Lexus Technology Summary

July 21, 2010

Lexus integrates advanced technology in all its vehicles, with a focus on enhancing ease of use, comfort, and driving pleasure. The brand's reputation for quality applies to every vehicle feature and system, and any technology that the customer contacts must be easy to understand and use. The following is a review of some of the advanced technology featured in 2011 Lexus models that enhances performance, comfort and convenience.

PERFORMANCE

Advanced Valve Timing Control

All Lexus engines employ continuously Variable Valve Timing with intelligence (VVT-i), which eliminates the compromise between low-end torque and high-rpm horsepower by optimizing valve overlap throughout the engine's speed range, not just at one or two set speeds. VVT-i helps improve fuel economy and lower emissions. Models powered by the new-generation V6 and V8 engines employ a Dual VVT-i system that acts on the exhaust valves as well as the intake valves.

The LS models and the GS 460 feature the more advanced dual Variable Valve Timing with intelligence and Electrically controlled intake cam (VVT-iE). This is the world's first electronically controlled valve-timing system, able to provide optimal intake valve timing over a wider operating range. The IS F, with its 5.0-liter high-performance Lexus V8, also features this groundbreaking valve control technology.

Direct Fuel Injection

In Lexus passenger cars except the ES 350 and HS 250h, a direct-to-cylinder fuel injection system allows a higher compression ratio for greater fuel efficiency and power output, lower emissions and enhanced drivability. The IS 350, IS F, GS 350, GS 460 and LS models in addition employ secondary port fuel injectors to provide even finer fuel delivery control.

World's First Eight-Speed Automatic Transmissions

The LS 460, LS 460 L and GS 460 models are equipped with the world's first eight-speed automatic transmission. This advanced transmission allows gear ratios that maximize torque up to the tire-grip limitations in the lower ranges, yet maintain quietness and admirable fuel efficiency on the high end. The transmission-control system allows simultaneous release and engagement of the clutches to negate gearshift shock when up shifting.

The high-performance IS F features the world's first eight-Speed Sport Direct-Shift automatic transmission, which combines the performance characteristics of an automated manual-type transmission with the smoothness and refinement of a torque converter, planetary-type automatic transmission. The driver can choose between ultra-quick manual shifts for performance driving and smooth automatic shifts when convenience is the top priority.

The driver can shift manually using either the console shift or steering-wheel-mounted paddle shifters. Hydraulic-control technology allows the IS F Eight-Speed Sport Direct Shift transmission to perform on par with manual transmissions without sacrificing the smoothness of a torque-converter automatic. Paddle-shifting operation is allowed in either D or M modes, but shifts are quicker and more direct in M mode. In M mode, the transmission will hold each gear to the 6,800-RPM redline, and up shifts are executed in just one-tenth of a

second. At higher engine speeds, downshifts are accompanied by automated and precise throttle blips to match engine rpm to vehicle speed.

Road-Sensing Throttle Control
Seeking to enhance driving smoothness at every level, Lexus equips the GS 460 and LS models with Torque-Activated Powertrain Control. Working with the electronic throttle control, this system helps to smooth out acceleration from a standing start by slightly delaying the throttle opening when the driver steps on the accelerator.

Dual-Air Intake System
The 5.0-liter V8 in the IS F employs a dual air-intake system that uses a primary intake passage for low and medium engine speeds. In the higher engine speed range (above 3,600 rpm), both the primary and secondary passages are opened, helping boost high-rpm power. Both intake passages share a common high-efficiency, low-restriction air filter.

DYNAMIC HANDLING CONTROL

All-Wheel-Drive Passenger Cars
The 2011 LS 460, LS 460 L, GS 350, IS 250 and IS 350 models offer all-wheel-drive as an option. A center planetary-gear type limited-slip differential (LSD) with a wet-type multi-disc clutch control power distribution. The system normally sends 70 percent (60 for the LS 460 AWD models) of the power to the rear wheels to provide the traditional performance advantages of a rear-drive vehicle, but the LSD will vary the torque split ratio from 30:70 (31:69 for LS 460 AWD) to 50:50 (48:52 for LS 460 AWD) in response to driving conditions and driver input. The system's electronic control strategy takes inputs from steering and throttle angle, combined with vehicle signals from wheel speed and yaw rate sensors.

Power in the LS 600h L flagship model is distributed by a full-time AWD system that delivers secure handling and traction in various driving and road conditions. A TORSEN® planetary gear-type limited-slip center differential (LSD) distributes torque 40:60 under most straight-line driving situations. The compact TORSEN differential is 30 percent smaller and 11 pounds lighter than previous TORSEN systems.

Unlike speed-sensing LSDs used in some AWD vehicles, the TORSEN unit in the LS 600h L is a full-time torque sensing, torque biasing system. Torque and differentiation are continuously managed between the front and rear wheels and biased instantaneously according to varying road conditions. As a result, power is automatically shifted to the wheel or wheels with the most traction even before wheel slip can occur.

Vehicle Dynamics Integrated Management (VDIM)
For 2011, models equipped with Vehicle Dynamics Integrated Management (VDIM) are all IS, GS, LS models and RX 450h. VDIM integrates and manages a host of handling technologies more quickly than other dynamic handling systems can.

An important component of VDIM is the Electronically Controlled Brakes (ECB), which translates brake pedal pressure into electric signals that, via computer control, help provide precise and optimized braking in virtually any traction condition. Electronic control provides quick brake response when needed, helping the VDIM system to anticipate and help correct slides before they might occur. The ECB system is backed by conventional hydraulic brake control in case of the unlikely event of electronic failure.

VDIM integration strategy provides precise control for the ECB, Electric Power Steering (EPS), Vehicle Stability Control (VSC), ABS, Brake Assist (BA), Electronic Brake-force Distribution (EBD) and engine torque via the electronically controlled throttle. On the LS 460 L, LS 600h L, GS 460 and GS 450h models, VDIM also

influences Variable Gear Ratio Steering (VGRS) to affect minor steering corrections when needed.

In the IS F model, VDIM is specially calibrated to accommodate the demands of high-performance track driving. Using a dashboard switch, the driver can select Normal, Sport or Snow driving modes. In Sport mode, VDIM allows higher dynamic thresholds before intervening and alters steering assist to increase steering feel. Sport mode enables optimal vehicle control on a track in areas where the skills of even top-level drivers are challenged.

Also in the IS F, VDIM provides an electronically controlled brake-based limited-slip differential effect on the rear wheels. During cornering, VDIM suppresses any tendency for the inside wheel to spin, transmitting more power to the outside wheel to maintain traction and momentum. The experienced driver can disengage VSC/TRAC by pressing and holding the TRAC-off button for more than three seconds.

Crawl Control

The LX 570 features Crawl Control for improved throttle modulation when maneuvering over rough or difficult surfaces. Crawl Control is available as an option on the GX 460. When the transmission is shifted into low range, Crawl Control regulates engine speed and output, along with braking force, to propel the vehicle forward or in reverse at one of three low-speed settings. With Crawl Control activated, the driver can more easily focus on steering over particularly rough level ground or steep grades without having to also concentrate on the throttle or brake pedals. Crawl Control also actuates a set of virtual locking differentials to help reduce tire slippage and optimize chassis behavior.

Such enhanced chassis control reduces the likelihood of bottoming the LX 570 or GX 460 on the driving surface. Without canceling Crawl Control mode, the driver can reduce vehicle speed by braking or adjust the crawling speed with a selector switch. Hill-start Assist Control (HAC) provides additional control for off-road driving by helping to keep the vehicle stationary while starting on a steep incline or slippery surface.

Electric Power Steering

Electric Power Steering (EPS) in VDIM-equipped Lexus models provides precise electric power assist using a DC motor built into the steering-gear housing, rather than traditional hydraulic assist. Eliminating the hydraulic steering pump reduces engine drag, and the simplified steering system is lighter and more compact than hydraulic steering systems.

The Variable Gear Ratio Steering System (VGRS) in the GS 460, GS 450h and certain LS models electronically adjusts the steering ratio according to vehicle speed. VGRS can vary the steering from 2.7 turns lock-to-lock for low-speed maneuverability (2.3 on LS 600h L) to a slower 3.2 turns lock-to-lock for highway-speed stability (3.7 on LS 600h L). Additionally, VGRS provides differential steering control, which helps correct for a delay in steering response, something that occurs in all vehicles. VGRS is standard on the LS AWD models and optional in the LS 460 L, where the steering range is from 2.5 turns lock-to-lock to 3.5 turns (2.4 turns to 3.5 turns with 19-inch wheels). This function helps enhance driving feel in lane changes and other transitional maneuvers.

Advanced Suspension Systems

The advanced Active Power Stabilizer system offered in the GS 450h, GS 460 and LS 600h L models reduces body roll and enhances vehicle control during cornering. This fast-acting system uses electric actuators. An Electronic Control Unit (ECU) calculates the force needed to counter excess body sway, which is then applied to the stabilizer bars by the front and rear actuators.

The Adaptive Variable Suspension (AVS) system is standard on the LS 600h L, GS 460 and GS 450h sedans and the GX 460 Premium and LX 570 luxury utility vehicles. Responding to road conditions, driver input and

vehicle speed, AVS continuously adjusts the shock absorber damping force to help provide the best balance of ride comfort and handling response. The driver can select from normal, comfort and sport settings.

The LS 460 offers an optional air suspension system designed to enhance handling, driving comfort and versatility. Automatic load leveling helps to ensure generous suspension travel and preserve ride comfort.

Adjustable SUV Suspension
The GX 460 features Adaptive Variable-air Suspension (AVS) with three settings (comfort, normal and sport) for increased ride comfort over various road surfaces. In addition, the Rear Adjustable Height Control (RAHC) is included to lower the rear by 0.8 inches or raise it by 1.6 inches for easier loading and unloading.

The LX 570's standard hydraulic four-wheel Active Height Control (X-AHC) and Adaptive Variable-air Suspension (AVS) allow the driver to raise the vehicle by up to about three inches to help clear rough off-road terrain and to lower it for easy entry and exit. A height-control switch and light indicate current suspension height, and the light flashes when height changes occur. For off-road travel, switching to High increases the angles of approach and departure by several degrees to help the vehicle negotiate obstacles. The LX 570 will go into Extra High mode if it is in low range and traveling over rough terrain, with the height rising automatically by 1.2 inches at the front and approximately 1.8 inches in the rear. If set in High mode, the suspension will automatically lower when the LX 570 exceeds 18.6 mph, which is a more than adequate speed for rigorous off-road conditions.

Kinetic Dynamic Suspension System (KDSS)
The GX 460's standard Kinetic Dynamic Suspension System (KDSS) enhances the vehicle's on-road ride and handling and off-highway capability. Electronically controlled hydraulic cylinders help vary the degree of roll resistance provided by the front and rear stabilizer bars. KDSS helps provide more roll stiffness when needed for crisp handling response and variable roll resistance to increase wheel articulation. This helps ensure comfort and optimize traction over uneven road surfaces.

The GX 460 also features two standard systems to help control the vehicle in rugged driving conditions. Downhill Assist Control (DAC) augments the low-speed descending ability in low range by helping to hold the vehicle to a comfortably low target speed with no intervention from the driver. The Hill-start Assist Control (HAC) system helps provide additional control when starting up an incline by gently applying the brakes if the vehicle starts to roll backward.

COMFORT and CONVENIENCE

A Car that Virtually Parks Itself
The LS flagship luxury sedan models offer the segment-exclusive Advanced Parking Guidance System (APGS) to assist with parallel and back-in parking. Once the driver has correctly positioned the car and identified the desired parking space shown on the navigation screen, APGS utilizes the rear back-up camera and parking sonar sensors to guide the car into the space. The driver controls vehicle speed by applying the brake pedal.

Wide-view Front and Side Monitor
The RX 350, RX 450h, LX 570, GX 460 and HS 250h (wide-view only) offer available Wide-view Front and Side Monitor feature designed for use in tight settings, such as parking garages. With cameras located within the grille and under the passenger side-view mirror, the driver can check hard-to-view areas by simply pressing a button on the dashboard and viewing the camera images on the standard navigation system screen. The Wide-view Front and Side Monitor functions up to a vehicle speed of about 7.5 mph and displays the front and side

views simultaneously in split-screen mode.

Rear Back-Up Camera
All 2011 Lexus models offer a rear back-up camera that provides an extra measure of confidence when reversing the vehicle. The rear back-up camera is standard in the LS 460 L, LS 600h L, the GS 450h hybrid sport sedan, and the GX 460 and LX 570 luxury utility vehicles. In other models, it is part of the available navigation package. The camera gives the driver a view of what its lens can detect behind the vehicle, projecting a color image onto the navigation screen when reverse gear is engaged.

Pre-Collision System with Dynamic Radar Cruise Control
All 2011 Lexus sedans (except IS) and luxury utility vehicles offer the Pre-Collision System (PCS), which integrates Dynamic Radar Cruise Control. A millimeter-wave radar sensor helps detect obstacles in front of the car, while vehicle speed, steering angle and yaw-rate inputs help to determine whether a collision is unavoidable.

In such a situation, PCS pre-emptively retracts front seat belts and pre-initializes Brake Assist so that increased braking will be applied the instant the driver depresses the pedal. The active braking feature will automatically apply the brakes up to a deceleration rate of 0.3 g if the driver fails to react to system warnings. On models equipped with Adaptive Variable air Suspension (AVS), when the PCS is activated the AVS system adjusts to firmer settings for optimal chassis response.

The Dynamic Radar Cruise Control sensors use radar technology to help maintain a pre-set following distance from the car traveling in front. If the vehicle gets too close, the throttle is automatically reduced and brakes are applied. Once the road clears, the vehicle returns to its pre-set speed.

The Advanced Pre-Collision System (APCS), available on the LS 460 L and LS 600h L is designed to help detect pedestrians in the vehicle's path. Using two small cameras mounted at the front of the car that work in conjunction with millimeter-wave radar, APCS is sensitive enough to detect certain non-metallic objects.

The APCS option also integrates a Driver Monitor System first introduced to the world by Lexus. A camera mounted on the steering column monitors the orientation of the driver's face. If the camera detects that the driver is not looking directly ahead for a few seconds or more, and if an obstacle is detected ahead, the system alerts the driver first with a warning beep and a flashing light. As the car closes on the obstacle, if the driver does not react, APCS can begin to gently apply the vehicle's brakes.

To assist the driver in maneuvering around the obstacle, APCS adjusts the steering ratio to quicken the degree and speed of steering response. Simultaneously, in anticipation of a potential impact, the system automatically retracts the front seatbelts and prepares the brake assist system to respond with full power when the driver applies the brake pedal.

Intelligent Climate Control
All Lexus models come equipped with automatic climate control. The LS 460 L models and LS 600h L come with a four-zone climate-control system that includes an overhead diffuser and infrared temperature body/seat sensor (with Executive Class packages).

The LX 570's climate control system, with 28 total air vents, is designed to bathe occupants in comfortable air, even during extreme heat, rather than simply project streams of cool air at them. For extreme cold situations, the LX 570 is equipped with an auxiliary positive temperature coefficient (PTC) heater. The PTC warms air instantly by passing it over an electrically heated ceramic element. The LX 570 comes standard with a four-zone climate-control.

ENTERTAINMENT, NAVIGATION and SECURITY

Lexus Navigation System

In all 2011 models, Lexus offers a hard-disc drive (HDD) navigation system which has a larger capacity and a quicker response than a DVD based system. The navigation system features voice recognition allows the driver to input the destination by voice command. "Building footprint display" for five major cities (Los Angeles, New York, Chicago, Detroit and San Francisco) can provide a graphic representation of the buildings near the selected destination or along a route to help the driver identify surroundings.

The system also features phone-number-based business address recognition. The newest navigation system offers Spanish for the voice prompt feature, along with English and French. The user can select language preference at system start-up. All Lexus navigation systems use a high-speed computer that offers quick route calculation and fast map scrolling.

Convenience features include multi-route calculation, route preview, simplified highway junction graphics and a dual-map screen mode. The Freeway Lane Guidance feature will alert the driver to the best lane for an upcoming exit. Additional functions of the navigation system vary by vehicle. All Lexus models either have or offer XM® NavTraffic with real-time traffic displays and dynamic route guidance (complimentary 90-day trial subscription).

Bluetooth® wireless technology integrates with the navigation system to allow the driver to make hands-free phone calls via its touch-screen control panel and to transfer personal phone books. Drivers can place a handset-free call by either using the keypad on the navigation system to dial a number, selecting their handset phonebook stored in one of two phonebook settings, selecting a point of interest or by using the one-touch dial feature. To help reduce driver distraction, the one-touch dial feature is the only dialing function that a customer can access when the vehicle is in operation. The customer can also use controls on the steering wheel to answer and end calls as well as to adjust call listening volume.

Anti-Theft System

Lexus equips all 2011 models with an advanced remote keyless entry system and a security system with immobilizer. Only the correct key code will start a Lexus vehicle. For convenience, Lexus integrates the remote lock/unlock unit into the key, eliminating a separate remote-control unit.

SmartAccess

Standard in the Lexus lineup, SmartAccess keyless entry with push-button start allows the driver to unlock the car simply by pulling on the door handle (with the remote control carried in pocket or purse) and then start the vehicle at the touch of a button. The SmartAccess key fob, carried in the driver's pocket, transmits a radio signal to onboard antennas, authorizing the security system to unlock the car and permit the engine to start. The LS 600h L and LX 570 (with an option package) have a SmartCard key wallet card that allows the driver to unlock and start the car without the key fob or if the main key fob is lost.

XM®/Sirius® Satellite Radio

XM or Sirius Satellite radio capability, with the appropriate subscription, provides a wide selection of music and news/talk stations coast to coast and is available in all 2011 Lexus models.

Mark Levinson® Sound

Lexus is the only automaker to offer an OEM mobile audio system by Mark Levinson. Audiophiles have long recognized the Mark Levinson brand as a leader in high-end home audio components since the early 1970s. A Mark Levinson system is standard in the LS 600h L models and available in all other Lexus models as an

option. The Mark Levinson systems feature discrete amplifier design with ultra-low crossover distortion. All occupants enjoy optimal sound quality no matter where they are sitting in the vehicle.

The ES 350, IS and GS models offer a Mark Levinson® Premium Surround Sound audio system featuring a maximum of 300 watts of power for ES and IS and 330 watts on the GS system. These models feature 14 speakers (including a center speaker and subwoofer) and 7.1-channel speaker architecture. Specifications vary by model.

A 330 watt maximum power Mark Levinson Premium Surround System is available for the GX 460 with 17 speakers and 7.1-channel speaker architecture.

Standard on the LS 600h L and optional for other LS models and the LX 570 is a specially developed 19-speaker, 450-watt, discrete 5.1 Mark Levinson® Reference Surround Sound audio system. This Mark Levinson Reference Surround system creates a new benchmark for automotive sound systems with its theater-level entertainment experience. In most models equipped with Mark Levinson audio systems, the display screen provides an in-car theater. With the transmission in Park and the parking brake set, passengers can view a DVD movie on the navigation screen.

Rear-Seat Entertainment
All Lexus SUVs offer an optional rear-seat DVD entertainment system which plays movies on an LCD screen. The nine-inch LCD screen for the LX 570 deploys from the headliner in front of the second-row seats. The RX and GX 460 feature dual seven-inch Video Graphics Array displays. Two sets of wireless headphones and a remote control are included with the option.

The Executive Class Seating Package for the LS 460 L and the Executive Class Seating Package II for the LS 600h L include a rear-seat entertainment system featuring the world's first ceiling-mounted 3.0 VGA high-quality display with a nine-inch screen that deploys via electronic-motor.

Safety Connect®
Safety Connect® is a new telematic offering standard on all Lexus vehicles. It offers four safety and security features: Automatic Collision Notification, Stolen Vehicle Location, Emergency Assistance (SOS), and Enhanced Roadside Assistance, which adds GPS data to the already included warranty-based Lexus roadside service.

Lexus Enform®
Lexus Enform®, available on navigation-equipped vehicles, includes all of the Safety Connect features and builds upon them with the premium services of Destination Assist and eDestination. Destination Assist agents are available via the on-board cellular equipment and can help drivers find a specific address, a business by name, or a type of business (e.g., gas station, movie theater, etc.), and even Zagat®-rated restaurants, and then send the coordinates to the navigation system for routing.

With eDestination, drivers can go online via LexusDrivers.com to save and sort destinations in up to 20 folders, each holding as many as 10 destinations. Then drivers can send the locations—up to 200 at a time—to their vehicle, where they will be available for download into the navigation system. Online, drivers can create personalized location names (e.g., "Favorite sushi," "1 PM Appt," "Kids' doc," etc.) and even list notes about their saved locations, all helping them see exactly the information they choose in the vehicle.

Lexus Enform vehicles are factory ready for subscriptions to additional premium services which require XM subscriptions including XM NavTraffic®; XM NavWeather™, available in 150 major U.S. cities; and XM® Sports & Stocks. All XM services offer a complimentary 90-day trial subscription.