An Emerging Field Ripe for Innovation

“We started from a blank page. There was no history on this topic,” declared Nicolas Misrariis, head researcher of the sound perception and design team at IRCAM (Institut de Recherché et Coordination Acoustique/Musique) Centre Pompidou, Paris. He was describing the assignment his team undertook two years ago when Renault asked the institute to help create sound for the Zoe, one of four new electric vehicles from Renault. The Zoe is due in mid-2012. Creating the sounds that electric vehicles will make is a rare opportunity for developers in automotive electronics to work in an area that is entirely new.

At speeds above 20 km/h, electric vehicles make about as much sound as cars with internal combustion engines, due to wind and tire noise. But because EVs make very little noise at low speeds, they must generate sound electronically so pedestrians and bicyclists will hear when a vehicle is approaching. The sound should vary according to the vehicle’s speed and acceleration to give more auditory clues to its approach. Despite the need to alert pedestrians, the EV sound should not be so noisy that carmakers miss an opportunity to contribute to a quieter soundscape. And importantly, because the sound will become inseparable from the vehicle’s brand identity, it needs to evoke very positive impressions.

Another requirement adding to the project’s difficulty was that the sound had to please many important people at Renault, all of whom have strong opinions about what a Renault electric vehicle ought to sound like. Upper management would have the final say, but the people who tune exhaust systems for sound, the

Source: IRCAM

MirrorLink Smartphone Standardization: Difficult

Apple and Google Not Onboard

The Car Connectivity Consortium (CCC) backing the MirrorLink smartphone connectivity standard issued a press release earlier this fall that was a little misleading. The release stated that the consortium is “backed by 60% of the automotive market and 60% of the smartphone market, worldwide.” More precisely stated, the consortium members collectively hold 60% share of the automotive and smartphone markets. While the CCC does have some pretty influential members, most notably General Motors, Volkswagen, Toyota, Hyundai, PSA and Honda among carmakers, and Nokia, Samsung, HTC, LG Electronics and Motorola Mobility among device makers, membership does not mean a company is necessarily committed to putting MirrorLink-enabled products into the market. The level of support for the standard varies widely.

For example, I was told by a well-placed source that HTC has a MirrorLink membership only to track what is going on. I was also told that MirrorLink prototypes developed by LG Electronics and Samsung were only research projects, and that “there is no commitment from product management or marketing to roll MirrorLink out into handsets.” Samsung, which holds the leading share of smartphone shipments with 24% of the global market in the third quarter, according to Strategy Analytics, is a member of the consortium but declined to be interviewed on behalf of this story.

Among the handset makers, only MirrorLink’s chief sponsor, Nokia, is publicly committing to the standard, and they are doing so in a big way. “All Symbian phones from last year onwards will be compatible with MirrorLink, with a download from the Ovi store,” said director of Nokia Automotive Floris van de Klashorst. Nokia’s Ovi app store did not yet offer any MirrorLink products in early November of this year. Nokia ranked third in global market share, with 14% of the smartphone market in Q3 2011.

Early this year, Nokia announced that it will switch from the Symbian platform to adopt Microsoft’s operating system for new smartphones to better compete with Apple’s iPhone and smartphones using Google’s Android operating system. “[While] the first of these Nokia Windows phones will not support MirrorLink, in

Turn to MirrorLink, page 2

MirrorLink Connectivity Architecture

Virtual Network Computing (VNC) is used to replicate the phone’s display and to control the smartphone from the vehicle’s switches and touch screens. In order to be independent of the physical transport mechanism, MirrorLink uses Internet protocol technologies. It supports legacy wireless solutions including Bluetooth, Hands Free Profile (HFP) and Advanced Audio Distribution Profile (A2DP). Universal Plug and Play (UPnP) is used to give access to only a limited set of applications. The wired USB connection supports charging.

Source: Car Connectivity Consortium
the future we are committed to include MirrorLink in Nokia Windows phones,” said Mr. van de Klashorst. Microsoft declined our invitation to say whether or not it is backing MirrorLink; it is not a member of the CCC.

The German Five carmakers, Daimler, Audi, Porsche, Volkswagen and BMW, had initially supported ‘Terminal Mode’ (now MirrorLink) through the CE4A consortium, but it is not clear how much support they are giving it now. Audi, Porsche and BMW are not members of the Car Connectivity Consortium. “I don’t see a big drive by the German carmakers to adopt the technology,” said Harman International CTO and co-president of Harman Automotive, Sachin Lawande. “MirrorLink is a good attempt, but it’s not quite there yet.”

“Many of the people who are participating [in the CCC] more or less just want to know what is going on; that is not 100% support, and it definitely doesn’t mean it will find its way into products on a broad scale,” explained Detlef Teichner, vice president of R&D for Continental’s infotainment and connectivity division, who spoke to us on his last day at Continental. “From the OEMs and RFQs and so forth, I see there is an interest, they want to understand how it might be implemented. But I haven’t seen it as a ‘must’ feature to be implemented right now. The question remains how much compatibility [with smartphones] will there be. Mobile devices don’t support MirrorLink on a broad enough basis,” he said, adding, “MirrorLink really needs to be supported by the maker of the operating system; it clearly needs to be rooted into the capabilities of the operating system.”

Mr. Teichner has joined Loewe, the German high-end home entertainment manufacturer, as a member of the executive board and CTO.

**No Apple, No Google**

Among smartphone makers, the most notable absentees from the CCC are Google, whose Android operating system underpins 43.4% of the global smartphone market, and Apple, whose iOS operating system supports 18.2% of the market.

“To be MirrorLink compliant you’ve got to be part of the consortium, you’ve got to pay your membership fee and go through the MirrorLink certification process,” explained Tom Blackie, vice president, mobile at Real VNC, a 70-person software firm headquartered in Cambridge, U.K. “That is almost completely the opposite of how Google wants to do things.

“This is similar to how Apple sees itself in this industry. Apple has their proprietary standard, iPod Out. They are all about controlling the user experience. I don’t see them changing that philosophy.”

Google and Apple both declined our repeated invitations to comment on whether or not they will support MirrorLink.

Samsung presented two prototype MirrorLink-compatible Android smartphones at the Car Connectivity Summit 2011 in Chicago in September. According to Mika Rytkönen, Nokia’s director of industry collaboration and Car Connectivity Consortium president, “Some of the device makers in the Android camp have created workarounds so Android licensees can build support for MirrorLink.” It’s not clear if those workarounds were sanctioned by Google.

According to Andy Gryc, automotive product marketing manager for QNX, who was at the Car Connectivity Summit, “People who build phones based on Android were there, so I think MirrorLink will eventually get supported. However, today there are a lot of challenges which make the [MirrorLink/Android] devices run pretty slow.”

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**J.D. Power and Associates’ 2011 U.S. Multimedia Quality and Satisfaction Study**

J.D. Power and Associates’ 2011 U.S. Multimedia Quality and Satisfaction Study, released in September, confirmed that problems with multimedia systems increase along with the system’s complexity.

When the system consists of AM/FM, single CD player and satellite radio, the industry average was just 4.8 problems per hundred vehicles. When navigation is added, the industry average jumps to 12.1 problems per hundred vehicles.

The survey was based on responses from 73,000 MY 2011 vehicle owners in the U.S.
Some Carmakers Warming to MirrorLink

MirrorLink has some major auto industry players who support it, for example Toyota will be the world’s first carmaker to offer MirrorLink connectivity. Later this year the Toyota Touch Life infotainment system will be available as a dealer-installed option in Europe on the Toyota iQ city car. According to Toyota, the Nokia Car Mode app with MirrorLink support will initially be available for download only on Nokia phones with the Symbian Belle OS. Other Nokia phones will be supported “at a later date.” Touch Life will also connect to Apple iPhones running iOS 4 or later. The iQ’s head unit is reportedly from Panasonic, which deploys commercial connectivity software from RealVNC.

Apart from the Toyota application, RealVNC’s VNC Mobile Solution for Automotive can support multiple mobile device platforms, not only MirrorLink but iPhone, Android and Windows Mobile as well. An end user would simply download to his smartphone an app containing the VNC Mobile Server software designed to work with the VNC Mobile Viewer software installed in the head unit. No accommodation from the operating system is required.

Daimler, who deployed MirrorLink in its F125 research car at the 2011 Frankfurt Motor Show, will apply the standard in a new vehicle in 2013, said Mr. Rytkönen.

General Motors went on record a year ago as not in support of what then was Terminal Mode: “Everybody will have their own way of doing something similar; it won’t be limited to what is being defined by Nokia,” said Micky Bly, executive director of global electrical systems, infotainment and electrification at General Motors. Today GM is an active member of CCC, and Alfred Tom, a GM researcher and investment analyst, chairs the Ecosystem Working Group, one of three CCC working groups and the only one headed by someone outside Nokia.

I asked Mr. Tom what led to GM’s apparent change of heart about MirrorLink. “Mr. Bly wasn’t a supporter of the original 1.0 and 1.0.1 specifications,” he said, “but MirrorLink is about to release version 1.1, which addresses some of his concerns such as testing and certifying the applications are safe before they get put in the car.”

GM got involved, Mr. Tom explained further, “because we wanted to make it more suitable to the automotive use case. ... Over the next year we will be working on guidelines that application developers can understand, and then putting together a process so the applications can be tested and certified.”

Ford’s director of Connected Services Solutions, Doug VanDagens, told us that while Ford’s proprietary AppLink connectivity is sufficient for today’s applications such as streaming Internet radio and static graphics images, Ford is evaluating MirrorLink and some other alternatives capable of handling more demanding video applications coming in the future, particularly navigation and streaming maps. Meanwhile, Ford is looking at the possibility of making AppLink available to other OEMs, based on inquiries it has received from carmakers and suppliers.

At Chrysler, vice president for connectivity and infotainment Marios Zenios has serious concerns about technology such as MirrorLink’s contribution to driver distraction, and is in no hurry to commit Chrysler to the standard. “How do you alter the HMI to make it safe, as opposed to just mirroring what is on your mobile device onto the head unit? My advice to the whole industry is to slow way down and focus on the driver distraction issue, because if we mess this one up, the regulatory guys will come after us,” he cautioned.

Mr. Zenios also noted that the longer the industry takes to agree on a standard solution, the more proprietary systems will emerge, making adoption of an industry-wide standard even less probable.

Harman and QNX Have Reservations

One of the biggest objections to MirrorLink being voiced in the industry is that the carmaker must essentially turn over his display and audio system to whatever application is on the customer’s smartphone. “The screen will be owned by whoever creates the smartphone app,” said QNX’s Andy Gryc, senior product marketing manager. “For example, if Nokia creates an application that does navigation and multimedia control, it is their brand that will show up on the head...continued on page 8
The Company Profile... S1nn GmbH & Co. KG

Headquarters: Gropiusplatz 10, D-70563 Stuttgart, Germany; Tel.: 49 (711) 901219-0; www.s1nn.de
Founded: 2004
2010 Sales: €68.7 million
2011 Sales Forecast: €100 million
R&D: approximately 10% of sales
Employees: 75
Sales per Employee: €1,333 million
Products: Connectivity devices and audio components
Top Customer: Volkswagen Group
Market: 100% Automotive OEM; all customers are German.
Ownership: ANTAS GmbH, Flextronics, founders (minority shares)

Background
While most companies profiled in The Hansen Report are major tier one and tier two suppliers whose products and strategies shape automotive electronics trends, this month’s profile takes a look at a small German start-up that sees a niche for itself in the already overcrowded and highly competitive infotainment market. With fewer than 100 employees, S1nn believes it can provide carmakers the best bang for their audio system buck: high quality sound from inexpensive components.

The company name is derived from the German word for sense: Sinn. S1nn literature states that hearing is the first cognitive human sense that develops, and that the ear is the number one organ of human perception. The company’s goal is to “reproduce every possible sound pattern one to one,” that is, to make the listener feel like he is hearing a sound exactly as it was created.

In Europe, S1nn is pronounced “sin,” but in English-speaking countries the company refers to itself as “s-one-n-n.” The business serves only the automotive original equipment market.

The Founders
S1nn was founded in September 2004, in Esslingen, Germany. Its four founders all previously worked for companies serving the OEM automotive market, and all were at some time associated with Bose Corporation, which has created one of the strongest audio brands in the world. Three were employed by Bose; one worked for a Bose supplier. All four founders hold management positions with S1nn.

Philipp Popov, age 55, was in charge of automotive sales for infotainment industry leader Harman International in Germany, until the end of 2003. Before that he worked at Bose headquarters in Framingham, Massachusetts. Mr. Popov is a managing director of S1nn, responsible for sales and financials.

Andreas Heim, age 42, worked until 2005 for Schefenacker, a now-defunct German tier one that was responsible for the mechanical integration of Bose systems into the vehicle. Mr. Heim is also a managing director of S1nn; he is responsible for all R&D, plus project management and purchasing.

Prior to S1nn, Heiko Henkelmann, age 45, was in charge of European automotive electrical engineering and software development at Bose. Mr. Henkelmann serves as S1nn’s unofficial chief technical officer.

Michael Fabry, age 47, was Bose’s top audio engineer in Europe. As S1nn’s audio technology expert, Mr. Fabry is known by his colleagues as “the Ear.”

“We all had come to the conclusion that there should be room for another automotive audio supplier, one that isn’t tied to a specific brand,” said Andreas Heim. “We had the know-how, we knew how to integrate very good audio systems into a vehicle, and we wanted to do it at a very attractive price. Bose and other branded audio systems such as those from Harman retailed for about 1,000 euros. We be-
S1nn's liquidity was sufficient to support strong sales in 2009, a very tough year for the auto industry. “We were lucky with our product timing,” said Mr. Popov. “Bluetooth and iPod connectivity were really taking off. Even with the lower vehicle production volumes, we were growing. There is still a big demand for such applications in the car.” Cash flow positive, S1nn managers keep their eyes mainly on revenues, gross margins and engineering expenses. S1nn’s EMS provider, Flextronics, carries most of the inventory.

Capital Structure
S1nn managers are not opposed to bringing in additional equity partners as long as they are strategic. “A partnership should lead to more infotainment market share,” said Mr. Heim. “Our core competency is integrating consumer electronics into the car in a reliable way. We are one of the first automotive electronics companies to have this business model of relying entirely on outside manufacturing. We have a very lean logistics and manufacturing process, which we manage with our own customized SAP [business management] software. We can support customers in different regions of the world using Flextronics’ manufacturing facilities.”

Intent on taking the company well beyond its German roots, as well as showing consistent sales growth and profits, S1nn shareholders intend to wait another four to seven years before considering taking the company public.

continued on following page
Strategy

A connectivity and audio manufacturer not at all intent on building its own consumer brand, S1nn is more interested in establishing its brand among the carmakers it serves. “We want to be a brand within the OEM world, similar to the way Gentex is,” said Mr. Heim. “Their electronic dimming mirrors are in many cars despite being unknown to most consumers.”

What does S1nn mean to the carmakers it serves? Good value, agility, flexibility and honesty were some of the attributes cited by S1nn’s founders. “As we work with our customers they see the personal commitment of the four founders, as well as that of the entire team,” said Mr. Heim. “We are always upfront with our customers. This is our culture.”

If there is one word to describe S1nn’s competitive distinction it’s agility. Compared with all of the companies it competes with, S1nn is much smaller. But this makes it faster on its feet, according to Mr. Henkelmann: “It can take three years to develop an automotive product, which stays on the market for six years, at least. And then you have the consumer electronics product development that takes just six months. The auto industry has to be a lot quicker. That’s where our flexibility and agility will give us an advantage.”

“We were thinking, what Cisco can do, or what Apple or Dell can do, we can do.” S1nn will stick with its fabless strategy even as it grows. “Did Apple bring manufacturing in house when it grew?” Mr. Popov quipped.

While S1nn’s market development efforts are focused on Volkswagen Group and the other German OEMs, it is also exploring ways to bring its U.S. business to the next level. A few years ago, providing contract engineering work for Flextronics, S1nn developed electronics hardware to run Ford’s first generation Sync, based on Microsoft’s reference design. Initially, Continental was the sole source for Sync hardware.

Flextronics manufactures the silver box that runs Bluetooth, speech recognition and text-to-speech features in Sync, and enables the USB, iPod and Aux-In connections accessible to the driver. “We did the validation for that product and a lot of the certification for Bluetooth,” said Mr. Heim. “We delivered the product design including the EMI concept in just eight months. S1nn is working on another development for Ford, which we hope leads Ford to consider our new connectivity products.”

S1nn will soon begin shipments of a digital amplifier to the U.S. electric-vehicle maker Tesla. S1nn would also like to do more work with Daimler, with whom it is developing a connectivity silver box for a new infotainment system that will be available in May 2012. “Our goal is to further develop our base market in Germany followed by the U.S.,” noted Mr. Heim. “We also have an eye on Asia.”

Products

Two main connectivity products, the media device interface (MDI) and the Universal Handy Vorbereitung (preparation or organizer) or UHV, comprise the vast majority of what S1nn ships. A big part of the work done by S1nn is making certain that each MDI and UHV not only interoperates properly with all types and versions of consumer devices, but also with the specific Volkswagen Group head unit it will be connected to. Volkswagen Group currently has at least 20 different head unit variations. “Quite often the head unit is already in production so it can’t be changed; it is our box that must be changed by modifying the software protocols,” said Mr. Henkelmann. “That work is ongoing.” A total of 2.2 million MDI and UHV electronic control units (ECUs) have shipped thus far, all of them to Volkswagen Group customers.

◆ MDI

The company’s biggest seller, MDI, is an ECU that supports USB/MTP (Media Transfer Protocol), iPod and Aux-In connectivity for consumer devices and provides access to the vehicle via the CAN bus. “That vehicle interface is, of course, isolated from the consumer devices to avoid corruption from hackers,” said Mr. Henkelmann. The ECU has two microcontrollers: a 16-bit device that connects to the CAN bus, and a 32-bit microcontroller that handles the consumer devices.

◆ UHV

S1nn’s second-biggest seller, UHV, is an electronic control unit that links the vehicle to several hundred types of mobile devices via Bluetooth, using either the A2DP (Advanced Audio Distribution Profile) or AVRCP (Audio/Video Remote Control Profile). The ECU provides speech recognition and text-to-speech functions for phone book operation, using a speech engine from Nuance Communications. It can also potentially read text messages to the driver.

◆ Amplifiers

S1nn has developed a low cost audio amplifier priced at 40 to 50 euros. Audi and Tesla are customers.

New Products

◆ New Infotainment Head Units

Building on its UHV connectivity ECU business, S1nn is developing two new head units, one based on Android, the open source mobile computing platform developed by Google, and the other on HTML5. HTML5 is the open source programming language used on the Web for presenting multimedia content, which is why it is finding its way into vehicles with embedded infotainment systems linked to smartphones and the Internet.
“Our vision is to bring the car into the Internet and the Internet into the car,” noted Mr. Heim. Both infotainment platforms will be scalable, meaning they will be able to cover a range of product offerings from the low cost to high end.

The first Android head unit product is scheduled for 2013. The first HTML5 head unit product will come after that. Prototypes of both versions are available now. Actual-size prototypes will be available in early 2012.

“The particular path, whether it be Android or HTML5, depends on what the carmaker wants,” said Mr. Henkelmann. “Android gives you access to a large market of apps and a big ecosystem of support. HTML5 gives you seamless transitions between local apps and apps that are in the cloud,” he said.

As infotainment systems get more and more complex, one of the biggest challenges is developing voluminous amounts of software in a timely fashion. S1nn is convinced the answer to software complexity is reuse, of both applications and APIs.

The new head units will include a global, software-defined tuner capable of playing radio anywhere, for example, DAB in Europe or HD Radio and SDARS (Satellite Digital Audio Radio Service) in the United States.

◆ Auro-3D Audio

S1nn believes it is very close to securing two orders from carmakers for audio systems based on Auro-3D technology from Auro Technologies, a business unit of Galaxy Studios (Mol, Belgium). “State-of-the-art audio has gone from monaural, to stereo, to 5.1, the current standard. 5.1 sounds very spacious, very interesting and very discrete. But Auro-3D sounds more natural, like the real event. It’s hard to explain, you really have to experience 3D sound. It’s what’s next,” said S1nn’s audio expert, Michael Fabry.

S1nn has had Auro-3D-equipped demo vehicles in the field for several years. While carmakers have been impressed with the sound quality, they doubted the feature could be commercially successful since there are relatively few selections available that were recorded with Auro-3D technology. Mr. Fabry noted, “Our customers really liked it, but if there are only a thousand recordings out there, what is the point?”

Working with Auro-3D engineers, S1nn found a way to adapt the Auro-3D technology so it provides a three-dimensional experience even when listening to non-3D recordings. And further, S1nn optimized the technology for the automobile. “Now we can process mono, stereo or 5.1 and make it sound like a 3D experience,” explained Mr. Fabry.

In the home, Auro-3D 9.1 systems (10 speakers and 9 channels) utilize two pairs of height speakers mounted near the ceiling, an approach that places sound around and above the listener. But that arrangement isn’t possible in cars. Mr. Fabry: “Car speakers are installed in crazy positions; you are sitting asymmetrically, and you can’t have the height speakers mounted two meters above you. And because automotive is very cost sensitive, we often have to compromise on the number of speakers, their size and on the algorithm.”

S1nn’s contribution to an Auro-3D implementation in a vehicle is twofold. “First, the automotive version of the 3-D algorithm comes from us,” said Mr. Fabry. “The second factor is our expertise in using equalizers, crossovers, compressors and limiters to fine tune the acoustics for the car. I have a background at Bose of ten years of tuning systems.”

S1nn first demonstrated an automotive-optimized Auro-3D system to an OEM customer two years ago. According to Mr. Fabry, “That got things going. On top of that, the carmakers’ marketing departments have realized that consumers are attracted to “3D” products, whatever that means. We have optimized the acoustics to where we are absolutely convinced that this will be the future multichannel format in cars.”

Future revenues will come through Auro Technology, not the OEM customers. S1nn provides no hardware to implement Auro-3D software, which it licenses from Auro Technologies.

Sound Design for Electric Vehicles

S1nn engineers have been working in the newly emerging field of sound design for electric vehicles. Without engines, electric vehicles are pretty quiet at low speeds and can sneak up on unaware pedestrians, creating a safety hazard. Another sound problem for electric-vehicle makers is the EV’s cabin. When traveling at high speeds, with no engine noise to mask mechanical and road noise, electric vehicles can sound cheap; the driver can hear vibrations, air leaks, squeaks and rattles he would not have noticed with an internal combustion engine running. Carmakers are developing audio systems that replace the engine noise with engine-like sound, both to mask unwanted noise for the vehicle occupants and to create a warning sound for pedestrians.

S1nn has already developed a prototype sound generator that has been installed in a customer’s electric vehicle. It produces sound both outside and inside the vehicle.

Mr. Fabry explained the challenges: “Since it will be located outside the cabin in the motor compartment or under the vehicle, the sound transducer [speaker] will have to be rock solid, able to withstand very high and low temperatures, humidity and salt. The housing has to be sealed. But as the vehicle drives along pretty fast, these boxes will see a lot of low pressure. If the pressure inside the box is allowed to remain unchanged, the speaker will experience a DC offset and then it cannot play. So we have to ventilate the box so the speaker works under all conditions.”

Given its environment outside the vehicle, the speaker itself will not have paper cones, which would be vulnerable to moisture, and the voice coil won’t use neodymium magnets, which are vulnerable to high temperature. The sound generating system consisting of speaker, amplifier and sound algorithm is connected to the vehicle’s CAN network, so it can change as the vehicle accelerates or decelerates to give pedestrians, especially those who are visually impaired, an audible clue about what the oncoming vehicle is doing.◆
Sound... Continued from page 1

noise vibration and harshness people and marketing would also weigh in.

“Our role was to understand all these inputs and synthesize them into a sonic realization. We started the project by going to domains outside of the auto industry, like the cinema, to see how filmmakers treated the problem. We looked at movies like *Galactica, The Fifth Element* and *THX 1138* for hints to imagine how an electric car might sound,” Mr. Misdariis recalled.

Andrea Cera, an Italian sound designer and composer, was part of the IRCAM team from the beginning. His work on sound installations and electronic music composition was instrumental to this meeting of art and engineering. The IRCAM team set up a sound prototyping environment based on MAX/MSP, a graphical environment for music, audio and multimedia. According to Mr. Misdariis, “The environment allows us to synthesize sound in real time. We put all the ideas we had into this environment, and we could create a lot of samples to test with the Renault engineers.”

The IRCAM team made recordings of urban environments and found that much of the sonic energy is in the range of 400 hertz, the frequency of sound emanating from vehicles with internal combustion engines. Their idea was to create the EV sounds at frequencies above that range so they could be easily heard at low volume.

Last year the Japanese Ministry of Land, Infrastructure, Transport and Tourism (MLIT) issued guidelines suggesting that quiet vehicles should generate sound that “reminds people of a vehicle in running condition.” In other words, electric vehicles should sound like engine-driven vehicles so blind people will recognize them. “We knew about that constraint coming from the Japanese because of Renault’s association with Nissan. We did some common work with both carmakers, but this was not a strong constraint in the Renault project. While some of our proposed sounds did imitate engine sounds, our last proposal was not engine-like,” Mr. Misdariis said.

“The sound we proposed to Renault had a lot of layers,” he explained. “Some of those layers are quite dense, quiet windy sounds. Above this layer are some layers that fulfill the function of warning the pedestrian that a vehicle is coming and at what speed it is coming. It is a hybrid of recorded and synthesized sound that is modified in real time as a function of the vehicle’s speed and acceleration.”

Near the completion of its first application, the IRCAM team is presently tuning the sound on the actual Zoe vehicle.

**Internal Sound Design**

The IRCAM team has also done some work developing what they refer to as the sonic computer human interface used inside the vehicle. They were asked to propose sounds that would be used to alert the driver when the battery would run out of energy. They also developed other sounds related to the interaction between the driver and the vehicle, for example the welcome sound heard when entering the vehicle and the turn signal sound.

Paul Jennings, who heads an engineering team at the University of Warwick (Coventry, England), has had a longstanding partnership with Jaguar to work on interior sound quality. He has recently become interested in sound design for electric vehicles, specifically in helping carmakers sample and choose what sounds are best.

According to Professor Jennings, “People are now realizing how successful the internal combustion engine is at masking some of the irritations heard inside the vehicle. You could either eliminate the irritations or bring in a masking sound that covers them up. You might see some carmakers use sound to affect the cabin’s ambiance. The driver could even choose from a list the sound he wants to hear, like the way suspension settings are chosen.”

But IRCAM’s Mr. Misdariis isn’t at all keen on the idea of adding more sound to what the driver already hears inside his vehicle. “We get a lot of criticism about putting sound in an electric vehicle that is silent and therefore improves the city’s soundscape. At low speeds, we do have to add some sound for safety, but putting sound inside the vehicle at high speeds is too much.”

For more, please see the Sound Design for Electric Vehicles section of the company profile, page 7.