The report of Japan GNSS Interoperability Workshop

November 12th 2014
Quasi-Zenith Satellite System Services Inc.

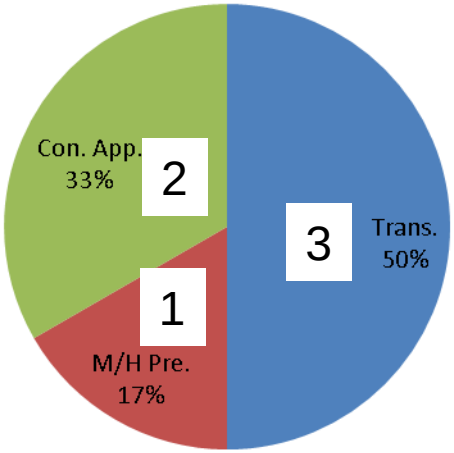
Japan GNSS Interoperability Workshop

- Date ; 1st August 2014
- Time ; 13:30 to 17:00 (JST)
- Location ; Matsushita IMP Building Osaka Japan
- Participant ; 27persons
  - ・General Participants（12）（Receiver manufacturers（3）、Others（9））
  - ・Via Web conference system（6：USA×3、China×1、Japan×2）
  - ・Presenters（5）
  - ・Others（4）

  - ・ICG Member：
    Mr.David Turner,USA、Mr.Jeff Auerbach,USA、Mr.Tom Stansell,USA
    Mr.Hung Tao, China
- Answers to the questionnaire
  ; 6 Receiver manufacturers
  （Only companies headquartered in Japan.
  Companies headquartered abroad, are not included
  in this questionnaire）

Comparison of questions for each providers(1of3)

- Adopted the original 30 questions in Japan.
- We asked six receiver manufacturers to give their answers to the questionnaire.
- The next page is a correspondence table between the United States, Russia, China and Japan.
- The numbers listed in the "Japan" column indicate the question number.
- Filled with gray parts indicate the common questionnaires among all countrie



Breakdown of receiver manufacturers who responded（total 6 companies）

・Trans. = Transportation
ITS/Car navigation/ Ship navigation

・M/H Pre. = Medium/High Precision
Surveying / Construction and
Public works/ precision agriculture, etc

・Con. App. = Consumer Application.
Watch device/ Digital Camera/
Mobile device

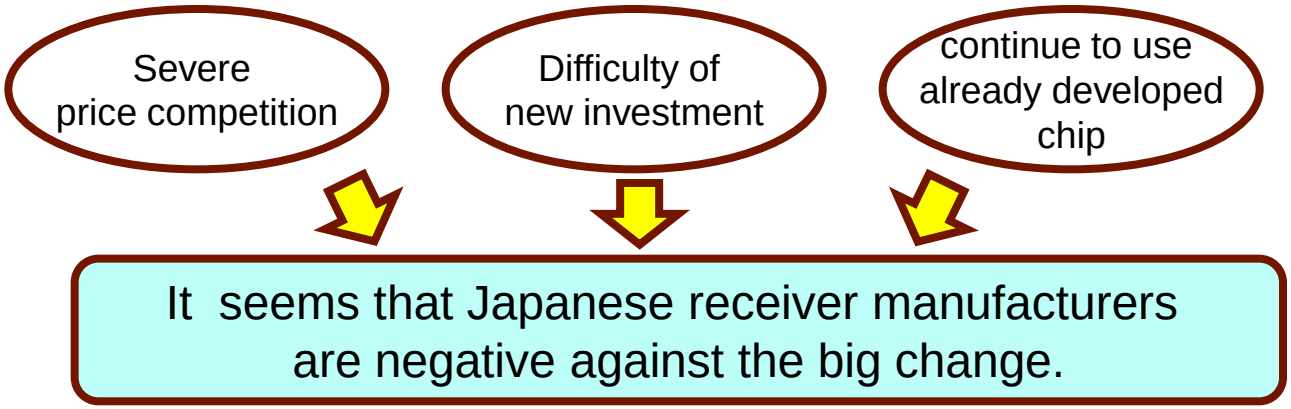
Comparison of questions for each providers(2of3)

	Interoperability Questions Posed to Industry			
NO	U.S.	Russia	China	Japan
1	**What types of applications do your receivers (or receiver designs) support?**	**What types of applications do your receivers (or receiver designs) support?**	**What types of applications do receivers from your company (or receiver designs) support?**	No.1
2	Do you see a threat to GNSS receivers due to many more GNSS signals centered at 1575.42 MHz?			No.2
3	**Whether you see a threat or not, do you prefer all new CDMA signals at "L1" to be centered at 1575.42 MHz or have some of them elsewhere, e.g., at 1602 MHz?**	**There is a threat for GNSS receivers due to many more GNSS signals centered at 1575.42 MHz . So do you prefer all new CDMA signals at "L1" to be centered at 1575.42 MHz or have some of them elsewhere, e.g., at 1602 MHz?**	**Do you prefer new CDMA signals at "L1" to be centered at 1575.42 MHz or have some of them elsewhere, e.g., at 1602 MHz?**	No.3
4	Given that most GNSS providers plan to transmit a "modernized" signal at 1575.42 MHz, what is your long term perspective on whether you will continue to use C/A? Why? How?		In the long term do you expect to continue using L1 C/A after L1C/B1C is fully deployed? Why?	No.5
5	Once there are a large number of good CDMA signals, will there be continuing commercial interest in FDMA signals? Why or Why Not?	Once there are a large number of good CDMA signals, will there be continuing commercial interest in FDMA signals?		No.6
6	**Do you prefer signals in different "L1" frequency bands for interference mitigation rather than at one center frequency for interoperability? Why?**	**You will prefer to use signals in various strips of L1 range in interests of increase of noise immunity or at one central frequency in interests of ensuring interoperability?**	**For the purpose of external interference mitigation do you prefer signals in different "L1" frequency bands? Why?**	No.4
7	If a satellite's signals do not meet quality standards, what should happen (see list in slide)?		If a satellite's signals do not meet quality standards, what should happen: Be set unhealthy? Transmit with a nonstandard code? Transmit with reduced signal power (reduce interference)? Be switched off? All above?	No.7
8	**To assure only "good" signals, should GNSS providers agree on minimum international signal quality standards and agree to provide only signals meeting the standard?**	**To assure only "good" signals, should GNSS providers agree on minimum international signal quality standards and agree to provide only signals meeting the standard?**	**To assure only "good" signals, should GNSS providers agree on minimum international signal quality standards and agree to provide only signals meeting the standard?**	No.8
9	**Given that L5/E5a will be transmitted by most GNSS providers, do you intend to use the E5b signal? If so, for what purpose?**	**Given that L5/E5a will be transmitted by most GNSS providers, do you intend to use the E5b signal?**	**Given that L5/E5a/B2a will be transmitted by most GNSS providers, do you intend to use the E5b signal? If so, for what purpose?**	No.9
10	For your applications, are small satellite "frequency steps" a problem?		For your applications, are small satellite "frequency steps" a problem?	No.10
11	If so, what interval between "frequency steps" and what delta-f magnitude would be excessive?		If so, what interval between "frequency steps" and what delta-f magnitude would be excessive?	No.10
12	**Assuming signal quality is acceptable from every provider, would you limit the number of signals used by provider or by other criteria? What criteria?**	**Assuming signal quality is acceptable from every provider, would you limit the number signals used by provider?**	**Assuming signal quality is acceptable from every provider, would you limit the number of signals used by provider or by other criteria? What criteria?**	No.11
13	Is having more signals inherently better or do you think there should be a limit?			No.12
14	Will the marketplace "force" you to make use of every available signal?		Will the marketplace "force" you to make use of signals from every available constellation (i.e. GPS, GLONASS, Galileo, Beidou, QZSS, IRNSS)?	No.13
15	**For best interoperability, how important is a common center frequency? How important is a common signal spectrum (PSD)?**	**For best interoperability, how important is a common center frequency? How important is a common signal spectrum?**	**For best interoperability, how important is a common center frequency? How important is a common signal spectrum (PSD)?**	No.14
16	**Will you provide "tri-lane" capability in the future? Why?**	**Will you provide "three-signals navigation" capability in the future?**	**Will you provide "tri-lane" capability in the future?**	No.15
17	**If so, do you prefer a common middle frequency or the combined use of L2 (1227.6), B3 (1268.52), and E6 (1278.75) if B3 and E6 open access is available**	**Do you prefer a common middle frequency or the combined use of L2 (1227.6), B3 (1268.52), and E6 (1278.75) if B3 and E6 open access is available?**	**If so, do you prefer: B3 (1268.52MHz)?, E6 (1278.75 MHz)?, L2 (1227.6 MHz)?, L2+B3+E6?, S Band?, C Band?**	No.15

Comparison of questions for each providers(3of3)

	Interoperability Questions Posed to Industry			
NO	U.S.	Russia	China	Japan
18	Would you prefer a common open signal in S Band? In C Band? Why?			No.16,17
19	**Does a wider satellite transmitter bandwidth help with multipath mitigation?**	**Does a wider satellite transmitter bandwidth help with multipath mitigation?**	**Does a wider satellite transmitter bandwidth help with multipath mitigation?**	No.18
20	**What minimum transmitter bandwidth would you recommend for future GNSS signals in order to achieve optimum code precision measurements?**	**What minimum transmitter bandwidth would you recommend for future GNSS signals in order to achieve optimum code precision measurements?**	**What minimum transmitter bandwidth would you recommend for future GNSS signals in order to achieve optimum code precision measurements?**	No.19
21	**Would you recommend GNSS or SBAS services provide interoperability parameters (see list in slide)?**	**Would you recommend GNSS or SBAS services provide interoperability parameters: system clock offsets, geodesy offsets, ARAIM parameters or others?**	**Would you recommend GNSS or SBAS services provide interoperability parameters: system clock offsets? geodesy offsets? ARAIM parameters? Others?**	No.20
22	Should they be provided by other means so as not to compromise TTFF or other navigation capabilities?		Should they be provided by other means so as not to compromise TTFF or other navigation capabilities?	No.20
23	For your applications and for each signal, what amount of drift between code and carrier over what time frame would be excessive?		For your applications and for each signal, what amount of drift between code and carrier over what time frame would be excessive?	No.21
24	For your applications and for two or more signals in different frequency bands, e.g., L1 and L5 (when scaled properly), what amount of relative drift in code and carrier between the signals would be excessive?		For your applications and for two or more signals in different frequency bands, e.g., L1 and L5 (when scaled properly), what amount of relative drift in code and carrier between the signals would be excessive?	No.22
25	Should the international community strive to protect all GNSS signal bands from terrestrial signal interference?	Should the international community strive to protect all GNSS signal bands from terrestrial signal interference?		No.23
26	Do the current differences (~10 cm) in Geodesy pose a problem for your users? Why or why not?		Do the current differences (~10 cm) in Geodesy pose a problem for your users? Why or why not?	No.24
27	If geodesy differences are a problem, what is the preferred method of compensation (see list on slide)?		If geodesy differences are a problem, what is the preferred method of compensation: Published values (e.g., on websites)? Satellite messages?	No.24
28	Do you want each system to cross reference the other's time (e.g., with a GGTO type of message) or compare itself to a common international GNSS ensemble time? To what precision?		Do you want each system to cross reference the other's time (e.g., with a GGTO type of message) or compare itself to a common international GNSS ensemble time? To what precision?	No.25
29	Will your future receivers calculate a time offset between systems based on signal measurements or use only external time offset data?	Will your future receivers calculate a time offset between systems based on signal measurements or use only external time offset data?		No.26
30	**What is the preferred method of receiving time offsets: Satellite messages, Internet messages, or internally calculated?**	**What is the preferred method of receiving time offsets: satellite messages, internet messages or internally calculated?**	**You prefer to get the time offset between systems by: Internally calculated by receiver? Extra data broadcast by: Satellite messages, Internet messages?**	No.27
31			Do you prefer transmit the time/space interferences into a same standard and calculate the offsets? What is the accuracy level?	
32			Will you consider using interoperability parameters provided by a third party? If so, which technique would you prefer: Provided by Telstar? Provided by mobile communication (e.g. GSM)? Provided over the Internet?	No.28
33			What interoperability transition parameters for time & space would you prefer: Fixed transition parameters? If so, what is your ideal transition precision? Transition model?	No.29
34			If you are faced with having to pay royalties to use a particular signal due to a patent on the signal design, what would you be most likely to do: Pay the royalty? Use different signals that are not patented? Other/Not sure?	No.30

Analysis of the Answers



In other words, Receiver manufacturers are not refusing to use the new signals, but rather prefers to keep using the conventional signals, where application validation of the new signals are not enough.

In relation, there were the following opinions in the workshop.

- ✓ Need more investment for new technology development.
- ✓ For example, QZSS-1(Michibiki) has the advantage that implement the use of L1C ahead of the world, but it's too early to make a commercial product.

The detailed answers that derive the above analysis result will be shown in the following pages.

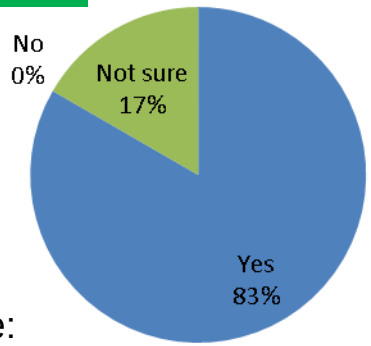
Interoperability Questions to Industry

Q.3

Common

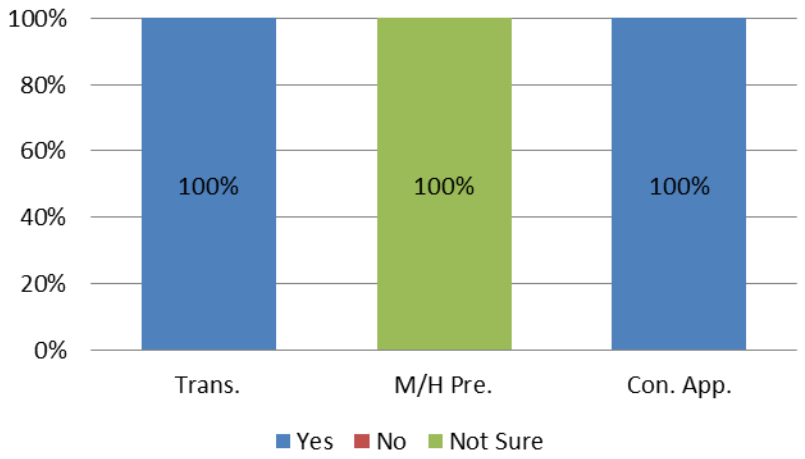
Do you prefer new CDMA signals at “L1” to be centered at 1575.42 MHz or have some of them elsewhere, e.g., at 1602 MHz?

A.



Not sure:
For critical high precision application is the best way to have signals in different band for noise immunity, but for low cost application is very interesting to have common signal in one L1 band.

Yes:
Because it is important for low cost receivers to use simple one frequency circuit for avoiding cost up, and for high-end receivers to achieve high-performance by plural frequencies.

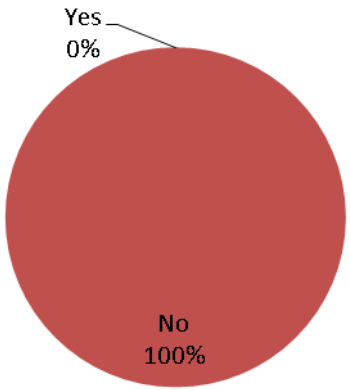


Interoperability Questions to Industry

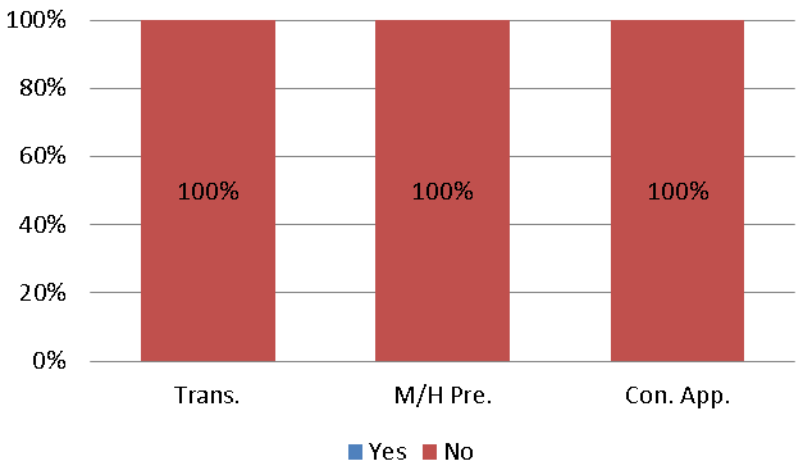
Q.6

Once there are a large number of good CDMA signals, do see any commercial interest in FDMA signals? Why or Why Not?

A.



No:
- FDMA makes cost up with the circuit delay compensation for precise positioning.
- We will be able to reduce chip size and power consumption of our receiver chips further if we do not have to process FDMA signal.
-it will cost a lot.
-not interested in FDMA signal as long as enough CDMA signal is receivable.



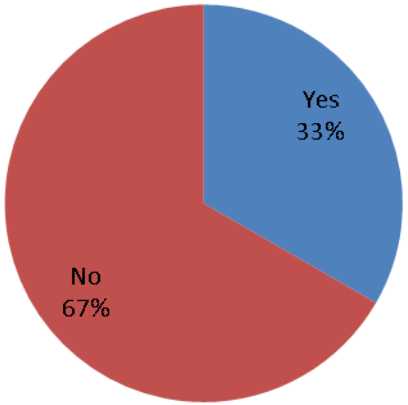
Interoperability Questions to Industry

Q.9

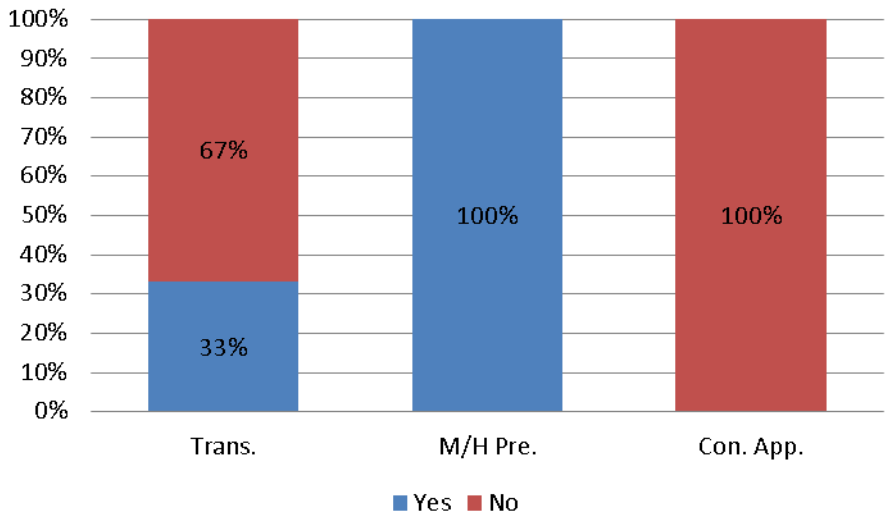
Common

Given that L5/E5a/B2a will be transmitted by most GNSS providers, do you intend to use the E5b signal? If so, for what purpose?

A.



Yes:
The E5a+E5b is a wide band signal and have small multipath. It will be interesting for high precision application (RTK, PPP) for minimize time-to-fix.



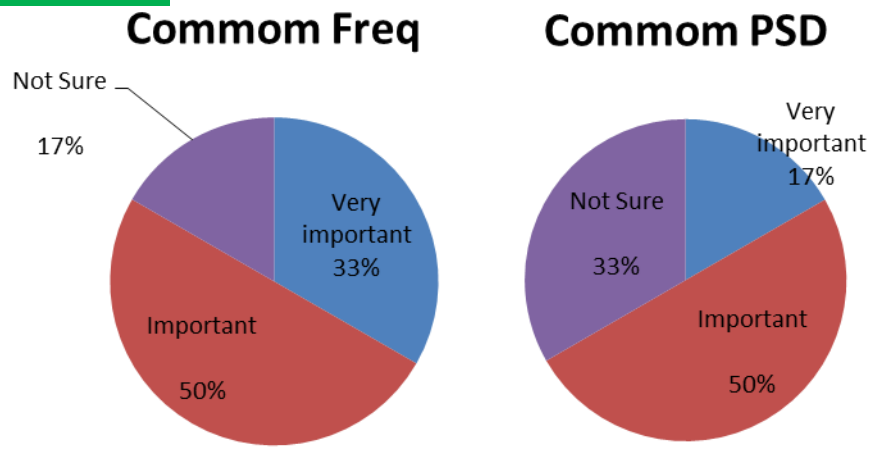
Interoperability Questions to Industry

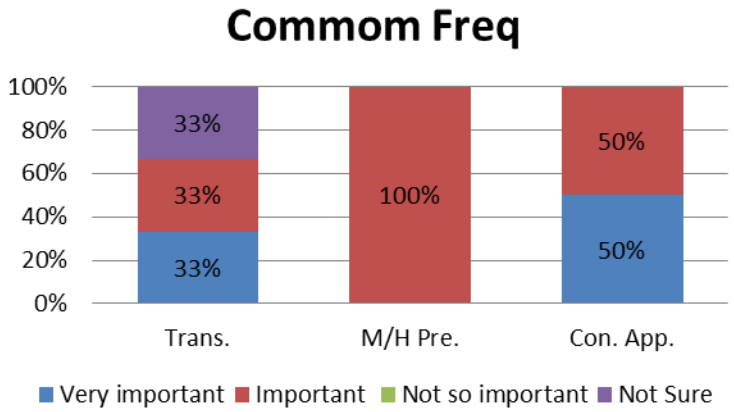
Q.14

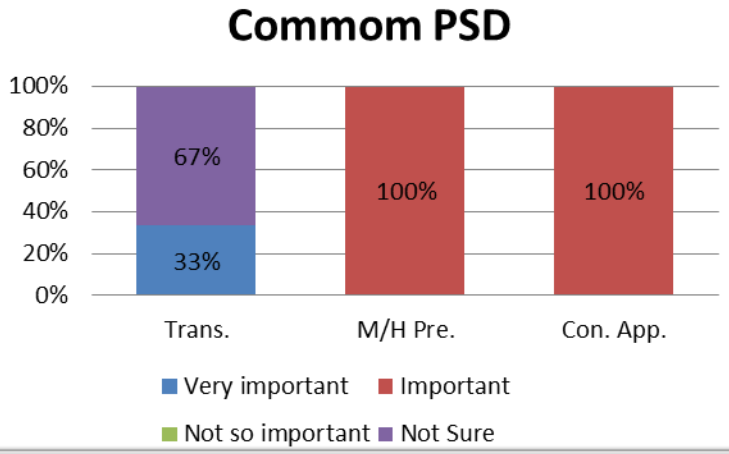
Common

For best interoperability, how important is a common center frequency?
How important is a common signal spectrum (PSD)?

A.







Very important:
It is important for low cost receiver to be a common center frequency and a common signal spectrum for avoiding cost up.

Comparative analysis with other provider's answer

Q3：Do you prefer new CDMA signals at "L1" to be centered at 1575.42MHz ~
⇒Japan:mostly Yes, USA and China:many yes, Russia:many Others

Q6：Once there are a large number of good CDMA signals, ~
⇒Japan:100% FDMA not necessary, USA and China:Many of the same opinion as Japan,
Russia: FDMA necessary

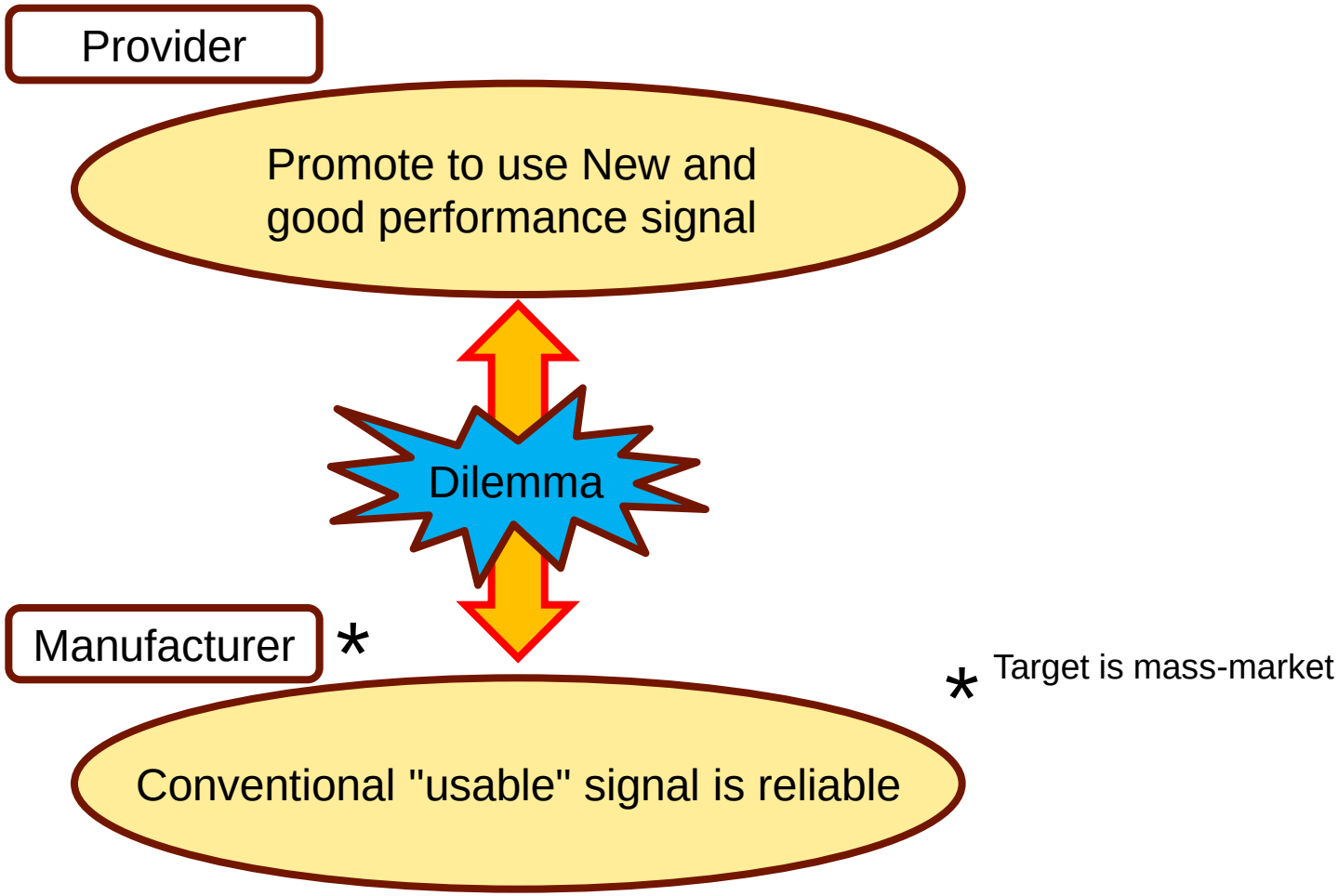
Q9：Do you intend to use the E5b signal?
⇒Japan:many No, USA, China and Russia:many yes
Japan answer is a little bit different from other countries answer.

Q14：Is having a common center frequency very important?
⇒Japan:mostly Yes, USA and China:many yes, Russia:many No

From the answers, receiver manufacturers, those sell the cheep chipset to mass-market, seem to have difficulty in quickly adopting the new signals in common.

Provider Manufacturer Dilemma

After analyzing the questionnaire results, the following Dilemma appears.



Summary & Future Tasks

- ✓ Different Tendency by the corresponding application
- ✓ In Japan, receiver manufacturers categorized in consumer applications and transportation(sell the cheep chip set to mass-market) prefer to keep using the conventional signals because of severe price competition.

In order to proceed, our providers engage to build an environment where manufacturers can use the new signals with confidence.

To establish paths for making the above environment is a future task to cope with.

Thank you for your attention!