

# An insight into spectrum consideration for the use of DECT in Japan

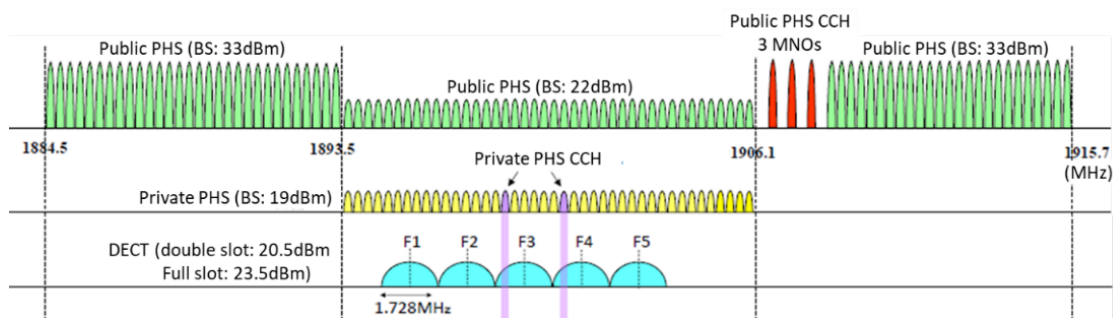
Yoshihiro Takehisa / Panasonic

## 1. Evolution of Digital Cordless Band in Japan

As far back as 1987, analog cordless telephones (250/380MHz band) were regulated by the Japanese government's MIC (Ministry of Internal affairs and Communications) which is the frequency allocation bureau and regulatory body. Fast forward to 1993, and MIC granted license exemption to the Digital cordless system, in the licensed Public PHS (Personal Handy-phone System) band, which kick started much wider deployment. The PHS technology vision was to enable home/office/outdoor communication on a cordless telephone, as a simplified mobile phone in an urban context and for leisure use as a 2-way radio.

The PHS system was successful for enterprise telephony, however the low-cost digital cordless telephone in the ISM band became dominant in residential telephony, and the 2G / 3G mobile phones with wide area coverage and high-speed mobility became the dominant mobile phones of that era.

In 2010 however, new regulation meant that a DECT compliant system could work in the existing Private PHS band, for the purpose of providing advanced performance, enhancing international competitiveness, and lower cost through economies of scale. Frequency allocation for PHS (Public and Private) and DECT can be seen in figure 1.

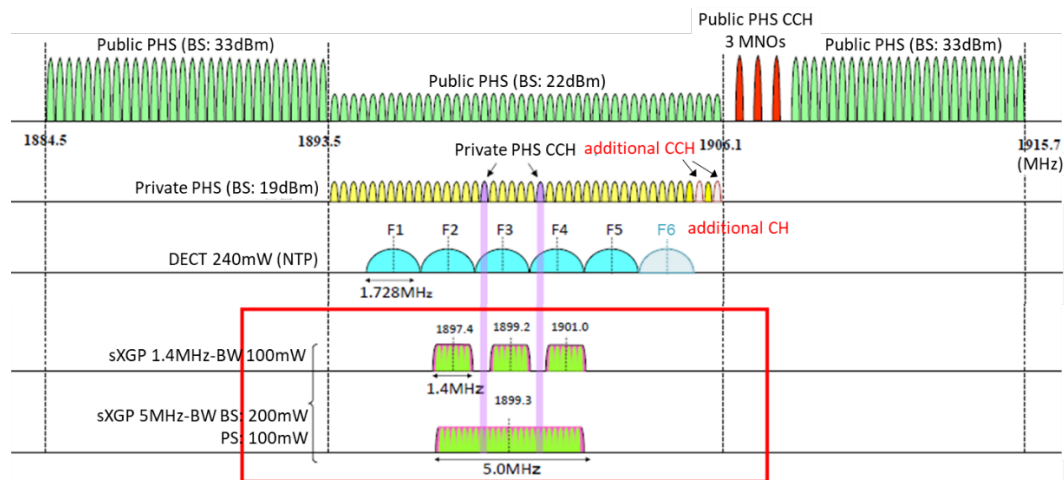


**Figure 1: Frequency allocation when DECT in Japan was institutionalized (2010)**

In 2017, new legislation was introduced to allow a TD-LTE compliant system named sXGP, to also use the same PHS frequency band, for more advanced applications using existing 4G smartphones. To offset the loss of bandwidth, DECT compliant systems received one new channel and the Private PHS system added two control channels (purple in Figure 2) replacing traffic channels.

Multiple systems were now using limited spectrum and some conditions were required for sharing. For instance, a channel scan done prior to using the channel dealt with

interference in the traffic and control channels. To ensure sufficient Quality of Service (QoS) for all system, frame structure and the duplex nature of the traffic had to be compatible with the existing PHS technology standard.



**Figure 2: Frequency allocation with the addition of sXGP (2017)**

## 2. Current Digital Cordless Band utilization

According to an MIC survey, there are about 3 million Private PHS systems used in the market, with around 400 thousand new devices added each year, while around 10 million DECT products are supplied to the Japanese market annually, not just home telephones but also office phones, audio/video doorbells, IoT devices and enterprise products such as wireless mics and intercoms.

As mentioned earlier, the use of sXGP in the same band was also introduced in 2017, and as of February 2020, there are about 100 certified sXGP devices, with which XGP Forum and its members have been performing Interoperability tests using diverse IP PBX equipment. With only 1 frequency channel of 5MHz bandwidth supported by sXGP smartphones, the take up has not materialized, since customers have concerns on QoS due to interference from the control channels of the Private PHS system. Therefore, there has been some pressure from the XGP community for the additional frequency allocation of a 5MHz carrier, and a wider bandwidth carrier (5MHz/10MHz/20MHz) for multimedia services to counter this concern.

With Public PHS voice services now discontinued (July 2020) and other services terminating by March 2023, frequency usage options for sXGP de-regulation are under review for this band.

In April 2019, the Land Radio Communication Commission decided to begin deregulating the sXGP system (Figure 3). It was premised on the construction of a frequency sharing system between sXGP and Public PHS at the beginning of the discussion in the Working Group, but in the end, only access control by carrier sensing was adopted.

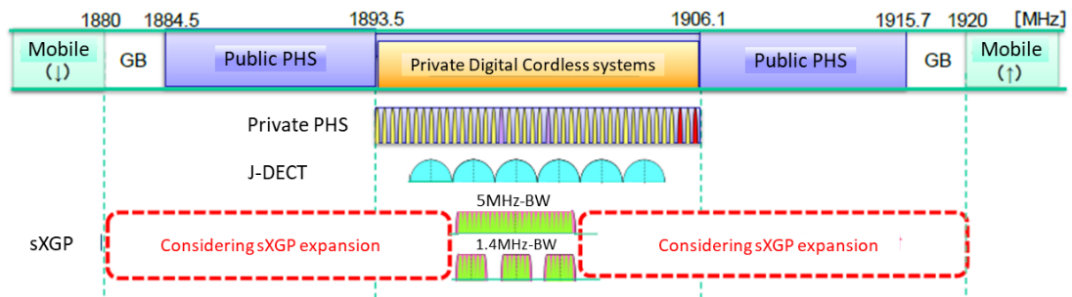


Figure 3: Considering sXGP expansion

The Working Group dealing with this, was set up by the Land Radio Communication Commission between May 2019 and February 2020. XGP Forum submitted various proposals for frequency allocation with various bandwidths (not only 5MHz, but also 10/15/20MHz bandwidth) for the additional proposed sXGP channels, and this eventually resulted in a proposal for the addition of two 5MHz bandwidth channels (Figure 4).

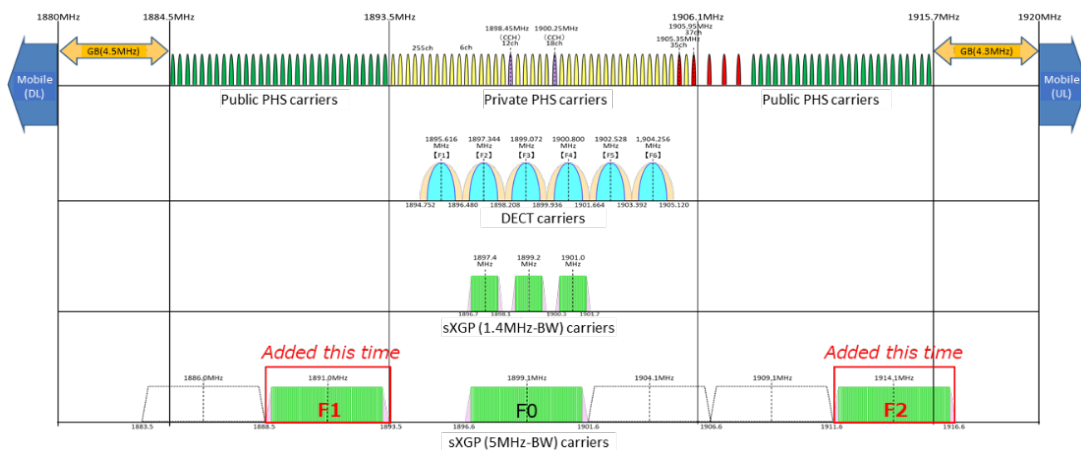


Figure 4: Final proposal of additional channels for sXGP

Details of the changes proposed in the Working Group

- Addition of two channels in total, one for the upper and one for lower side in the Public PHS band, considering protection of Public PHS services that will continue in those bands until March 2023.
- No new channels in the Digital cordless band, for protection of both DECT and Private PHS operation.
- Deregulation of DECT PP-PP direct communication (transceiver mode) to enhance a multi-hop mesh network. (with usable carriers, talk duration limit, time interval for continuous talk)
- Permission to add non-certified DECT equipment to test systems conforming to the technical standard. (Max. 180days, but needs to comply with ARIB STD-T101)

Proposed Schedule: MIC published the new regulations in September 2020, with enforcement and start of type approval by January 2021.

How the changes may impact to use of DECT in Japan

- One of the concerns is the interference on DECT channel F1 in case both sXGP F1 and DECT F1 are operated on the same floor (of a building). The unwanted emission level of sXGP is lower than the adjacent DECT carrier's, but it is higher than Public PHS's. In this case XGP F0 channel would significantly impact the current use of the DECT spectrum.

Future outlook/actions for DECT Forum

- In light of the discontinuation of Public PHS service by March 2023, DECT Forum Japan WG has recently expressed the intention of introducing DECT-2020, a future enhancement to the DECT specification, which allow for co-existence with legacy DECT. This is an opportune moment to accommodate that.
- We would propose to clarify the parameters of DECT-2020 at this early stage (e.g., Calculating acceptable interference levels with other systems, using unwanted emission characteristics at different bandwidths).

Challenges of Co-existence:

Since each system has a relationship in which the frame period is also an integral multiple, coexistence with other systems is possible depending on the arrangement (uplink/downlink) of the communication channel on the time axis.

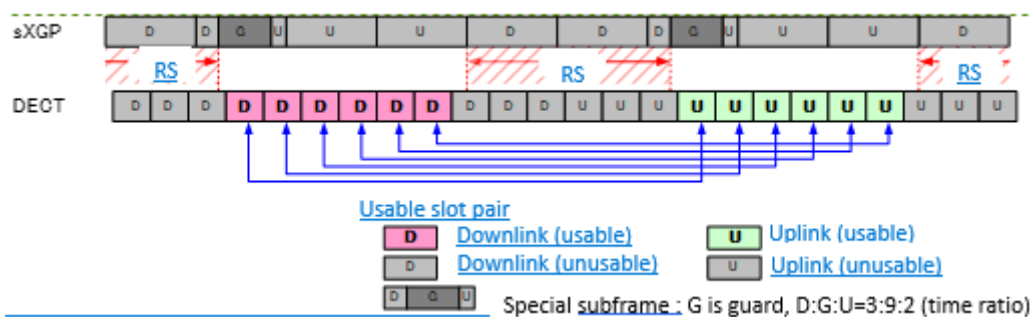
For this reason, we examine how each method coexists with other systems.

**3. Coexistence of sXGP and DECT**

The sXGP (TD-LTE) system and the DECT system have the same frame period 10ms, and both systems employ the TDD (Time Division Duplexing). The RS (Reference Signal) of the sXGP system is sent continuously in the downlink even when the line is unused, so other systems cannot be used during downlink.

In this case, the DECT system can only use the uplink period and guard space in the special subframe of the sXGP. As a result, they can coexist on the time axis, as shown in the figure below.

Both systems need the "Listen before Talk" scheme to establish a radio link on the same frequency channel. It also needs lower emission than the adjacent channel leakage for each system at the non-overlap frequency channel.



**Figure 5: sXGP and DECT**

#### 4. Coexistence of sXGP and Private PHS

Since the PHS system operates in 5ms frame, it cannot coexist on the time axis by using the uplink period and the guard time in the special subframe of the sXGP systems.

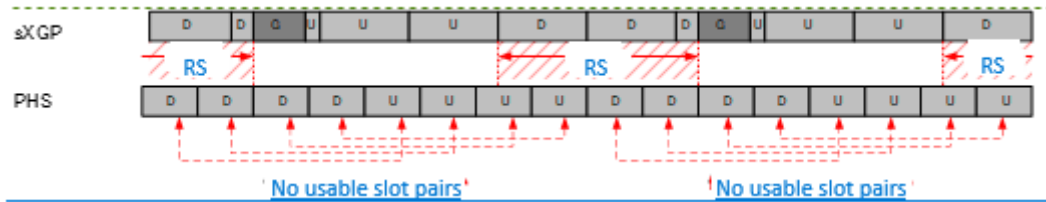


Figure 6: sXGP and PHS

#### 5. Coexistence of DECT and Private PHS

The PHS system operates in 5ms frame period and the DECT system operates in 10ms frame period, both employing TDD. The slot pairs used by the DECT system will always interfere with a specific slot of the PHS system in any frame. However, since DECT does not use all channels continuously the PHS system can coexist on the time axis by using the time that the DECT system does not use. See Below.

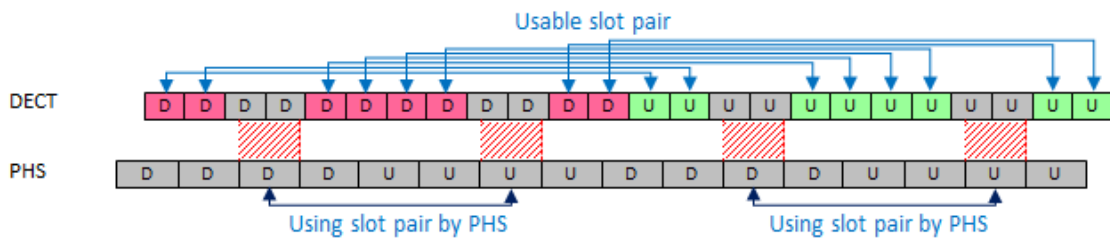


Figure 7: PHS and DECT

#### 6. Next Steps for DECT Forum Japan WG to take

Our next milestone will be aligned with the discontinuation of all Public PHS services by March 2023, when the entire Digital cordless band (for Private PHS, DECT and sXGP) will be reorganized. This implies that by 2021-22, we will have to develop and agree on the form of a new frequency allocation and spectrum etiquette that enables an effective use of spectrum for all. Representing DECT Forum, Japan WG again will play a key role to achieve this upcoming goal.

#### Conclusion

The effective use of available spectrum is paramount for the introduction of new goods and services using wireless communications. The DECT technology standard incorporates mechanisms that support the avoidance of other DECT systems in close proximity. This applies to both DECT-2020 and legacy DECT. Together with MIC, XGP Forum and the PHS community, DECT Forum is convinced that with a constructive approach from all involved parties, solutions can be found for every technology to achieve its potential and for the Public to experience the true promise of wireless communications in their lives. We look forward to a fruitful cooperation with all parties. Please visit us at [www.dect.org](http://www.dect.org)