

2005:
IP Traffic:
29 exabytes

2005:
First Smartphone

2008:
Video Traffic:
21 exabytes

2010:
0.5B Smartphones

2010:
7B Connected Devices

2011:
90M Smartmeters

2012:
25M Connected Cars

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The Evolution of the Internet

Business and Societal Impact

Connectivity

Digitize Access to Information

- Email
- Web Browser
- Search

Networked Economy

Digitize Business Process

- E-commerce
- Digital Supply Chain
- Collaboration

Immersive Experiences

Digitize Interactions (Business & Social)

- Social
- Mobility
- Cloud
- Video

Internet of Everything

Digitize the World

Connecting:

- People
- Process
- Data
- Things

Intelligent Connections

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Business Opportunity in an Evolving World

The Internet of Everything

Create and Expand New Markets and Services

Create Better Experiences to Build Better Relationships

Empower People/ Increase Efficiency

Deeper Insights for Greater Decision Making

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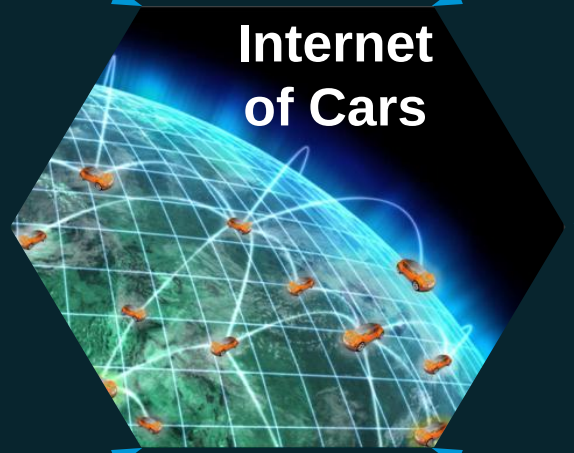
Trends Transforming Transportation

Smart

Intelligent Transportation

Networked

Pervasive Computing



Electric

Smart Grid

Source: Cisco IBSG Automotive 2011

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Many Connected Vehicle Profit Pools – Albeit Largely Disconnected, So Far…

Car Manufacturers

Navigation

TOMTOM GARMIN NAVTEQ

POI / LBS

AAA foursquare Cheap Gas!

Social Media

myspace a place for freedom twitter facebook

X-Mode Travel Assist

Tripit Organize your travel Expedia travelocity

Finance

Ford FordCredit TOYOTA FINANCIAL SERVICES CHRYSLER FINANCIAL

Infotainment

NETFLIX iTunes PANDORA

Productivity

skype Microsoft Office salesforce.com Success On Demand.

PAYD Insurance

MILEMETER AUTO INSURANCE BY THE MILE PAY HOW YOU DRIVE PROGRESSIVE

ITS Management

Songdo Songdo International Business District I ♥ NY MASDAR ABU DHABI FUTURE ENERGY COMPANY

Vehicle Telematics

ATX A Cross Country Automotive Services Company OnStar HUGHES TELEMATICS

Service Providers

verizon wireless at&t

Car Apps

Car Rental/Share

AVIS Hertz Budget

Road Pricing/VMT

OEM Car Care

BMW KIA

Aftermarket Car Care

DriverSide COSTCO WHOLESALE jiffy lube

Online Business

ebay amazon.com Google

Energy Producers

PG&E bp ExxonMobil

Road/Parking Ops

autostrada BECHTEL Cintra

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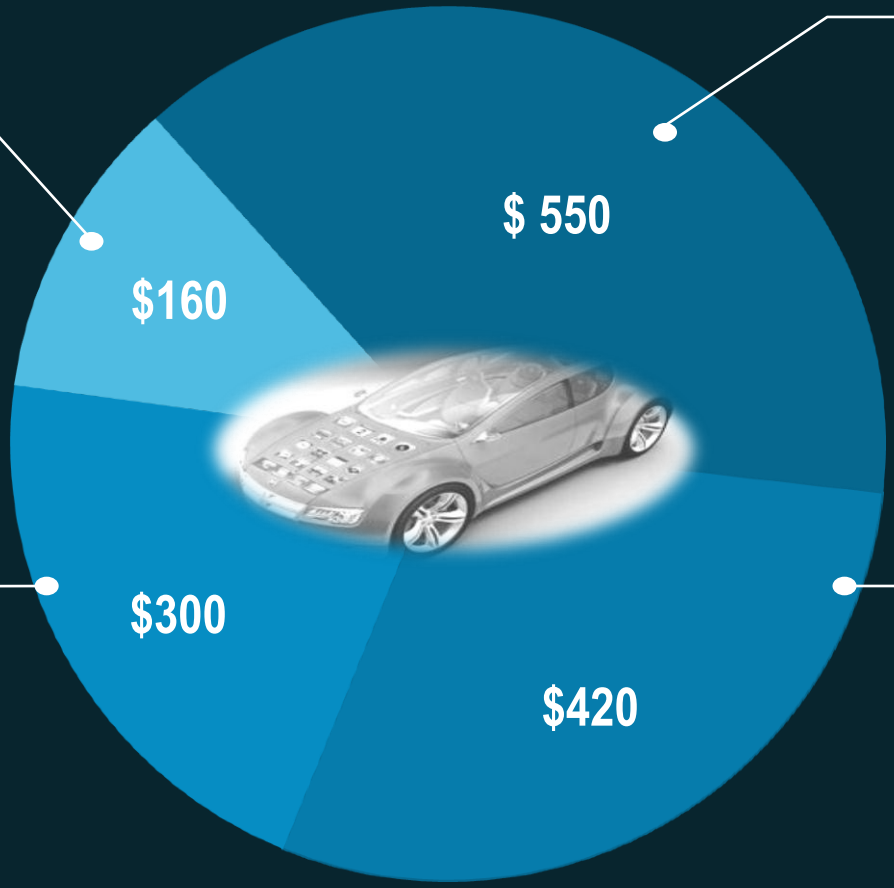
Internet of Cars: Unlocking $1,400 in Benefits per Vehicle, per Year

Internet of Cars Service Providers

- Traffic guidance, navigation, emergency services
- "Google on wheels," PAYD insurance, location-based services

Vehicle User

- Lower insurance
- Lower operation cost
- Less time stuck in traffic, more productivity



Auto OEM/OES

- Lower service/warranty costs
- New profit pools
- Architectural savings

Society

- Fewer crashes
- Lower traffic/road/toll operation costs
- CO^2 reduction

Benefits per vehicle, per year

Source: Cisco IBSG Automotive and Economics Practices, 2011

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The Internet Takes to the Road…

Transportation Services Delivered by Technology

Safety and Security	Operational Efficiency	Travel Experience	Revenue Generation

Source: Cisco IBSG Automotive, 2011

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Road to More Safety & Less Congestion Is Mainly Driven by Government Policy

Source: Cisco IBSG Automotive 2011

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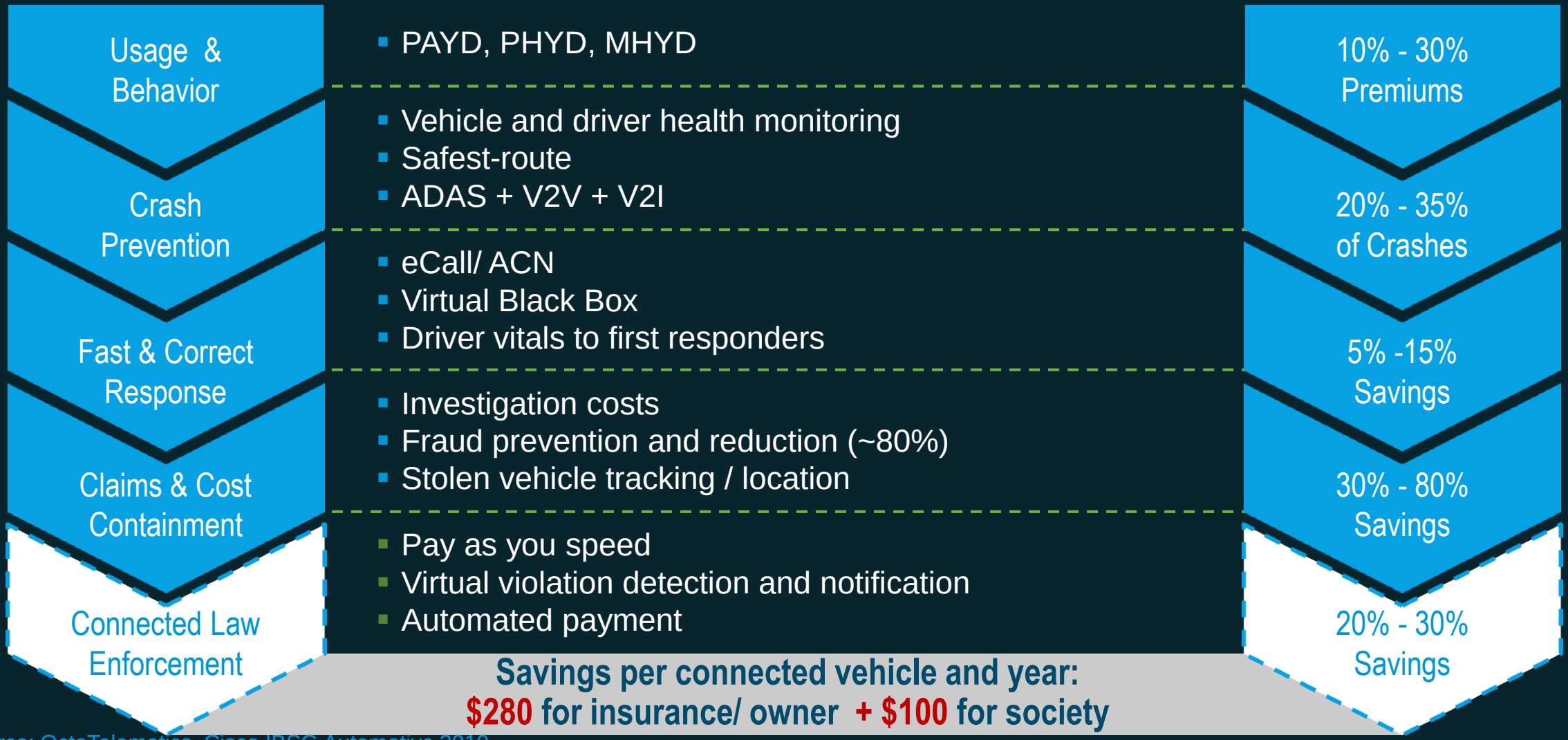
THE “Savior-App”: Strategic Asset for the Entire Car Insurance Value Chain



Source: OctoTelematics, Cisco IBSG Automotive 2010

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Marginal Return on U.S. Road "Business"

U.S. Roads:

4,000,000 Paved Road Miles

x $6,800,000 Price per Mile

= $27,000,000,000,000 Assets

$100,000,000,000 Fuel Tax + Tolls

= 0,4% Return on Assets

"Depreciated" over 250 Years

Source: An Analysis of the Current Investment Trend in the U.S. Toll Road Sector, MIT, 2008, Cisco IBSG Automotive 2011

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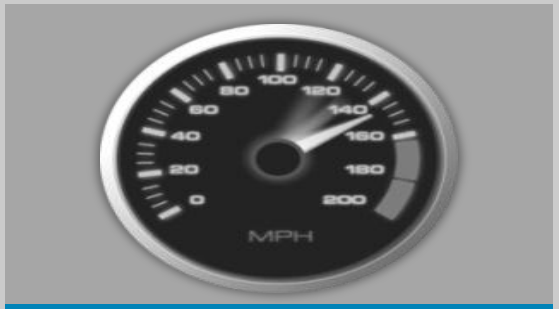
THE Future "Finance-Application": Connecting for Smart Road Pricing

Smart Road Pricing / Vehicle-Miles-Traveled Tax

Time of Day

Occupancy

Congestion



Speed

Weight

Road Type

Fuel Economy

Emissions

Source: Cisco IBSG Automotive 2011

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New Battleground:
From Building Cars to Selling Travel Time Well Spent

Connecting
the Value Chain

Extended Design and Supply Chain

GARMIN · CISCO · Google · INRIX

CONNECTED
within the car

CONNECTED
to personal devices

CONNECTED
around the car

CONNECTED
to the cloud

Marketing, Advertising, CRM

facebook · Auto Trader .com · cars.com · twitter

Travel Experience & Location-Based Services

aha · ZAGAT · Parking Carma · GROUPON

Distribution and Service Network

DentBetty · RepairPal Car Care Confidence · CarsDirect · DriverSide

Source: Cisco IBSG Automotive, 2011

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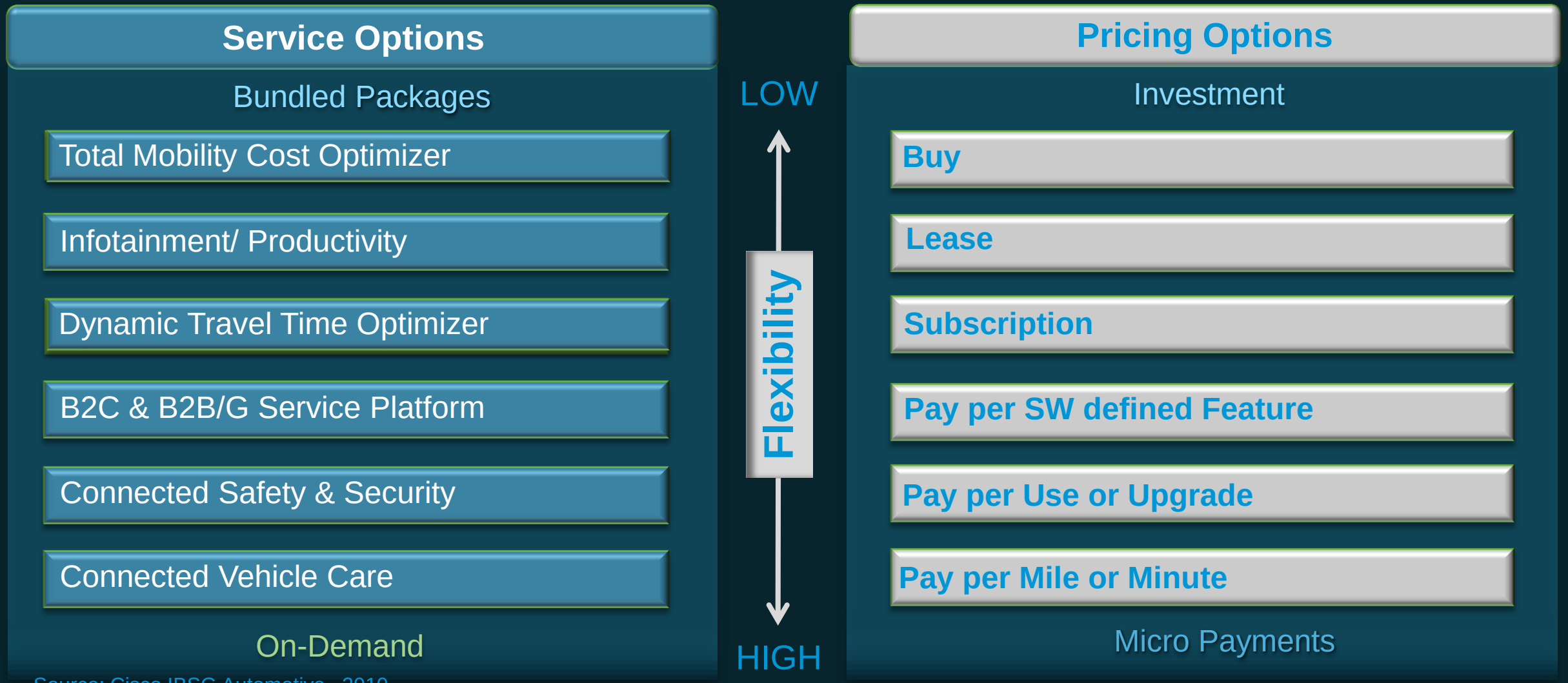
Connectivity Enables New Services and Pricing Models



Source: Cisco IBSG Automotive, 2010

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Emergence of New Business Models

Smart Parking

STREETLINE
Connecting the Real World

Parking Carma™

parking in motion
a smarter way to park

Parkmobile
PARKING MADE SIMPLE™

PARK Smart
New York City
New Rates = More Parking

Mobility On-Demand

zipcar

CAR2GO

CAR SHARING iGO

AUTOLIB'

GETAROUND

buzzcar

RelayRides
Neighbor-to-Neighbor Carsharing

CAR 2GETHER

iCarpool™

Hertz On Demand
Rent Spontaneously

Source: Web Research, 2011

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Smart Shared Vehicle Concept: Dynamic Incentives for Redistribution

$
High Demand +
Low Vehicle Stock
= Low **Drop-off Price**

$$$
High Demand +
Low Vehicle Stock
= High **Pick-up Price**

Trip Destination

Cheapest Trip Route

$$$
Low Demand +
High Vehicle Stock
= High **Drop-off Price**

?

$
Low Demand +
High Vehicle Stock
= Low **Pick-up price**

Trip Origin

Source: Kent Larson, MIT, Meeting of the Minds, Boulder 2011

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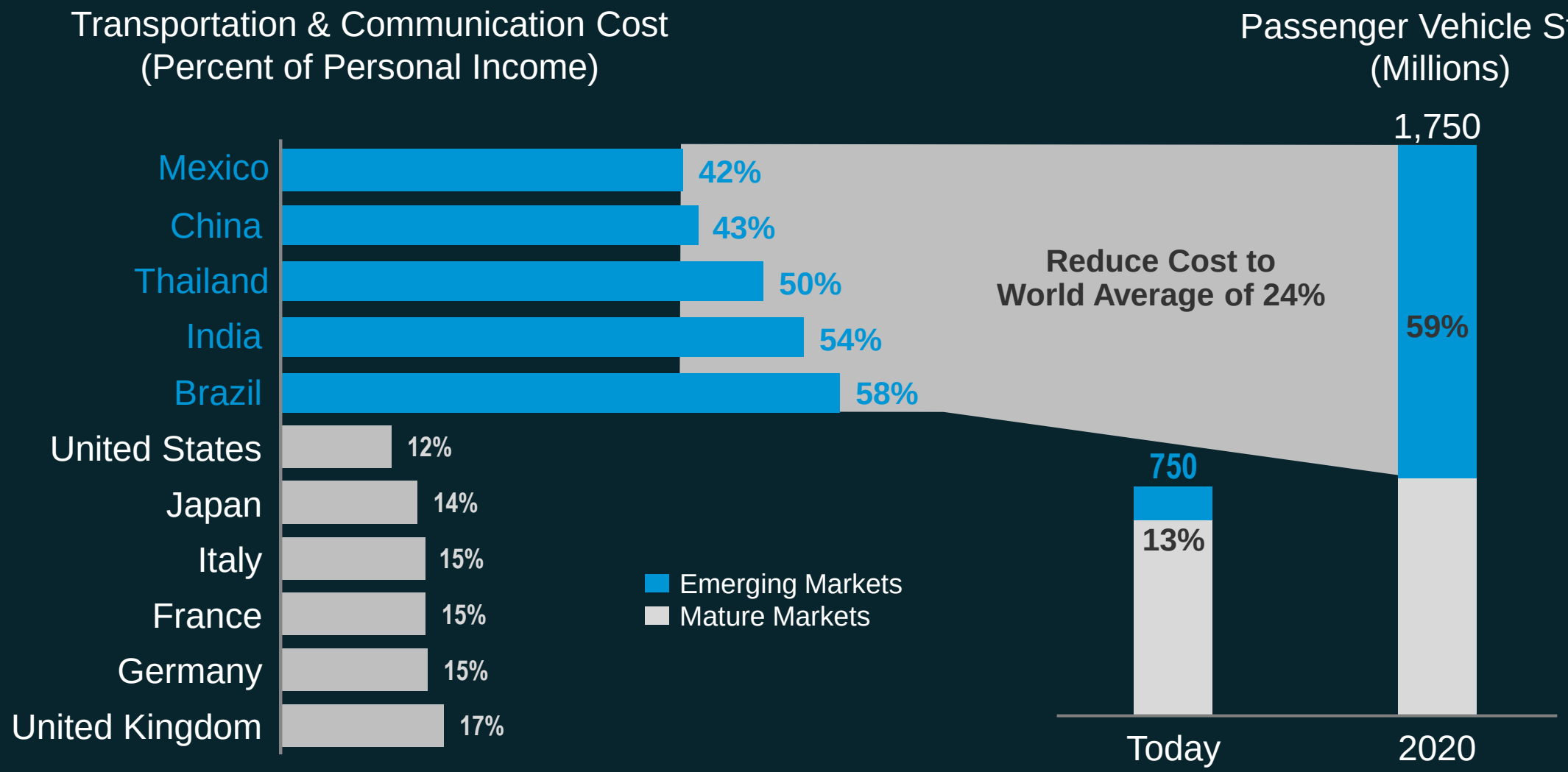
Making Mobility More Affordable for One Billion People



Source: EIU Data, Cisco IBSG Automotive 2010

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Internet of Cars = Better Experience = Key Growth Market for Service Providers

Pervasive Computing

Users

Grow the number of mobile revenue-generating subscriptions

Ubiquitous Connectivity

Artificial Intelligence

Uses

Find more things users can do with their mobile devices

M2M Network

Usage

Drive the frequency with which people use mobile data services

Source: Cisco IBSG 2011

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New Funding Models: Add Value and Enable New Vehicle & Travel Experiences

- Comes with car
- Basic plan for “free”
- Data & services for premium

Service Providers

verizon wireless · Sprint · at&t

- OBU paid via two-year plan
- “Kindle model”
- B2B co-funding
- Value added service kick-back

Navigation

GARMIN · TOMTOM · NAVTEQ

Infotainment

NETFLIX · iTunes · PANDORA

POI / LBS

foursquare · AAA · Cheap Gas!

- Pre-installed
- X months for free
- Click to purchase

Productivity

skype · Microsoft Office · salesforce.com Success On Demand

X-Mode Travel Assist

hotels.com · Tripit Organize your travel · Expedia

Online Business

Google · ebay · amazon.com

Social Media

facebook · loopt · twitter

Car Apps

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The Fuel of the Internet of Cars: "Big Data" Analytics and Prognostics

TSP

- Remote Diagnostics
- Connected vehicle care
- Navi + traffic

PAYD

- Driver behavior
- Driver vitals
- Vehicle vitals
- eCall/ ACN
- Virtual Black Box
- Vehicle recovery

EV Clearing

- Available station
- Reservation
- Charge amount
- Price + payment
- Smart grid data

ITS

- Cybernetic traffic management
- Crash prevention
- Smart road pricing

And more…

- Infotainment
- B2B/G service platform
- Smart LBS
- Meshed maps

"Big Data" (U.S. Estimates)

- 300 M vehicles
- 7,000+ variables
- 24,000 for EVs
- Per day/ second

- 100 M drivers
- 100 trips/ month
- 500+ variables
- Per second

- < 5 M EVs
- < 5 M homes
- < 400 k public CS
- 500+ variables
- Per minute

- 15-45 M on route
- 2.5 M traffic lights
- 2 M cameras
- Billions of sensors
- 100+ use cases
- 500+ var. each
- Per millisecond

- 300 M drivers / passengers
- 5 M enterprises
- 100+ use cases
- 100+ var. each
- Per second

Source: Cisco IBSG Automotive 2012

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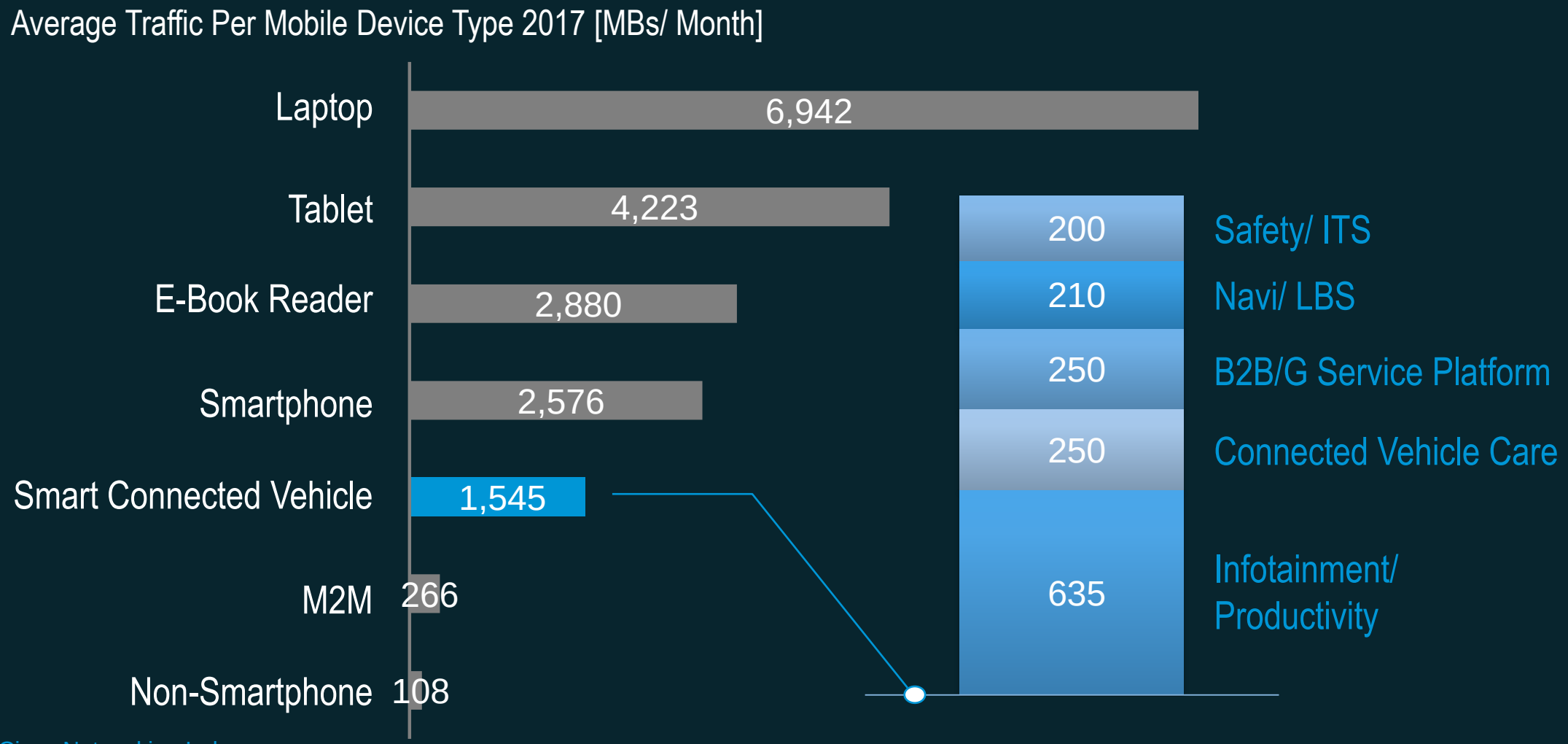
Future Connected Cars Expected to Drive 1.5 GB of Monthly Data Traffic



Source: Cisco Networking Index

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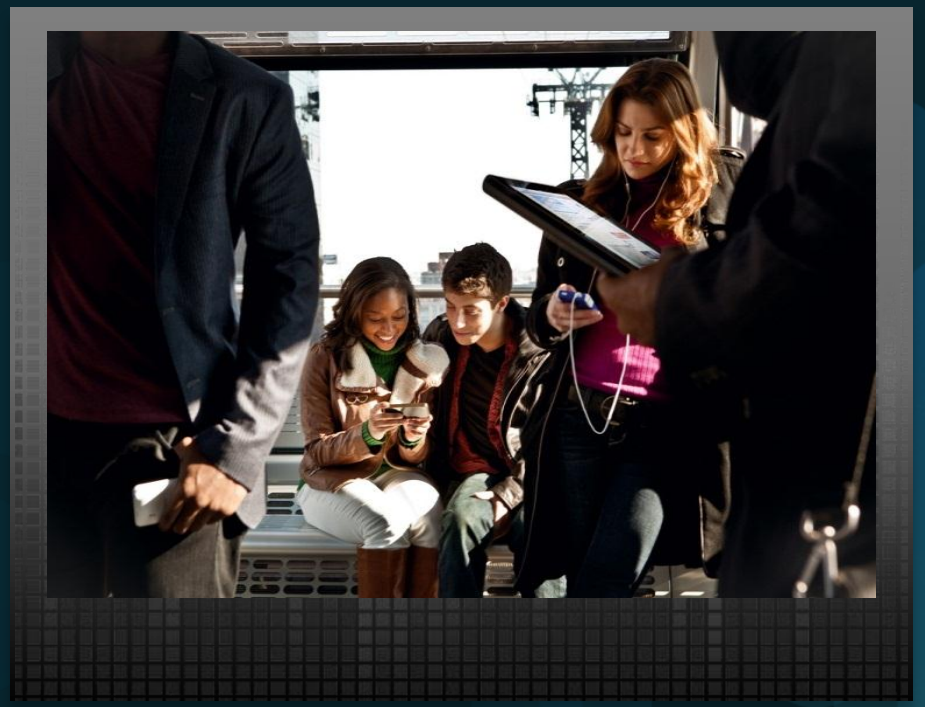
In one year, 2016 to 2017, the net amount of mobile data traffic added will be 4X the total amount generated in 2012.



Source: Cisco VNI Global Mobile Data Traffic Forecast, 2012–2017

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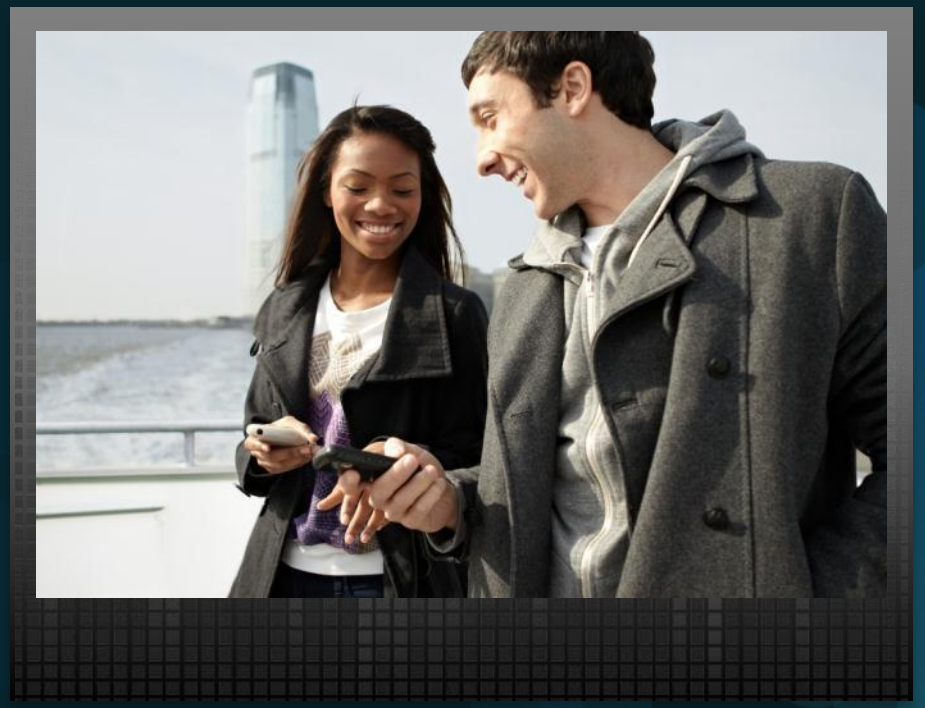
By 2017, global mobile data traffic will reach an annual run rate of 134 exabytes per year.



134 exabytes is equal to:

- 46 X all Mobile IP traffic generated in 2010
- 30 trillion images (e.g., MMS or Instagram)
- 3 trillion video clips (e.g., YouTube)

Source: Cisco VNI Global Mobile Data Traffic Forecast, 2012–2017

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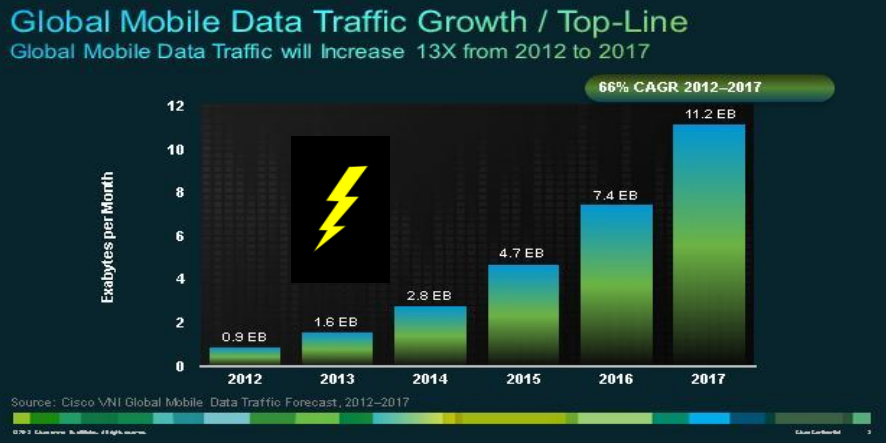
FCC Band Sharing Assessment is a Win-Win Opportunity for Wireless and ITS Community



500+ companies

Can 5 GHz band be shared without causing harmful interference to primary licensed users ITS?

FCC Technology Assessment:
Validate to the satisfaction of all stakeholders that Wi-Fi does not cause unacceptable interference to ITS operation

No

Spectrum is expected to remain exclusive to the primary licensed users

Yes

Foundation for innovation and faster deployment

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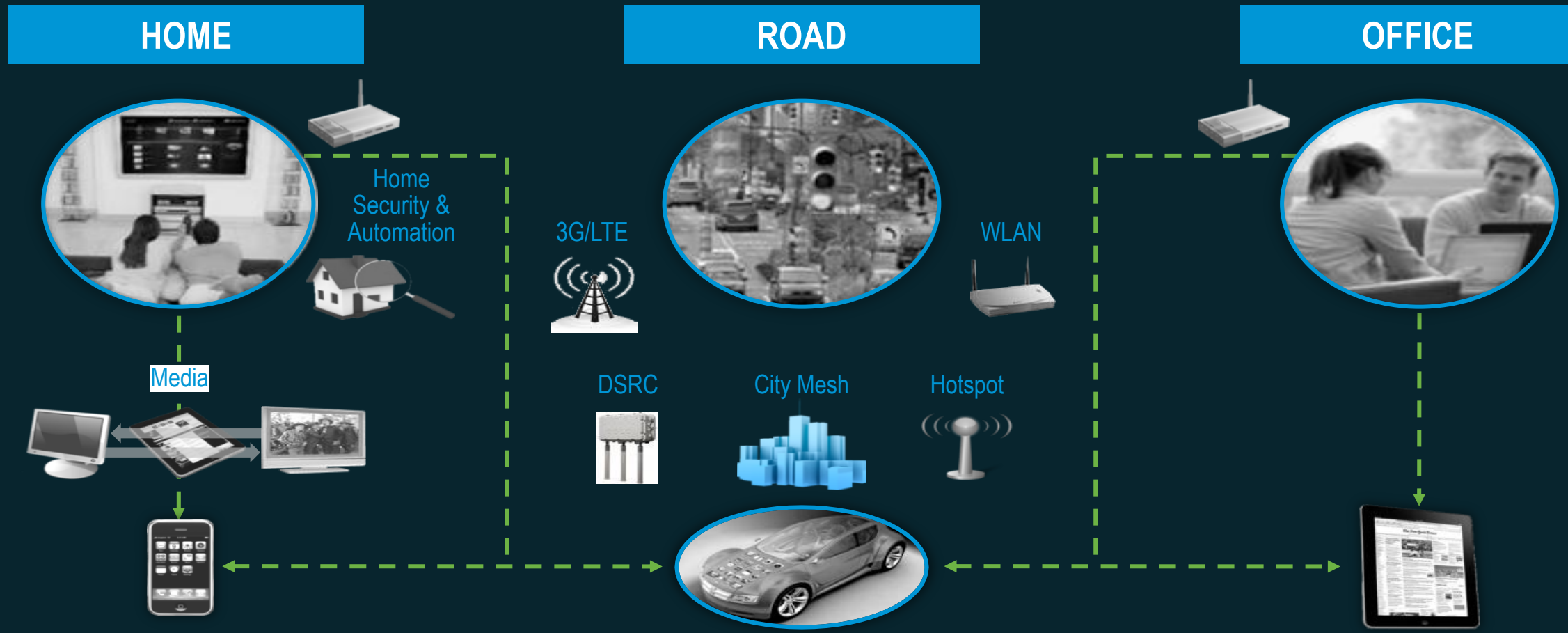
Off-Loading Data and Switching Is Key to Improve Experience and Contain Cost



Source: Cisco IBSG Automotive 2011

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How to Unlock the Societal Benefits of Intelligent Traffic Systems + Telematics?

ITS

Connects Vehicles & Roads

- V2X security requirement
- Smart road pricing/ VMT
- Better traffic management
- Better road management

=

- Less crashes
- Less congestion
- Less fuel and pollution
- Compensate fuel tax erosion

Enterprise Grade Network

Telematics

Connects Vehicles

- Connected safety & security
- Connected vehicle care
- B2B/G service platform/ PAYD
- Dynamic navigation/ LBS
- Infotainment/ productivity

=

- Better Crash “Safety”
- Better user experience
- Higher profitability

Government Lead

Private Sector Lead

Source: Cisco IBSG Automotive, 2011

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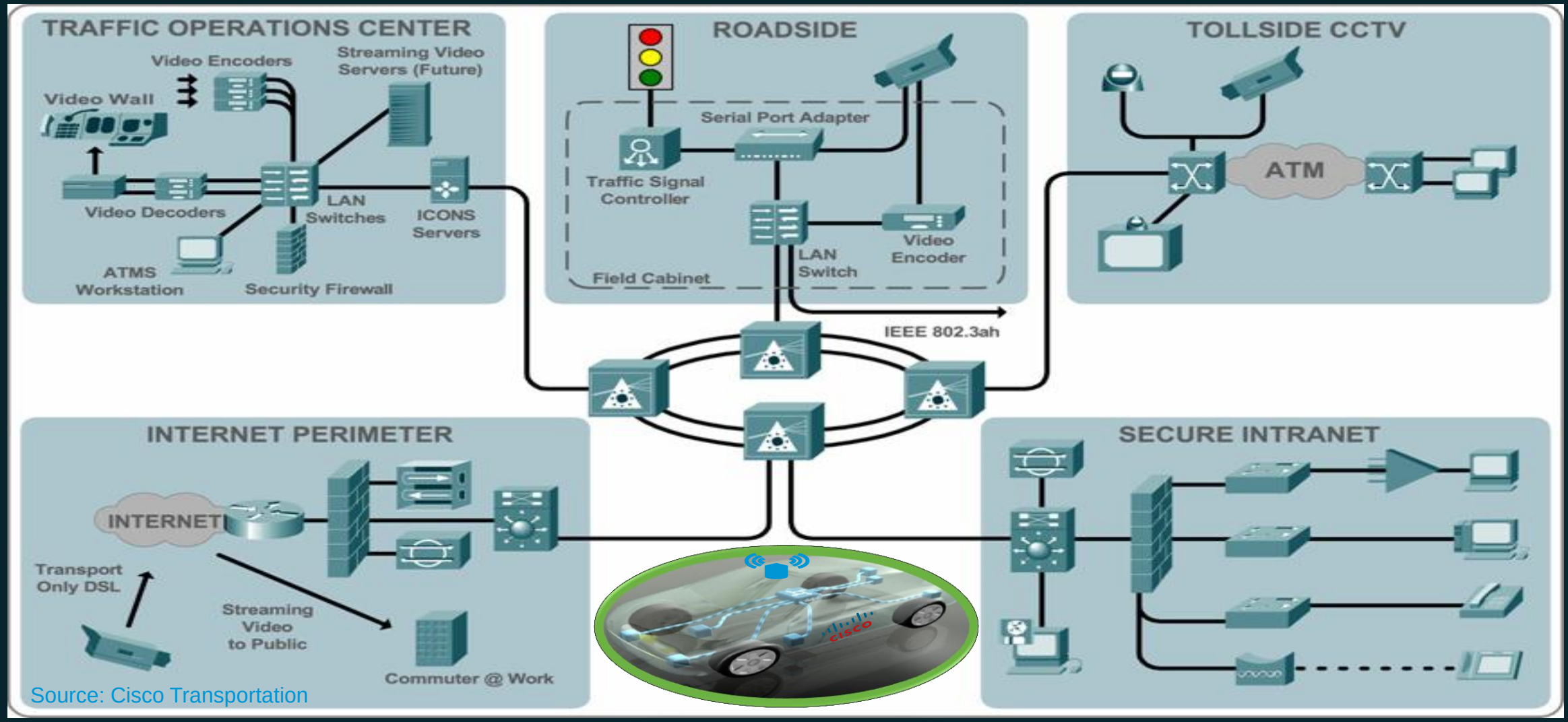
Enterprise Grade Network is the Platform for the ITS Architecture



Source: Cisco Transportation

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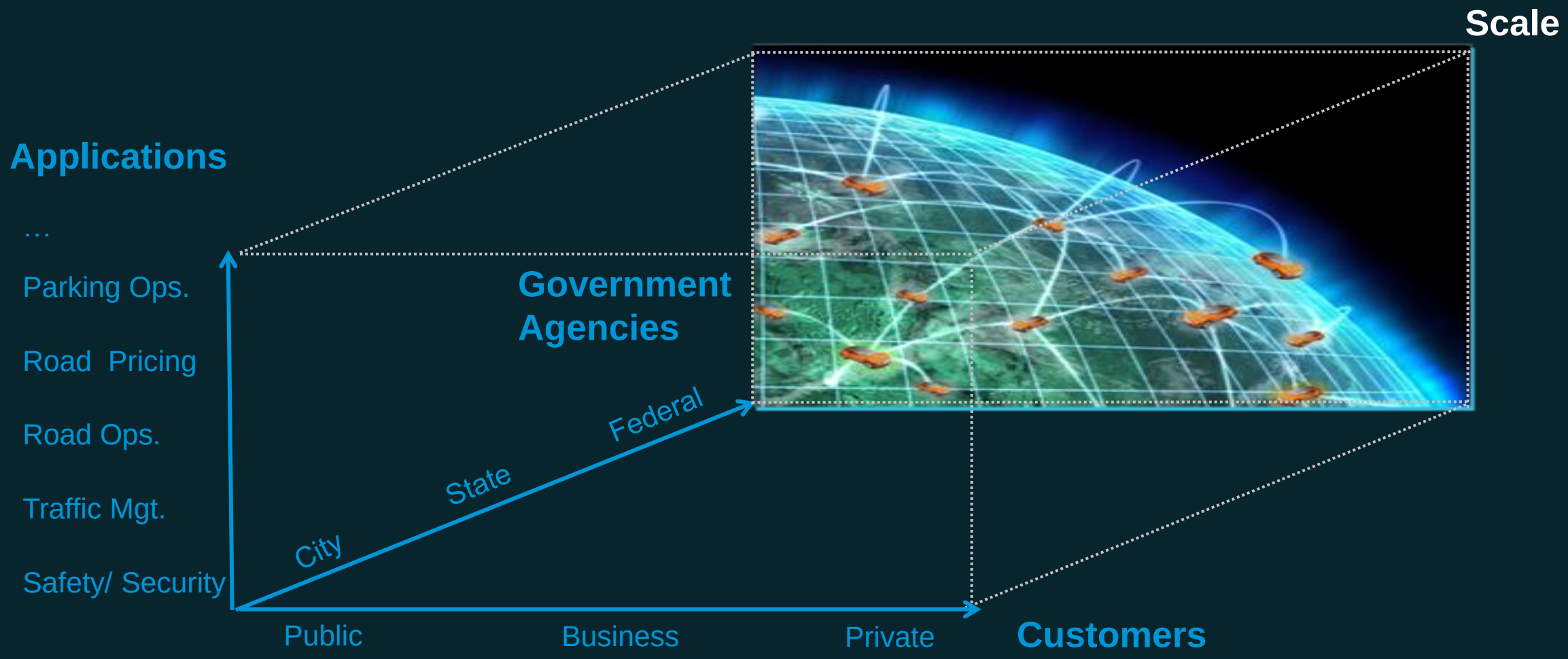
Internet of Cars is a Scale Business …



Source: Cisco Smart Connected Vehicles Team, 2013

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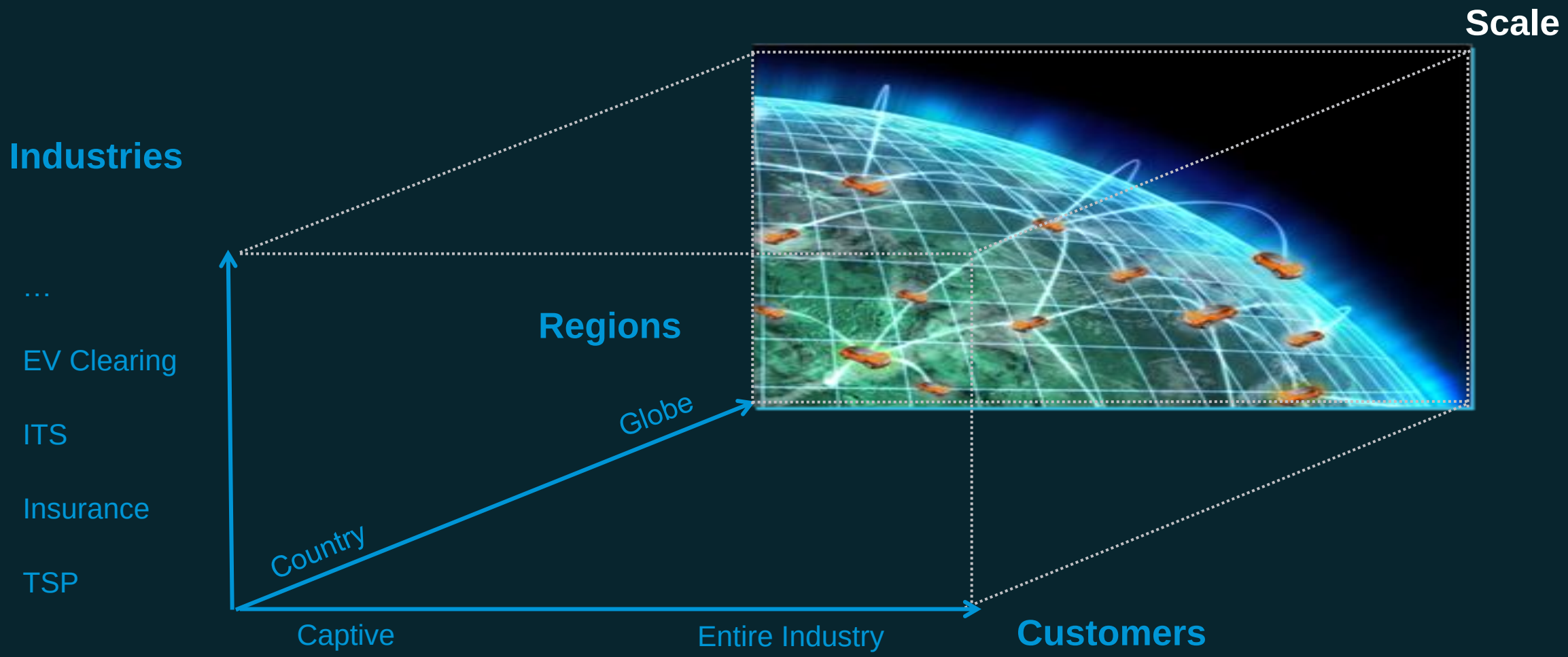
… Especially as a Globally Competitive Business



Source: Cisco Smart Connected Vehicles Team, 2013

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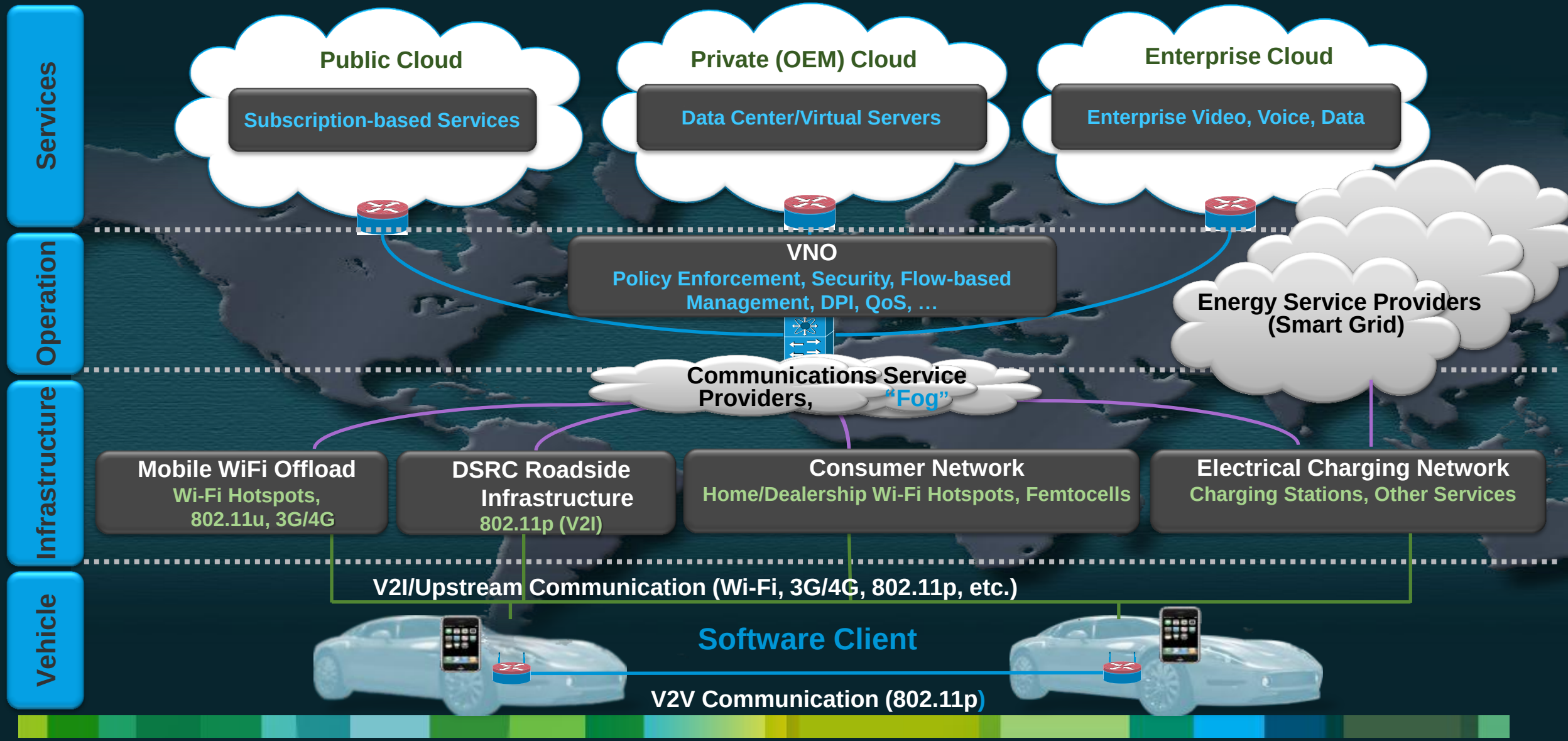
Cisco's Role: End-to-End Architecture is Essential

– Especially for Scaling Globally



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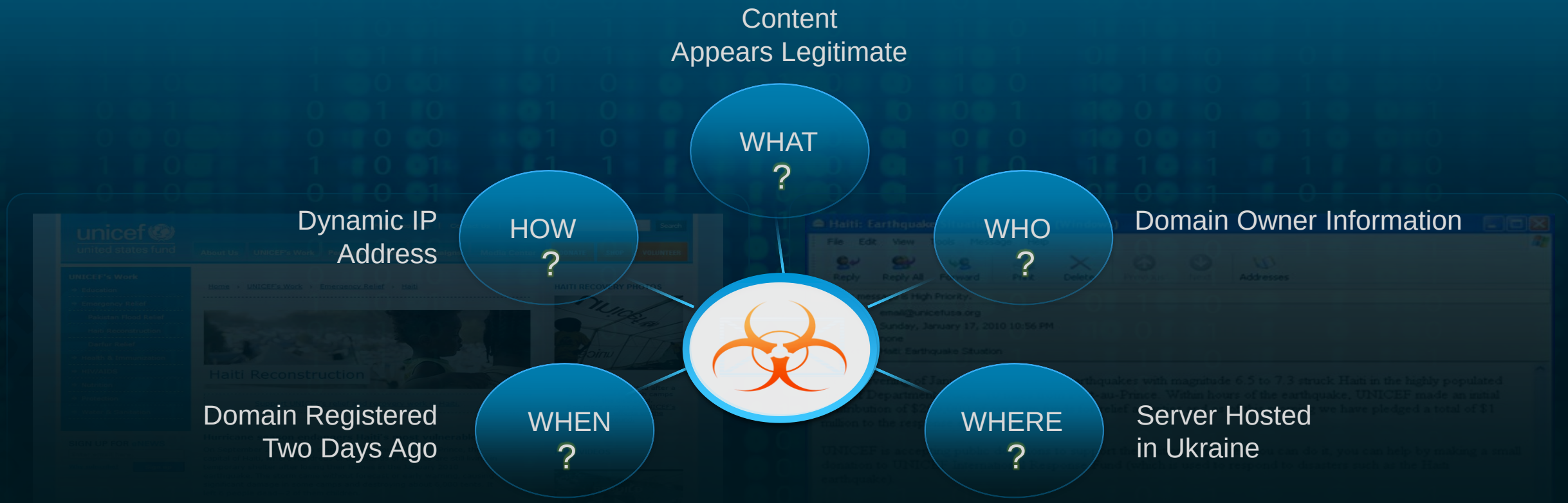
Content
Appears Legitimate
WHAT
?
HOW
?
Dynamic IP
Address
WHO
?
Domain Owner Information
WHEN
?
Domain Registered
Two Days Ago
WHERE
?
Server Hosted
in Ukraine

CONTEXT

cisco
SIO
1 TB
DATA RECEIVED PER DAY
700,000+
GLOBALLY DEPLOYED DEVICES
30B
WEB REQUESTS
HTTP://
100M
EMAIL MESSAGES
35%
WORLDWIDE TRAFFIC
SensorBase
Threat Operations Center
Dynamic Updates

Global Context: Data Makes a Difference

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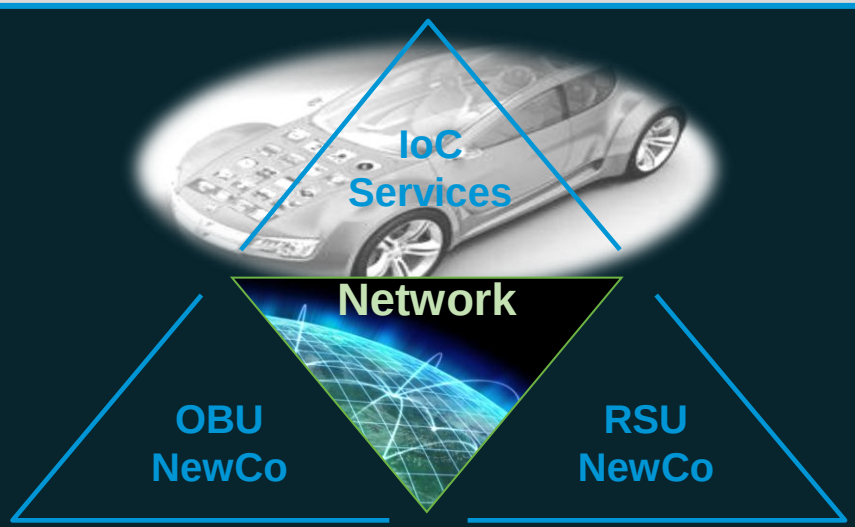
New OBU and RSU Business Models: Enabling Internet of Cars Services



Subsidize OBU Upgrade For Right to Monetize Data & CV Services

Source: Cisco Smart Connected Vehicles Team, 2012

Build & Operate WiFi + DSRC Network to Monetize Off-Load and ITS & LBS Services

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The Connectivity Infrastructure Could be a Profitable Business at 1/10th ¢ / VMT

U.S. Roadside Equipment (RSE)
PPP Revenue Model [US$ Million]

	CapEx	P&L
Initial Total 5 Year RSE Investment (10 Depr.)	6,261	626
Repair/ Replacement	616	62
Operating Expenses		440
Subtotal RSE Cost		**1,128**
Hypothetical Margin	100%	1,128
Revenue Required to Fund "RSE Business"		**2,256**

=

~3,000,000,000,000

Per Month

Source: Vehicle-Infrastructure Integration (VII) Initiative, Benefit-Cost Analysis, Version 2.3, US-DOT, 2008 Cisco IBSG Automotive, 2011

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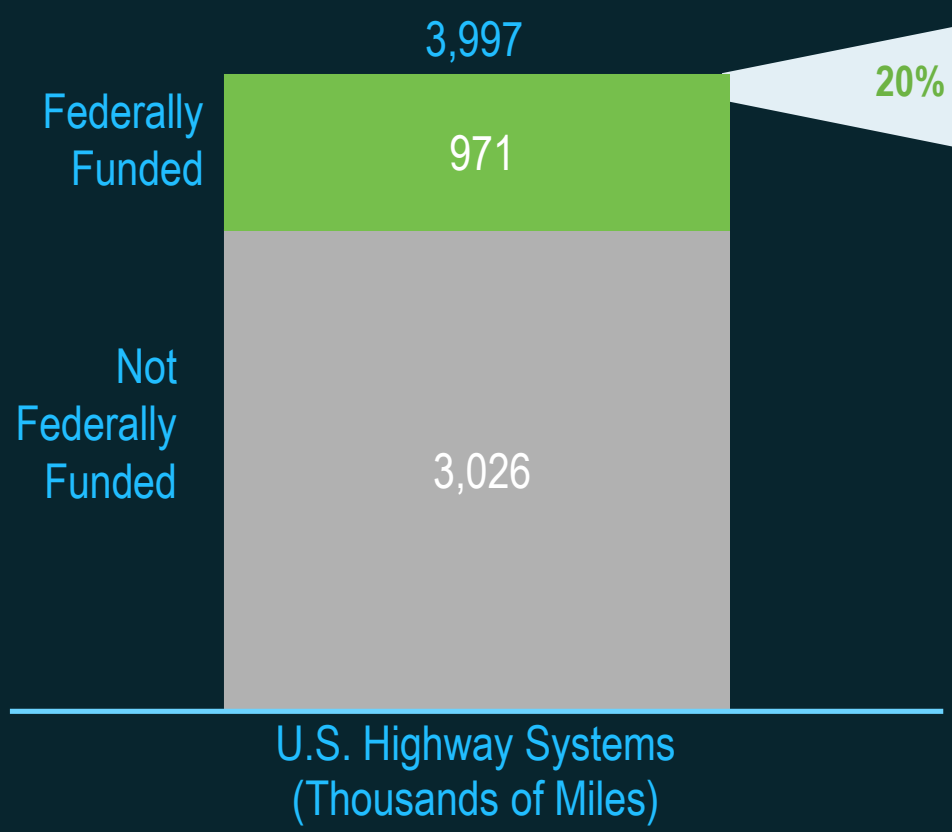
20% Privatization of Federal Aid Highway System = $ 1.3 Trillion Value

Tolling and Privatization Scenario for U.S. Highway System



20% Toll PPP 189,000 Miles x $6.8M[1] per Mile = $1.3 Trillion

Select Top 20% by Priority:

- High Congestion
- High Crash
- High Repair

[1] Weighted average of price paid in Europe

Source: An Analysis of the Current Investment Trend in the US Toll Road Sector, MIT, 2008, Cisco IBSG Automotive 2011

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Connecting the Mobility Value Chain: New Business Model Opportunities

Integrate…

Transform… → Develop | Source | Make | Sell | Deliver | Service

- **Vehicle**
- **Energy**
- **Service Provider**
- **Infrastructure**
- **ITS**
- **New Services**

Source: Cisco Smart Connected Vehicle 2013

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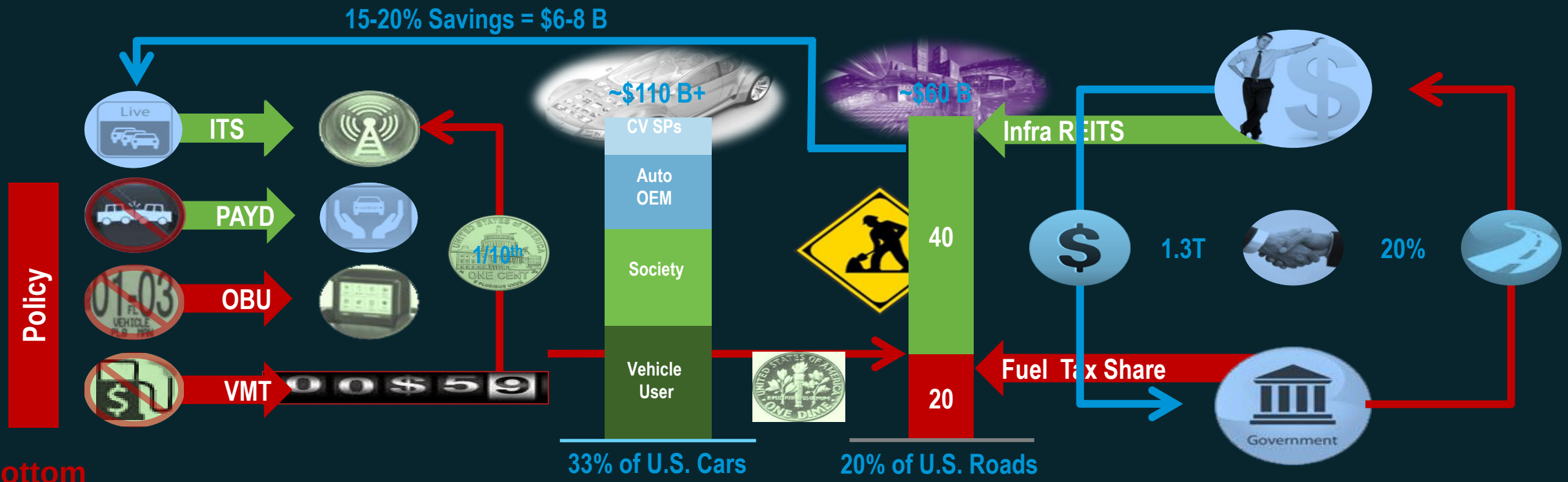
Food For Thought…



Bottom Line

550,000 Jobs

$20-30B

↓ U.S. Budget

Source: Cisco IBSG Automotive 2012

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Making the Internet of Cars a Business

Together We Can…

Automotive

Government

Service Provider

Infrastructure

Insurance

ITS

Source: Cisco Smart Connected Vehicle Team 2012

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Thank you.

TOMORROW starts here.

More Food for Thought on the "Internet of Cars"

- **Executive Summary:** A Business Case For Connecting Vehicles
- **Government:** A Catalyst to Unlock Societal Benefits of Transportation
- **Carriers:** Service Providers at a Crossroads
- **Automotive:** From Building Cars to Selling Travel Time Well-Spent
- **Insurance:** The Business of Preventing Crashes

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