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Sony Pro Audio Development Group Interview
- UWP Wireless Microphone Design Innovation

UWP-V series

The Birth of the UWP Series and the Opening of New Markets for Wireless Microphone Packages

Yoshihiro Murakami
General manager of Pro Audio Dept.

Sony's professional wireless microphones enjoy a very strong reputation and an excellent record of success. To what do you attribute this success?

Murakami: Sony entered the professional wireless microphone business about 40 years ago, and since the beginning we have maintained a design policy that focuses on providing (1) high-quality sound with wide dynamic range, (2) a stable transmission system, and (3) simultaneous use of multiple channels. In particular, we have managed to deliver the simultaneous multi-channel capability required in broadcast stations and large halls, and to bring high stability and reliability into settings where radio conditions are often quite challenging—for example, for on-the-spot coverage of marathons and golf tournaments. We offer very high-quality sound, thanks to the use of Sony's originally designed microphone capsules and lavalier microphones. And we have always been very careful to get feedback from our customers and to build their suggestions into our designs, and that's another big reason for our reputation and our standing in the marketplace.

What were your reasons for planning and developing the UWP Series?

Murakami: When we launched our DVCAM™ compact professional camcorder in 1996, we stimulated the need for wireless microphones that could be mounted on these types of camera. At the time, wireless microphones were using big transmitters and big receivers. And the receivers had only one antenna, so you didn't have any diversity reception, and the units were not suitable for stable, continuous use. So we saw a real need for wireless microphones that could deliver high stability, great sound, and ease of use—the three targets of our design policy—to a larger base of users. And that's when we started to plan and design a wireless microphone system that would not only deliver on our design policy but that would also be compact, lightweight, and affordable. That was the start of the UWP Series. In fact, it turned out to be quite a challenge to achieve high reliability at an affordable price. But thanks to considerable technical know-how built up over many years of experience with professional wireless microphones, we finally succeeded in March 2003 in launching our UWP-C1, the embodiment of our concept of an all-in-one transmitter/receiver package that could be installed and used right off the shelf.

How did people respond to the UWP-C1 when it was first launched?

Murakami: The UWP-C1 combined the transmitter and receiver into a single package, and was available at an affordable price. And—despite its low price—it used space diversity to enable highly stable reception. And it used our Sony channel plans, which we brought in from higher level models, to enable multi-channel operation and high reliability. So the model sold very well, gained a very solid reputation, and became the new standard for wireless microphones. It also extended the use of these microphones into new avenues. For example, video photographers began using them for wedding receptions and other applications.

The UWP-C1 became the new standard for wireless microphones.

Sony professional microphones are used throughout the world.

A video photographer using a wireless microphone.
The UWP-C1 opened up new markets for wireless microphones.

The UWP-V1: Evolving to Meet Customer Needs

After the UWP-C1 became the new standard for wireless microphones, the model went through various changes. Can you explain?

Murakoshi: With the introduction of the UWP-C1, it became easy to mount wireless microphone receivers onto compact camcorders and get clear sound. In fact, we saw a big rise in the number of people using small camcorders with UWP-C1 receivers when producing shows and when covering weddings and other such events.
But the last few years have seen some significant advances in camcorder performance, including a large jump in image quality, such as high-definition recording being substituted for standard-definition recording. Better image quality brought about changes in market demand. People began to seek better sound quality together with a more professional feature set, combined with ease of use. So that's when we began planning our next generation of the UWP Series, which would continue to meet the needs of the UWP-C1 user base while also satisfying the requirements of users looking for higher performance.

Can you be more specific about the demands coming from the market?

Murakoshi: Because we wanted the UWP Series to respond to demands from our customers, we began by getting feedback about the UWP-C1 from our users throughout the world, and we analyzed the responses carefully.
We found that people gave high marks to the UWP-C1's quality and reliability. In particular, they cited the stability that came from the use of the diversity receptor, the ease of use that allows virtually anyone to operate the system, and the integration of the transmitter and receiver into a very reasonably priced package. When asked what they wanted to see in subsequent models, customers indicated a desire for a more efficient operation and a better match to actual conditions in the field. For example, they wanted us to (a) improve the sound quality and reduce the size of the lavalier microphone, (b) make the entire package smaller and sturdier, and (c) include the free-channel search capability that was already available on higher-end models. So we began to develop the UWP Series with an eye to meet as many of these needs as we could.

What issues got the highest priority when you were developing and planning the second-generation model, the UWP-V1?

Murakoshi: High sound quality, stable transmission, and ease of use. The last of these was specifically requested by our UWP-C1 users, who wanted a system that was easier to use in the field.
To improve the sound quality, we developed a new microphone capsule, and we produced a new high-quality lavalier microphone that we designed to match the performance of the ECM-77, the de facto model at broadcast stations. To improve transmission stability, we gave top priority to reliability and we brought in Sony's original True Diversity reception. We improved ease of use in the field by making the product smaller and by changing the casing material—making the unit more robust and giving it a professional, high-class feel. And we built in some convenient functions to enhance usability. And this became our second-generation model, the UWP-V1.

Miho Murakoshi
Product planner of UWP-V1

The second generation of the UWP Series, the UWP-V1, was specifically designed to meet customer demands.

The Goal: Match the Sound Quality of the ECM-77, the De Facto Model at Broadcast Stations

Katsuyuki Mishiro
Designer of microphone

Hiroshi Kanda
Designer of microphone

Shin Jimbo
Designer of circuit

Sound quality is probably the most important of all performance characteristics. What advances did the UWP-V1 bring to sound quality?

Mishiro: Since the marketplace very much wanted to see a higher level of sound quality in our new UWPs, we started our design work with the goal of matching the sound delivered by the ECM-77, the main model used at broadcast facilities. Of course, we were also working, at the same time, to meet our customers' demands for smaller size and affordable pricing. To get better sound, we made four important changes.

(1) We integrated the capsule case with the enclosure, so we had greater rigidity and better acoustic grounding.
(2) After looking at many possibilities, we decided to use a new gold-deposited diaphragm that gives a clean, clear sound and delivers a mid-range presence ideal for natural reproduction of the human voice.
(3) We used a relatively large rear chamber, just as on the ECM-77, so that we could use a small aperture and still get high sensitivity and low noise.
(4) We placed a metal mesh over the microphone's inside front, so that we could get natural extension into the treble ranges, and we combined it with a wind screen to reduce wind and popping noises.

As a result of these efforts, we gradually came up with a design that gave full weight to sound quality. And we devised a lavalier microphone that is not only much smaller than the one we used on the UWP-C1, but also has a metal enclosure to improve durability.

Kanda: The sound quality is largely determined by the capsule, which is where the sound enters. For this reason, we always use wired connections to evaluate wireless microphone capsules. When evaluating lavalier microphone designs for the UWP-V1, we compared performance for male and female voices against both the ECM-77 lavalier microphone (our target) and the existing UWP-C1 microphone. We carried out repeated evaluations on numerous sample products as we worked to get a strong mid-range that would give natural reproduction of human voices, and we gradually decided on the specifications we would use—the structural design, the diaphragm material, the use of metallic mesh, and so on.
At the same time, we were also evaluating wireless systems. We compared the UWP-V1 against the UWP-C1, and ultimately against our WRT and WRR 800 Series models, which are higher-end systems used by broadcasters. And eventually we came up with a design that matched the performance of these systems in targeted applications.

Jimbo: The lavalier microphone for the UWP-V1 is made by Sony Taiyo. Within the Sony group, Sony Taiyo is the only company that makes professional microphones from start to finish, from the microphone capsule up through the enclosure. They also produce the C-800G and C-38B studio condenser microphones. Since lavalier capsules are rather small and somewhat difficult to make, we had an experienced technician do the evaluations and produce the final unit. The technician was already experienced with the production of the ECM-77 and ECM-88, our smallest-diameter lavaliers, and I think this approach has helped us maintain stable performance all along.

Experienced technicians at Sony Taiyo making Sony microphones.

The internal structure of the UWP-V1 lavalier microphone – a new design providing better sound quality.

The ECM-77 lavalier microphone, the standard model in broadcasting.

The smaller unit offers a more robust design – the new UWP-V1 (left) alongside the older UWP-C1.

An evaluation room for professional microphones.

Using True Diversity Reception to Achieve Stable Transmission

What innovations and concerns were involved when you designed the transmission section?

Araya: Sony's design policy emphasizes transmission stability and simultaneous multi-channel operation, and of course the UWP-V1 had to deliver these. But one thing to keep in mind is that today's wireless microphone designers are faced with a changing environment: there's a mix of analog and digital technologies being used in the field, there are many extraneous radio waves, and so there's more interference. So we had to be considerably more careful in tuning the system.
Also, since UWP Series receivers are often mounted on compact camcorders, we reduced the diameter of the two receiving antennas, while maintaining original reception efficiency and the ability to freely adjust antenna angles. So the unit is very easy to use.

What are the advantages of space-diversity reception?

Fukazawa: The main principle of wireless receiver design is that audio reception is smooth without interruption. Wireless microphones must be able to maintain stable transmission. This requirement remains the same even when we are talking about relatively low-priced models such as the UWP Series. This is the reason that Sony implements its True Diversity* system for all of our receivers. The system incorporates two symmetrical demodulator circuits, and continuously selects the circuit with the best receiving conditions so as to maintain stable transmission at all times. It is as if you have two separate receivers picking up a single channel, and you choose the one with the best result.
As you know, radio waves bounce off walls and interfere with one another, and these conditions change as you move the receiver. So two antennas, even when spaced only slightly apart, experience quite different reception conditions. That's why it is essential to use two reception demodulators for the purpose of avoiding dropout caused by reflection and interference. On the other hand, the use of twin demodulators raises the cost and doubles the size of the circuitry. But Sony's high-density mounting technologies and our emphasis on small-size design have enabled us to overcome the problems and achieve a small size even with the double circuits.

When reporters are at a location, you often have multiple transmitters and receivers working together. What techniques do you use to maintain stability when transmitting on multiple channels?

Fukazawa: In the field you often have several crews working in a relatively confined space, so you have many wireless systems operating in close proximity. So Sony designs our systems to allow for use of multiple channels at any given location. In particular, we have formulated a number of original channel plans based on our own simulation testing and analysis.
We have also built in added flexibility by designing the system so that you can switch between lower RF output for avoiding interference when using multiple channels over a small range, and higher RF power output for working with more distance.
Our receiver also includes a new Auto Channel Scan feature that instantly looks for a free channel in the event that interference occurs while on location. This feature effectively provides automated checking of the radio wave conditions on site and rapidly seeks a new channel when needed.
So with these various strategies in place, the UWP-V1 is able to deliver very stable and reliable on-site operation. Users can take the UWP-V1 to all kinds of location feeling confident that it will deliver solid performance.

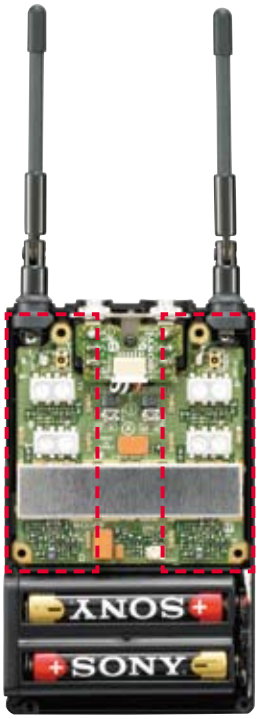
Toshihiro Araya
Project leader of product developing

Takahiro Fukazawa
Designer of circuit

Hirotaka Sato
Designer of circuit

* True Diversity is superior to antenna diversity, another method that uses two receiving antennas to improve reliability. While True Diversity has two separate receiving circuits, an antenna-diversity system has only one. When the level at the currently selected antenna falls, the antenna-diversity system automatically switches to the signal from the other antenna. But because it has only one circuit, it must make the switch based on prediction rather than on actual input conditions—so it is unable to reliably prevent dropouts caused by reflection and interference.

Receiving antennas are designed for easy mounting on camcorders.



The True Diversity system uses twin receiving circuits, and selects the better of the two signals for input.

Building in Greater Convenience and More Advanced Features to Meet Customer Demand

UWP-C1.

UWP-V1.

WRT-850

Probably the biggest advance with the UWP-V1 has been in usability. Can you tell us the approach you took when planning and developing these improvements?

Murakoshi: Our goals when planning the UWP-V1 were to resolve any issues that customers had pointed out about the UWP-C1, to improve current feature set, and in general to provide the very best wireless microphones available in the targeted price range. We carefully evaluated the UWP-C1 market, and we placed heavy emphasis on determining and analyzing what customers were looking for and how they planned to use the system. What we found was that customers expressed a strong desire for greater ease of use. So while we continued to enforce our policy of ensuring reliability, we also addressed a wide range of usability issues and achieved much greater ease of use. As a result, the UWP-V1 delivers high customer satisfaction.

Can you name some of the specific improvements that you made in the area of usability?

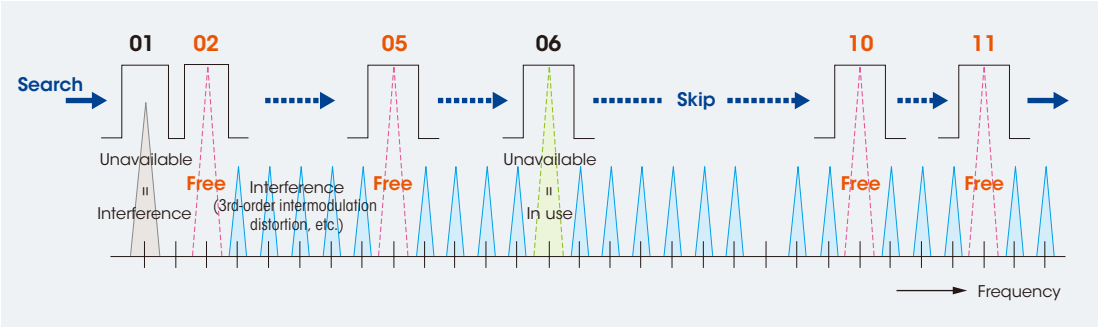
Murakoshi: First, we changed the body from plastic to metal, because we wanted the unit to feel sturdier. We also made the unit smaller, so it's easier to use. We added automatic free-channel searching, a backlit LCD for better visibility, and a cartridge-type battery case to allow for faster battery changes. In general, our goal was to make operation faster and more straightforward.
The change to an aluminum body and the smaller size of the unit are particularly striking design changes. Can you describe some of the advantages of the new design, and some of the problems you had to face during development?

Sato: One of the things we gave a lot of attention to was the miniaturization of the bodypack transmitter. Because the user generally carries the bodypack at the hip, usability goes up as the size comes down. The body pack on the UWP-C1 was a bit large and perhaps somewhat unwieldy. So we decided that this time we would make the transmitter into a thinner, smaller pack. So where we used a single relatively large circuit board for the UWP-C1, for example, we split it into two smaller boards for the UWP-V1, and we mounted the boards in a dense three-dimensional layout. As a result, we reduced the size to the same as our higher-end model that's just about as small as they come. But since high density can adversely impact on performance if it's not done right, we optimized the layout using 3D CAD and cutting-edge high-density mount designs. The resulting system can deliver stable, uncompromised performance in all kinds of environment.
The change to the aluminum casing is also aimed at achieving stability and ease of use over the long term. Aluminum is both very strong and very light. And we processed it to give it high resistance against scratching, so it will hold up nicely over time.

Can you explain the new Auto Channel Scan feature? And what are the search criteria used to search for a clear channel?

Araya: To put it simply, the receiver automatically scans through the channel frequencies stored in Sony's channel plan and displays unoccupied channels as it finds them. The user can then easily select from the display. This makes it easy for users to find clear channels when working on location. In fact, they can easily set a combination of channels for multi-channel use, with high confidence that these channels will be free from interference. As for the search criteria: the channel is considered to be unoccupied if its reception level is above the squelch level. Auto Channel Scan is a great feature, and I think people will find it very useful.

The transmitter bodies and internals of the UWP-V1 (left) and UWP-C1.



Auto Channel Scan makes it easy to find clear channels when on location.

Many people will probably be mounting the UWP-V1 on HDV™ and XDCAM EX™ camcorders. Have you done anything to facilitate that?

Araya: At the very start of development, we communicated with the camcorder planning and design groups to determine whether there was anything that might get in the way of mounting and using the UWP-V1 on their camcorders. We tried mounting it on camcorder prototypes, and we made various subtle improvements—for example, we adjusted the shape of the mount area, we reduced the amount of play when used with a shoe-mount adapter, and we altered the shape so that it would be easier to take off the camcorder when finished. Of course we also carefully checked the sound quality that the microphones deliver when mounted on camcorders. So users can be quite confident that the system works well when mounted on a camcorder.

Stability and reliability are critical requirements for professional equipment. Have you done anything specifically to design these into the UWP-V1?

Araya: With professional equipment in particular, you don't want your users to experience any operational problems while working in the field. We therefore maintain a simple and consistent design—in button layout, displays, and operating methods—so that both newcomers and seasoned Sony users will find the new model easy and straightforward to use. To maintain consistency, we avoid major changes in operating characteristics.
Professional equipment must be designed so that it will never cause problems on location. We build our equipment to maintain reliability and stability in a wide range of environments, and we take sufficient time to collect data and verify the results.

The UWP-V1 design was carefully tested on Sony camcorders.

High and low temperature tests.

Bend testing of receiver antennas.
(Photo shows antennas for WRR series)

Vibration tests on the unit itself, and when mounted on a camcorder.

Product drop test.

Looking Forward to Further Advances

What are your thoughts about the future evolution of the UWP Series?

Murakoshi: I think the second generation of the series, the UWP-V1, has gone very far in meeting user requirements and addressing user concerns, and it offers the best quality you can get in its price range. Sony feels confident that the UWP-V1, as currently built, will provide highly satisfactory performance for years to come. So we are very comfortable about recommending it for long-term use. We heartily recommend the UWP-V1 to anyone considering the purchase of wireless microphones—we think our customers will be delighted with its excellent features and performance.
But even though the UWP-V1 delivers top quality, that does not mean that we, as designers, are satisfied with everything about it, so we are committed to continually working on technical development, and improving the product. Of course, this is the approach we take with all of our products. Competition in the area of product development is never ending.
For example, in line with our goal of producing the ultimate in wireless microphone systems, we were a leader in introducing digital wireless microphones to the market in May 2008. Our digital system includes our own original coding—designed specifically to facilitate wireless transmission—and it delivers sound quality and performance that are far above those available from analog systems. We also included wireless remote control, a new feature that further enhances usability.
So, as you see, we have twin goals—we are always working to make major technical advances, but we are also always working to improve usability and increase customer satisfaction. As we move ahead, we shall continue to collect and analyze opinions and feedback from our UWP users, and we will incorporate their ideas when planning and developing new-generation products offering even better quality and ease of use. So I think we can look forward with much anticipation to our next generation of wireless microphones.

Sony's digital wireless microphone system—an industry first.

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