



Telematics: Status & Future Perspectives

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- Telematics Overview
- Technology Trends
- Market Opportunities
- Telematics Summary

Telematics Definition/Segmentations

Telematics is solutions based on information flowing to and/or from a vehicle

	Segmentation	Comments
Auto-Centric	<ul style="list-style-type: none"> • Auto solutions 	<ul style="list-style-type: none"> • Pays for itself-eventually
Customer-Centric	<ul style="list-style-type: none"> • Driver/passenger solutions 	<ul style="list-style-type: none"> • Meets customer needs
Service-Centric	<ul style="list-style-type: none"> • Monitored telematics 	<ul style="list-style-type: none"> • OEM supplied (OnStar)
Device-Centric	<ul style="list-style-type: none"> • Non-monitored telematics 	<ul style="list-style-type: none"> • Aftermarket supplied
Application-Centric	<ul style="list-style-type: none"> • Safety and security • Navigation & traffic • Cell phone HFI • Entertainment • Tracking applications • Auto solutions 	<ul style="list-style-type: none"> • ACN, e-call, b-call • Real-time routing • Docking, Bluetooth • Music/video download • Location, speed, SVT • Diagnostic, SW upgrades

Telematics: Two Overlapping Worlds

Auto OEM Telematics

- Auto & OEM focus
- Connection to ECUs
- Remote diagnostics/upgrades
- Cost savings/avoidance
- Productivity/operational gains
- Compliance with mandates
- Lower society's auto crash cost

Customer Telematics

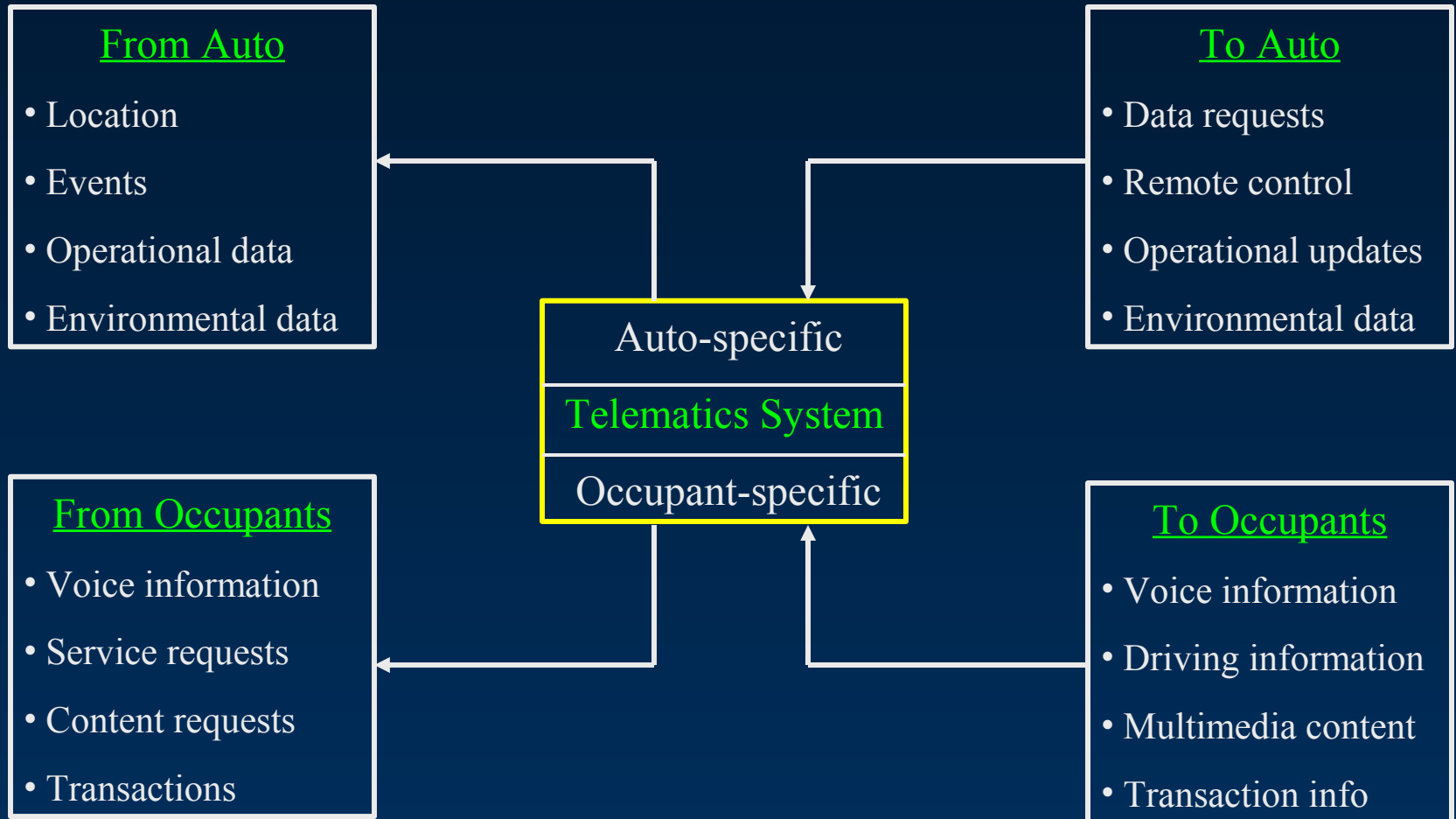
- Driver & passenger focus
- Connection to outside world
- Connection to mobile device
- Safety & security applications
- Navigation applications
- Entertainment applications
- Tracking applications

Telematics is solutions based on information
flowing to and/or from a vehicle

Auto & Customer Telematics

	Auto Telematics	Customer Telematics
Long-Term Goals	<ul style="list-style-type: none"> • Competitive advantage • Secure link to auto ECUs • Business process change agent 	<ul style="list-style-type: none"> • Meet customer demands for: • Communication & content • Appeal to cell phone generation
Apps & Solutions	<ul style="list-style-type: none"> • Remote diagnostics • Data mining & prognostics • ECU software corrections & upgrades 	<ul style="list-style-type: none"> • Mobile device integration • Real-time navigation • Personal & office content access
Advantages	<ul style="list-style-type: none"> • Driver telematics can be done • Eventually pays for itself • Customer cost savings & convenience • Improved CRM 	<ul style="list-style-type: none"> • Low start-up costs • New revenue opportunities
Drawbacks	<ul style="list-style-type: none"> • High start-up costs & long ROI • System complexity 	<ul style="list-style-type: none"> • Auto telematics is difficult • Auto telematics is limited
Summary	<ul style="list-style-type: none"> • Needed by large OEMs by 2010 • Required by all OEMs by 2015 • “A 6-Sigma program after sales” 	<ul style="list-style-type: none"> • Required by all OEMs by 2010 • Expected by SMS/IM generation • Is this enough versus OnStar?

Information Flowing to/from Auto



Telematics is solutions based on information flowing to and/or from a vehicle

Telematics Application Spectrum

Segment	Wireless Data
Navigation	<ul style="list-style-type: none">• Traffic & weather information• Off-board navigation routes• Map & Point Of Interest (POI) updates
Hands-Free Phone Use	<ul style="list-style-type: none">• Voice communication, text messages & email
Safety & Security	<ul style="list-style-type: none">• GPS location, speed & direction• Automatic collision notification, E-call, B-call
Stolen Auto Tracking	<ul style="list-style-type: none">• GPS tracking, speed & direction
Content Retrieval	<ul style="list-style-type: none">• Email, web content & location-based (POI)
Entertainment	<ul style="list-style-type: none">• Digital music & digital video downloads
ITS Applications	<ul style="list-style-type: none">• Electronic Toll Collection data (ETC)• Roadway to auto communication (future)
Auto Electronics	<ul style="list-style-type: none">• Remote diagnostics & Software upgrades• Auto operational data• Crash data & statistics (Event Data Recorder)

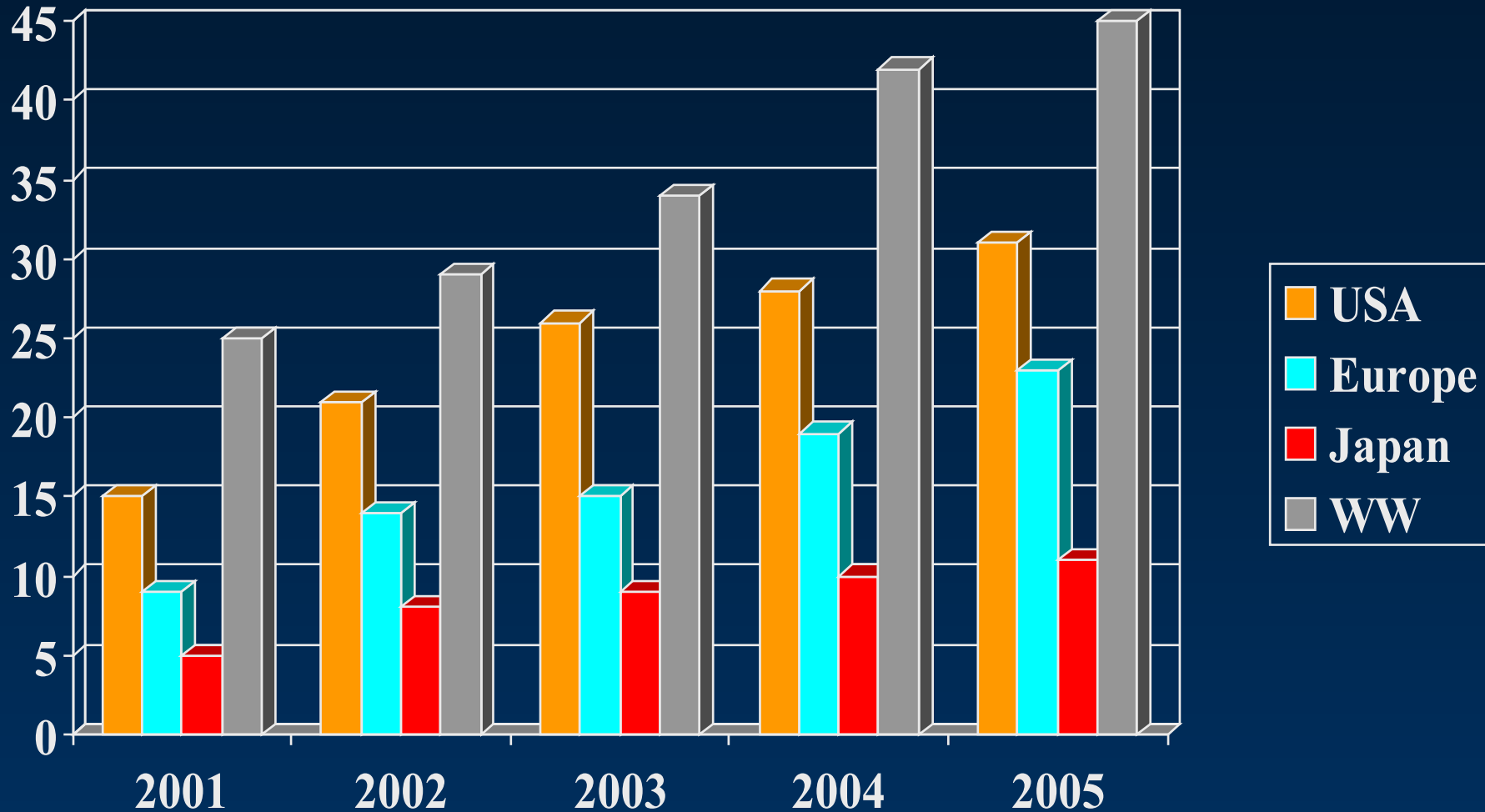
Telematics Approaches

Approach	Features	Advantages	Comments
Cell Phone Centric	<ul style="list-style-type: none"> • Hands-free IF • Speech recognition • IF to radio 	<ul style="list-style-type: none"> • Customer need • Low cost solution • Rapid intro 	<ul style="list-style-type: none"> • Strong aftermkt • May be mandate • Bluetooth growth
Navigation Centric	<ul style="list-style-type: none"> • Navi w/traffic info • Cell phone HFI 	<ul style="list-style-type: none"> • Customer need • Time/cost savings 	<ul style="list-style-type: none"> • Costly solution • PND emerging
Safety & Security	<ul style="list-style-type: none"> • Monitored services • ACN & concierge 	<ul style="list-style-type: none"> • Save lives & cost • Piece of mind 	<ul style="list-style-type: none"> • Big investment • Long payoff
Auto Centric	<ul style="list-style-type: none"> • Remote diagnostics • Software upgrades 	<ul style="list-style-type: none"> • Cost savings • Pays for itself 	<ul style="list-style-type: none"> • Often with safety/security
GPS Tracking	<ul style="list-style-type: none"> • Location tracking • Many applications 	<ul style="list-style-type: none"> • Cost savings • Productivity gain 	<ul style="list-style-type: none"> • Commercial TM • For fleet ops

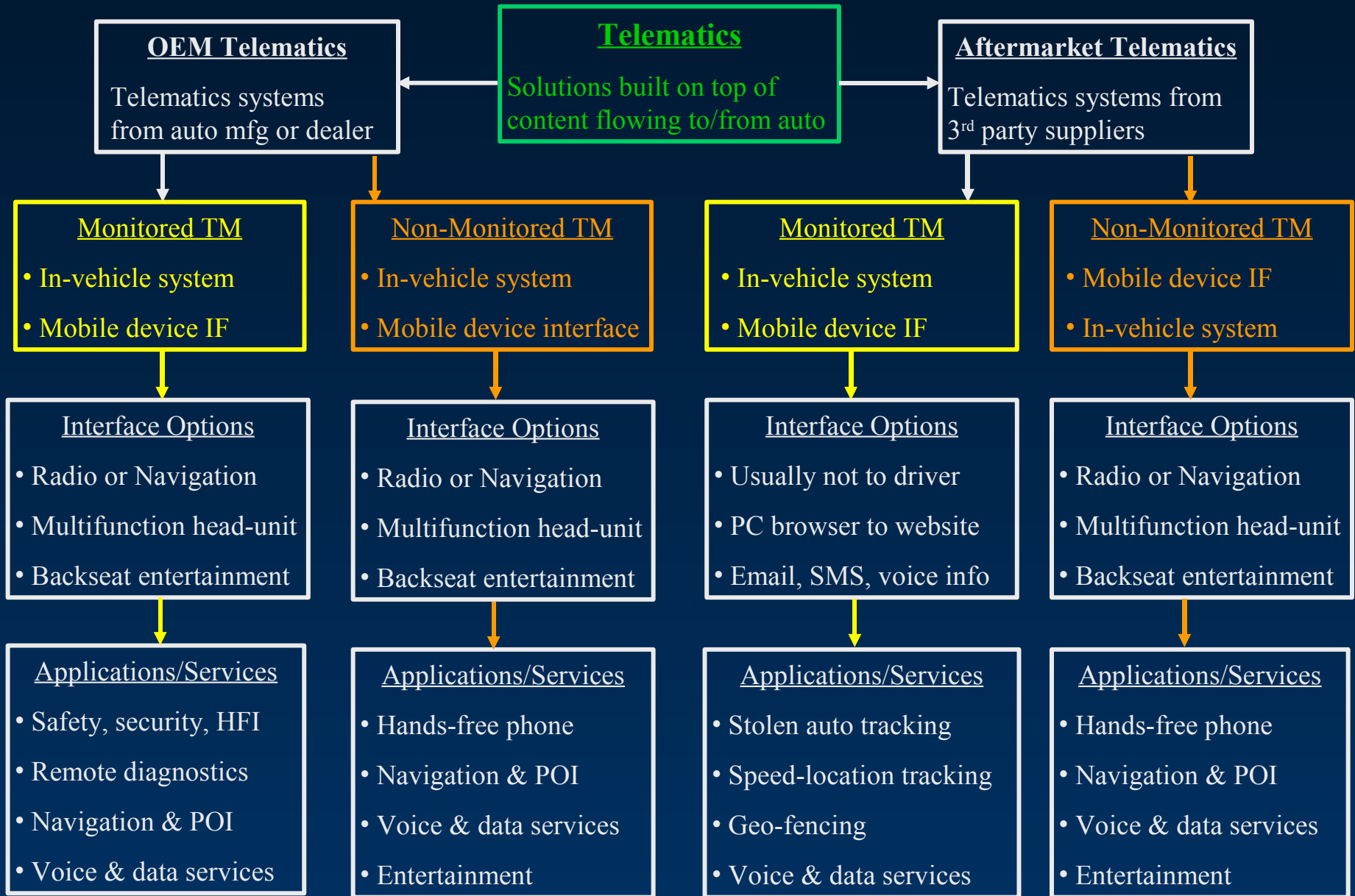
Telematics Applications by Countries

	Approach	Leaders	Others
USA	<ul style="list-style-type: none"> • Safety/Security • Cell phone HFI • Navigation • Auto centric 	<ul style="list-style-type: none"> • OnStar: S/S, AC, CP HFI • BMW: CP HFI, S/S, navi • M-B: CP HFI, navi, S/S • Honda: Navi S/S, CP HFI 	<ul style="list-style-type: none"> • Chrysler: CP HFI, navi • Toyota: Navi, CP HFI • Ford: CP HFI, navi • Nissan: Navi, CP HFI
Europe	<ul style="list-style-type: none"> • Cell phone HFI • Navigation/traffic • Infotainment • Safety/Security 	<ul style="list-style-type: none"> • BMW: S/S, navi, CP HFI • M-B: Navi, CP HFI • PSA: CP HFI, navi • Fiat: CP HFI, navi, S/S 	<ul style="list-style-type: none"> • GM: CP HFI, navi • Volvo: CP HFI, navi, S/S • Toyota: CP HFI, navi • VW: CP HFI, navi
Japan	<ul style="list-style-type: none"> • Navigation/traffic • Cell phone HFI • Infotainment 	<ul style="list-style-type: none"> • Honda: Navi, CP HFI • Nissan: Navi, CP HFI • Toyota: Navi, CP HFI 	<ul style="list-style-type: none"> • BMW: Navi, CP HFI • Mazda: Navi, CP HFI • M-B: Navi, CP HFI
Korea	<ul style="list-style-type: none"> • Cell phone HFI • Navigation/traffic • Safety/Security 	<ul style="list-style-type: none"> • SK NATE: Navi, CP HFI • Mozen: S/S, CP HFI, navi 	<ul style="list-style-type: none"> • LG Ez Drive: Navi, CP HFI • EverWay: S/S, CP HFI, navi
Others	<ul style="list-style-type: none"> • Cell phone HFI • Navigation 	<ul style="list-style-type: none"> • K-Ways: Navi, CP HFI • European luxury brands • Other luxury brands 	<ul style="list-style-type: none"> • R.S.INS: S/S, CP HFI, navi • Australia: Holden, Toyota • Taiwan: Nissan

OEM Telematics Availability



Telematics Categories



Telematics In Key Countries

	Approach	Leaders	Others
USA	<ul style="list-style-type: none"> • OEM monitored • OEM non-mon • Aftmkt non-mon • Aftmkt monitored 	<ul style="list-style-type: none"> • OnStar: Monitored • BMW: Mon & non-mon • M-B: Mon & non-mon • Honda: Mon & non-mon 	<ul style="list-style-type: none"> • Chrysler: Non-monitored • Toyota: Mon & non-mon • Ford: Non-monitored • Nissan: Non-monitored
Europe	<ul style="list-style-type: none"> • Aftmkt non-mon • OEM non-mon • OEM monitored • Aftmkt monitored 	<ul style="list-style-type: none"> • BMW: Mon & non-mon • M-B: Non-mon • PSA: Mon & non-mon • Fiat: Mon & non-mon 	<ul style="list-style-type: none"> • GM: Non-monitored • Volvo: Mon & non-mon • Toyota: Mon & non-mon • VW: Mon & non-mon
Japan	<ul style="list-style-type: none"> • OEM monitored • OEM non-mon • Aftmkt non-mon 	<ul style="list-style-type: none"> • Honda InterNavi • Nissan CarWings • Toyota G-Book 	<ul style="list-style-type: none"> • BMW: Mon & non-mon • Mazda: Mon & non-mon • M-B: Non-monitored
Korea	<ul style="list-style-type: none"> • Aftmkt monitored • OEM non-mon • OEM monitored 	<ul style="list-style-type: none"> • SK NATE Drive: AM* • Hyundai/Kia Mozen-AM • K-Ways: Aftmkt mon 	<ul style="list-style-type: none"> • LG Ez Drive: Aftmkt mon • SsangYong: KTF EverWay • Renault-Samsung INS
Others	<ul style="list-style-type: none"> • Aftmkt non-mon • OEM non-mon 	<ul style="list-style-type: none"> • European luxury brands • Other luxury brands 	<ul style="list-style-type: none"> • Australia: Holden, Toyota • Taiwan-Nissan

*AM=Aftermarket monitored

Telematics Regional Differences

- Telematics customers and applications have major regional variations that are driven by geographic, social and technology adoption differences
 - Population and auto density (units per square Km)
 - Navigation and routing complexity
 - Cell phone adoption rate & auto usage restrictions
 - Multi-country travel (multiple languages)
 - Auto purchase patterns (dealer lot or customer order)
 - Auto manufacturers' strategy and home market
 - Average auto price
 - Other: mass transit, road tolls, traffic information

Telematics Business Models

	Characteristics	Comments
Auto Solutions Network ROI	<ul style="list-style-type: none"> • Large investment • Operational cost savings • New capabilities 	<ul style="list-style-type: none"> • Operational data • Remote diagnostics • Software upgrades
Customer Solutions Equipment purchase	<ul style="list-style-type: none"> • Crash mitigation/savings • Cost/time/stress savings • Convenience/enjoyment 	<ul style="list-style-type: none"> • Safety & security • Cell phone HFI • Navigation & infotainment
Content Solutions Pay-per-use/Subscrip.	<ul style="list-style-type: none"> • Driving-related • Personal content • Office/work content 	<ul style="list-style-type: none"> • TM service providers • Cellular service providers • Other service providers
Data Value Data access fees/disc.	<ul style="list-style-type: none"> • Driver owns data • Value to 3rd parties 	<ul style="list-style-type: none"> • Insurance & Gov orgs • First responders
Mandate Required use	<ul style="list-style-type: none"> • Economy of scale • Rapid deployment 	<ul style="list-style-type: none"> • Tight deadlines

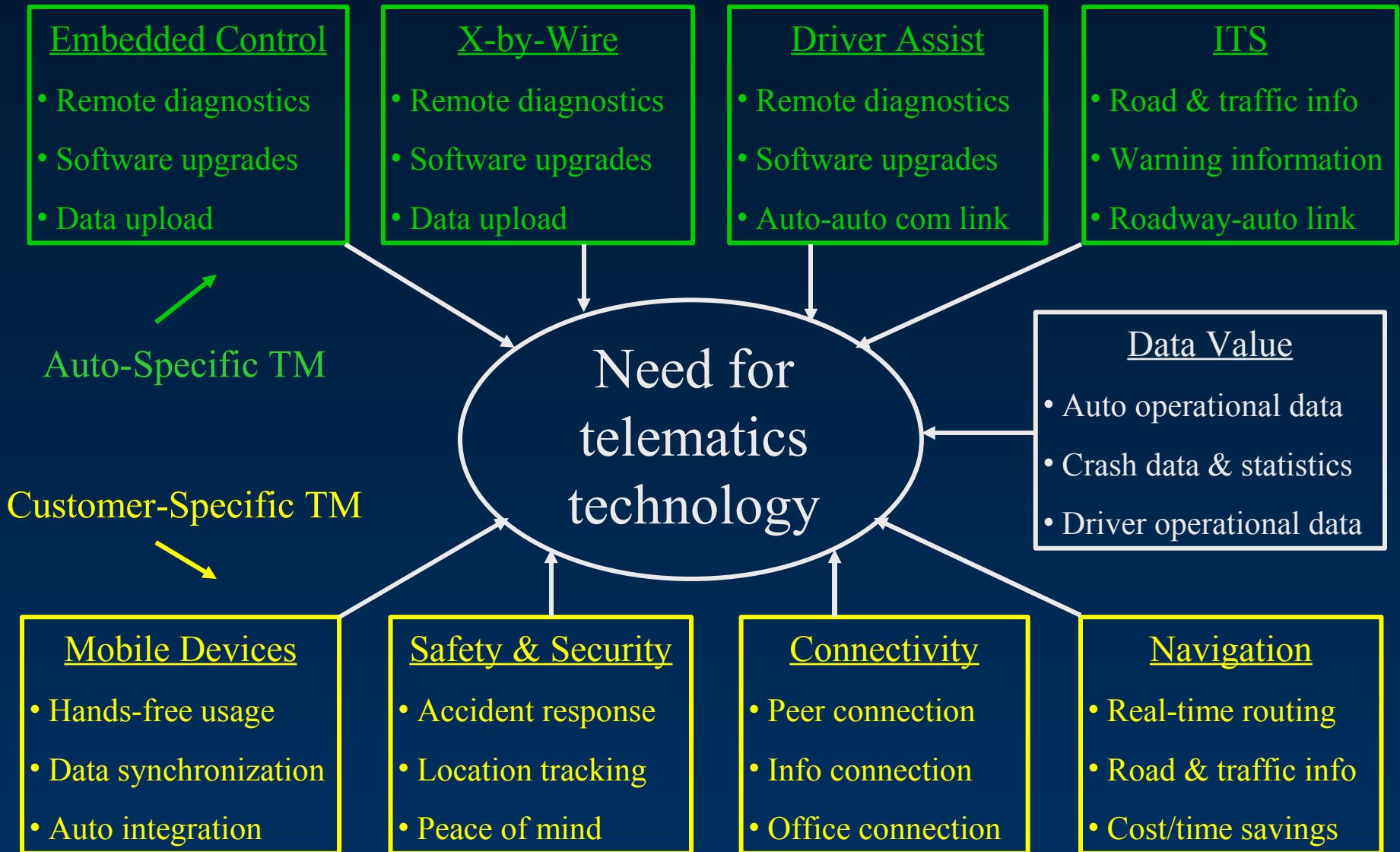


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Telematics Technology Needs



Semiconductor Impact on Telematics

<p>TCU Microprocessor</p>	<ul style="list-style-type: none"> • Lag high-end PC microprocessor performance by 4-6 years • Current TCU MPU has performance of 1999 Pentium 4 (500 MHz) • 2007 TCU MPU will have performance of 2002 Pentium 4 (1+ GHz) • 2010 TCU MPU will have performance of 2005 PC MPU (3+ GHz)
<p>Embedded Microprocessor</p>	<ul style="list-style-type: none"> • High-end embedded MPUs will be used for intelligent vehicle systems • Mid-range embedded MPUs for engine, power train and X-by-wire control • Low-end embedded MPUs for many controller tasks
<p>Communications, DSP & Sensors</p>	<ul style="list-style-type: none"> • Cell phone, Bluetooth & Wi-Fi will go from multi-chip to single chip by 2005 • Camera, radar & infrared chips will follow wedge: lower cost, increasing speed • DSP is a MPU for processing digital data representations of analog signals • DSPs will be important for every TM, X-by-wire & intelligent vehicle systems
<p>Micro Electro Mechanical Systems (MEMS)</p>	<ul style="list-style-type: none"> • MEMS sensors will lower cost, improve reliability and increase capabilities • MEMS accelerometer (air-bag deployment), MEMS gyroscope (navigation) • MEMS pressure sensor (tire monitoring), MEMS mirrors (HUD projection) • MEMS pitch and roll sensors (active suspension systems)
<p>System On Chip (SOC)</p>	<ul style="list-style-type: none"> • Combines MPU, DSP, memory, sensors and other functions on single chip • SOC will decrease TM and related systems dramatically in the next decade • SOC will increase capabilities of low-cost telematics and related systems

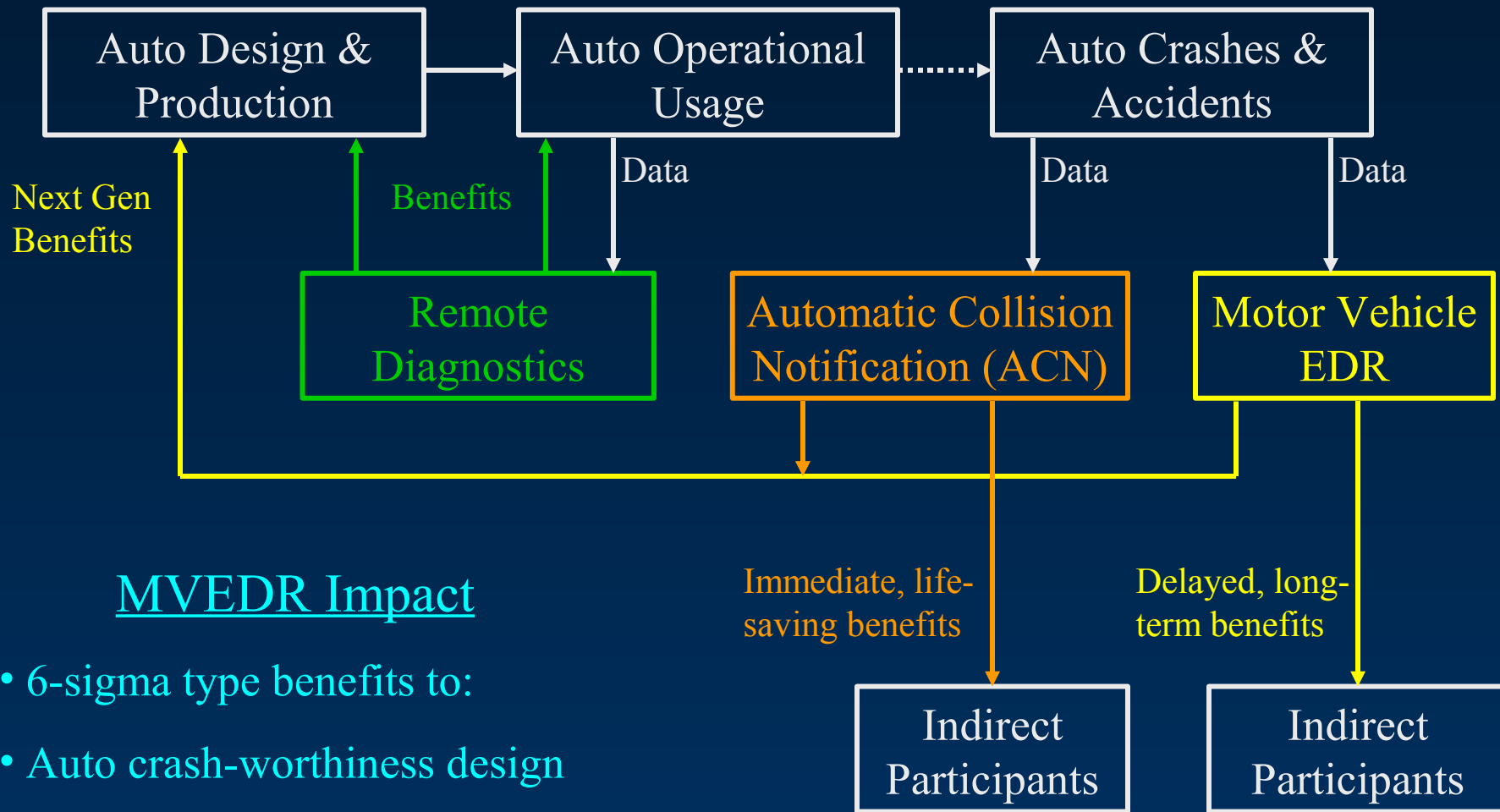
Telematics and Wireless Technology

	Technology	Type	Comments
Cellular Networks	<ul style="list-style-type: none"> • 1G-Circuit switched • 2G- Circuit switched • 2G-Packet network • 2.5G-Packet network • 3G-Packet network • WiMax 	<ul style="list-style-type: none"> • Analog • Digital • Always-on • Always-on • Always-on • Always-on 	<ul style="list-style-type: none"> • U.S. analog phase out in 2007 • GSM-TDMA-PDC & CDMA • One success network: i-mode • GRPS, EDGE, CDMA-1X • W-CDMA & CDMA2000-EV-DO • Fixed wireless in 2006, Mobile 2008
Short Range Wireless	<ul style="list-style-type: none"> • Bluetooth • Infrared (IrDa) • IEEE 802.11b (Wi-Fi) • IEEE 802.11a • DSRC (based on 11.b) • Ultra Wideband (UWB) 	<ul style="list-style-type: none"> • Near broadband • Line of sight • Broadband • Broadband • Broadband • Broadband 	<ul style="list-style-type: none"> • Peer-to-peer network • On all PDAs, some PCs, handsets • Wireless LAN • Wireless LAN • Dedicated to ITS & telematics • Emerging versatile technology
Broadcast	<ul style="list-style-type: none"> • FM Radio • Digital Audio Broadcast • Digital Radio Mondiale • In-Band On-Channel • SDARS 	<ul style="list-style-type: none"> • Sideband • Digital FM • Digital AM • Digital AM/FM • Satellite Radio 	<ul style="list-style-type: none"> • Used for a variety of applications • DAB is used Europe & Canada • DRM is emerging ITU standard • IBOC or HD Radio is for USA market • 2 U.S. systems: XM and Sirius
Other	<ul style="list-style-type: none"> • Global Positioning 	<ul style="list-style-type: none"> • Satellite 	<ul style="list-style-type: none"> • GPS, Galileo, GLONASS (Russia)

Telematics I/O Technologies

Type	Function	Technology	Comments
Displays	<ul style="list-style-type: none"> • Driving information • TM system info • Convenience info 	<ul style="list-style-type: none"> • Active matrix LCD • Organic LED/EL • Vacuum fluorescent 	<ul style="list-style-type: none"> • Small safety-related displays needed in front of driver • Larger TM displays needed for convenience applications
Head-Up Display	<ul style="list-style-type: none"> • Projects driving info on front windshield 	<ul style="list-style-type: none"> • LCD & image source • Scanning Photonic System 	<ul style="list-style-type: none"> • HUD needs imaging source and a projection device
Speech I/O	<ul style="list-style-type: none"> • Driver commands • Content reading • Warning & alerts 	<ul style="list-style-type: none"> • Speech recognition SW • Text-to-speech SW • Pre-recorded speech 	<ul style="list-style-type: none"> • Hands-free issues are making speech technology very important for telematics
Input Control	<ul style="list-style-type: none"> • Driver selection of functions & options 	<ul style="list-style-type: none"> • Multifunction switches • Haptic controls 	<ul style="list-style-type: none"> • Multifunction controllers are controversial due to learning time
Biometric	<ul style="list-style-type: none"> • Driver identification by comparison to pre-recorded pattern 	<ul style="list-style-type: none"> • Finger print • Voice recognition • Face or eye recognition 	<ul style="list-style-type: none"> • Finger print technology is most viable for telematics applications • Face recognition emerging

Importance of Auto Telematics Data





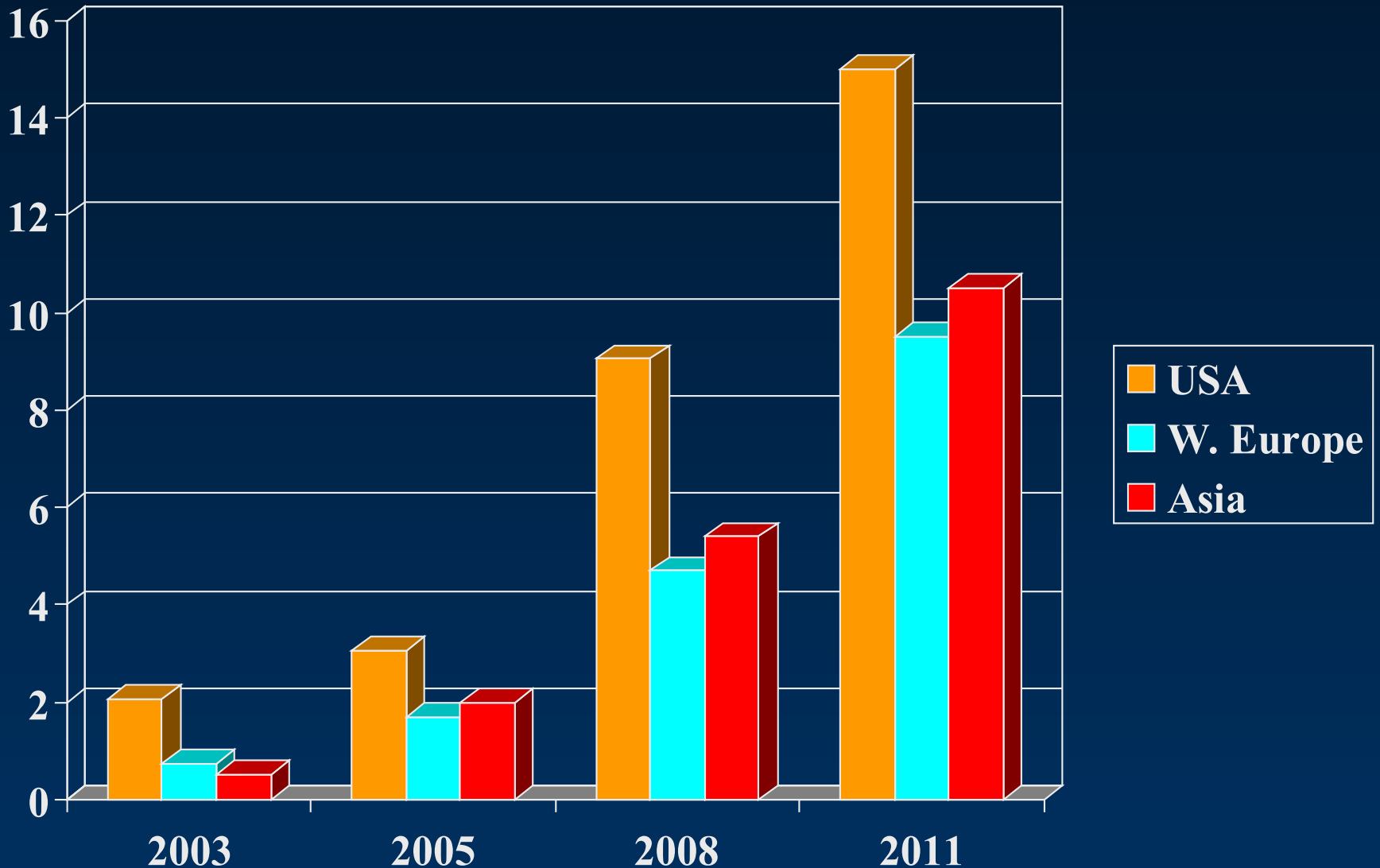
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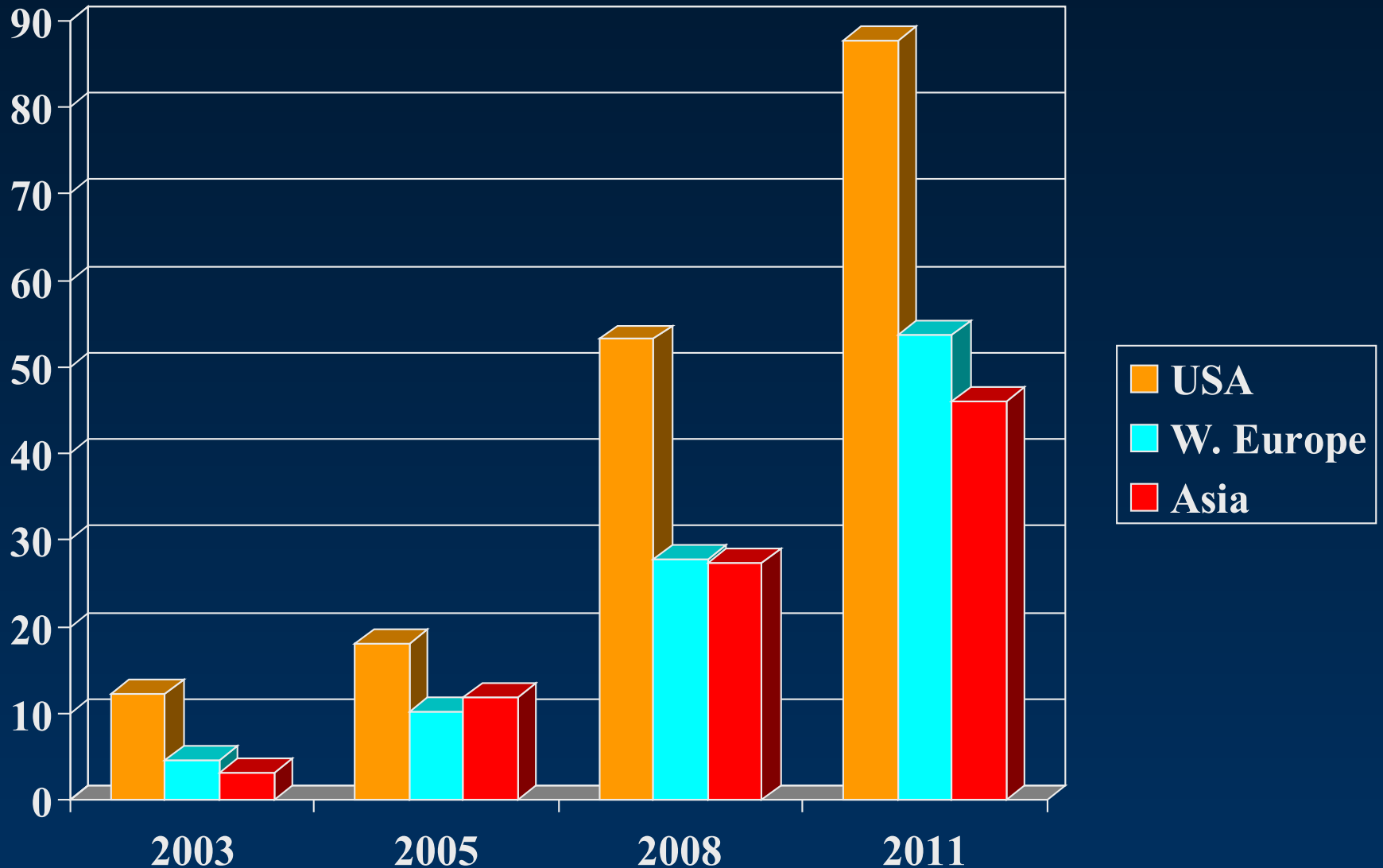
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Telematics System Sales

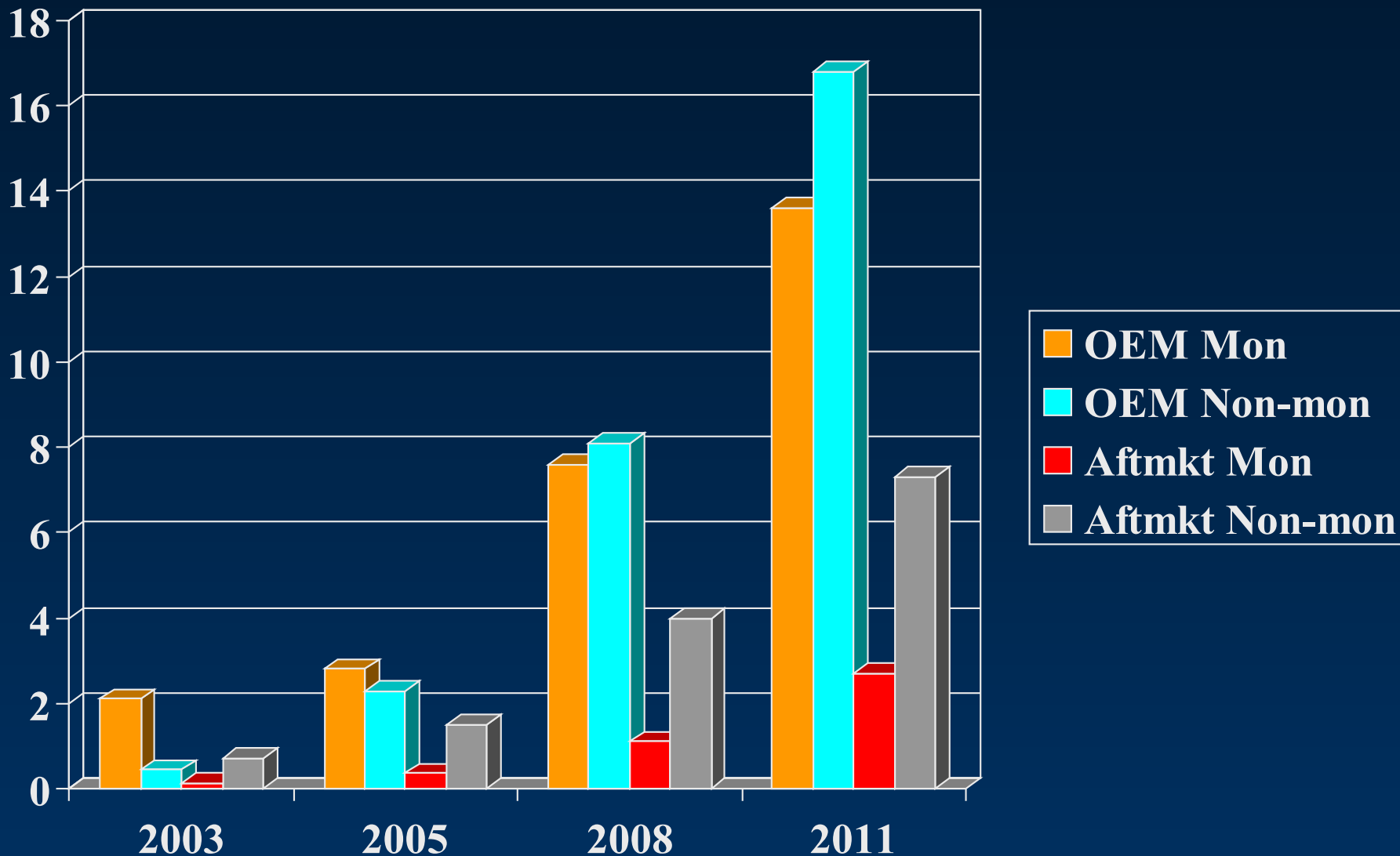
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% Telematics System Attach Rate



#M WW Telematics Segment Sales





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Telematics Segments

Devices:
2M to 50M
per year

In-Vehicle Telematics

- Safety & security TM
- Navigation TM
- Mobile device integration TM
- Entertainment TM
- Tracking TM

Devices: 10M
to 500M per
year

Personal Telematics

- Cell phone users
- Hands-free operation
- Emerging applications
- Entertainment & info
- Location-based services

Overlap

- Technology
- Systems
- Applications

Commercial Telematics

Light truck fleets

- Mobile workforce mgmt

Heavy truck fleets

- Asset tracking & mgmt
- Cost reduction/avoidance
- Efficiency & productivity

Overlap

- Technology
- Mobile devices
- Applications

Commercial Telematics Perspectives

Telematics Software Applications

Productivity Improvement

- Driver communication
- Customer communication
- Compliance communication
- Voice and data

Asset Tracking

- Equipment
- Goods
- Compliance
- Driver

Telematics Hardware Platforms

Homeland Security

- Security management
- Compliance reporting
- Problem detection
- Hazardous goods tracking
- Geo-fencing

Cost Savings

- Equipment performance
- Preventive maintenance
- Breakdown prediction
- Unnecessary usage

Communication Tech

- Satellite
- 2.5/3G Cellular
- Short-range (Wi-Fi & others)

Tracking Tech

- GPS technology
- Cellular networks
- Satellite networks

Telematics: Technology Discontinuity?

- Telematics technology increases functionality
 - Impact on X-by-wire & embedded auto electronics
 - Impact on driver assist systems & ITS networks
- Telematics hastens OEMs' need for core competency in software and computer technology
 - Which OEMs will win the race for this competency?
- Technology discontinuities create market change
 - Which OEMs will gain market share?
 - Which OEMs will lose market share?

TRG's Telematics Scenario

- TRG believes that by 2015-2025 (region-dependent) most autos sold will have 2+ communication links
 - An embedded link to OEM for auto-related telematics applications
 - The OEM link may be used for driver/passenger applications
 - A mobile device integrated or embedded link to content from service providers
 - An embedded link to roadway infrastructure and auto-auto communication
 - This link may be used for driver/passenger applications
- TRG believes this is a when-question; not if-question
- We may disagree on when and how long it will take