

# Experiences of Leap Second Adjustment Operations and Questionnaires in Japan

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# NICT = National Institute of Information and Communications Technology



1952~1988 ⇒ RRL (Radio Research Laboratory)

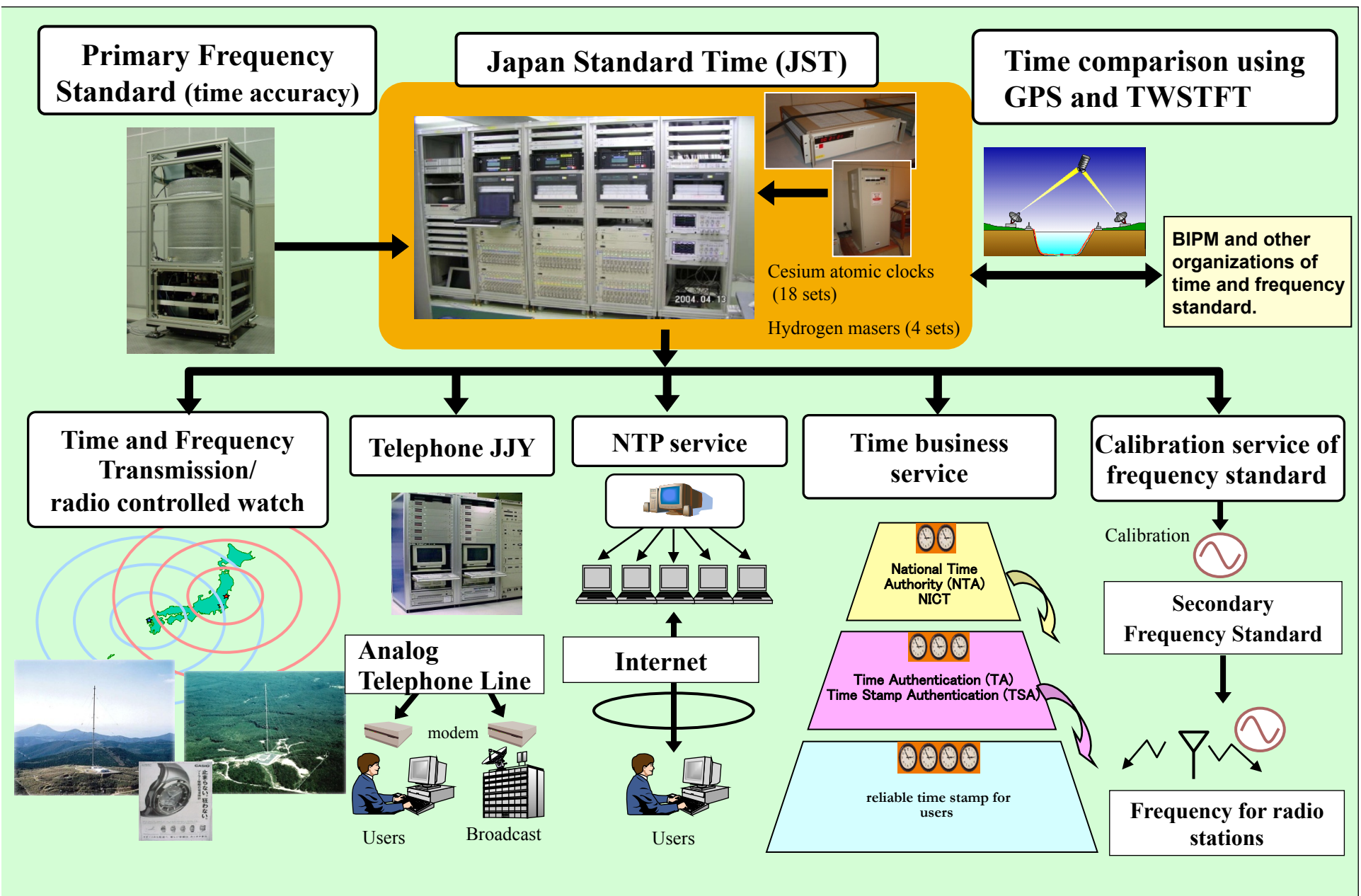
1988~2004 ⇒ CRL (Communications Research Laboratory)

2004~Present ⇒ NICT

- Telecommunications, Radio-wave Applications
- Frequency Standard, Emission of Standard Signal
- Space Communications



# Time and Frequency Standard and Related Services



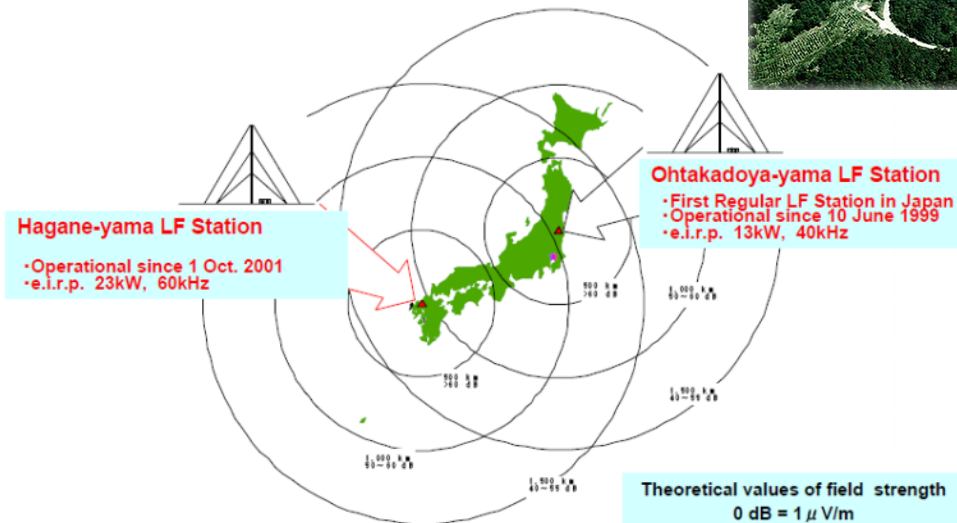
# Contents

- Generation, Maintenance and Dissemination of JST
- Leap Second Adjustment in 2009
- Leap Second Adjustment in 2012
- Questionnaires Conducted in Japan



# Dissemination of JST : LF radio

- 40kHz (1999~) and 60kHz (2001~) LF radio signals are emitted from two radio stations to cover the country of Japan.
- More than 50 million radio controlled clocks/watches have been sold.

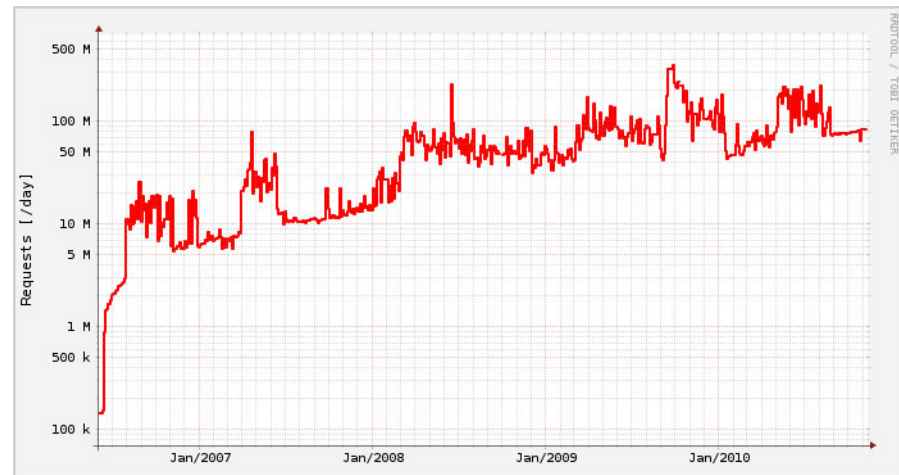


The values under the distance (km) shows the approximate strength calculated as the assumed electric field.



# Dissemination of JST : Public NTP

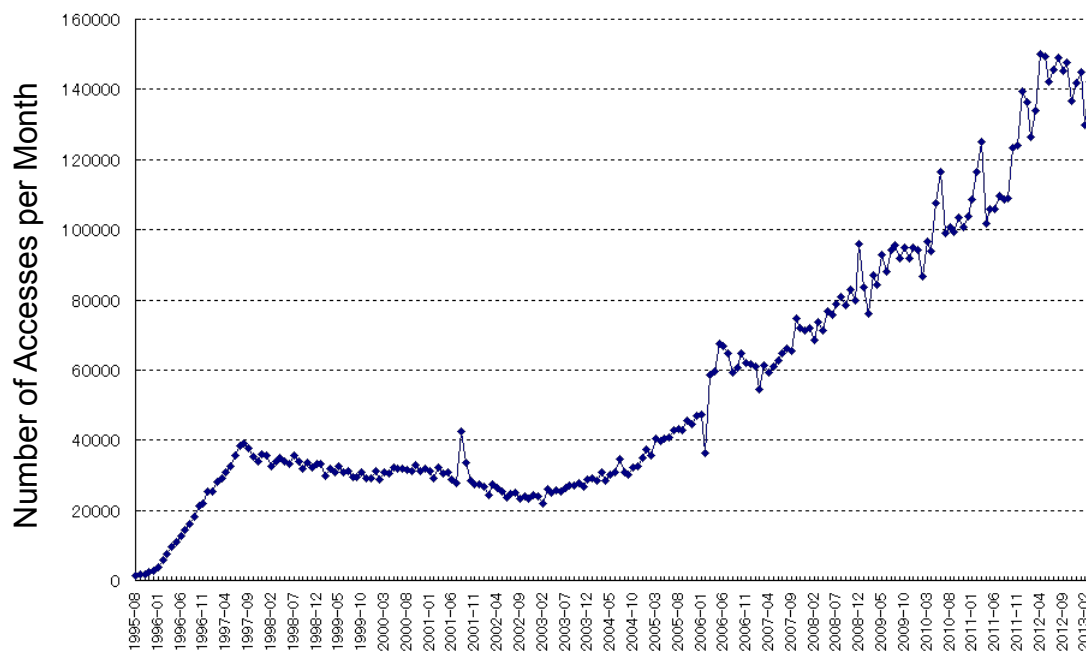
- Stratum 1 Network Time Protocol (NTP) service since 2005.
- Specially designed, powerful (up to 1 million access per second), secure, reliable, and standalone servers in operation at <ntp.nict.jp>.



# Dissemination of JST : Telephone JJY

- Interactive server accessible by acoustic modem over public telephone line.
- Accurate ( $\sim 200\mu\text{sec}$ ) and reliable service.
- Train operators, broadcasting stations, etc.

Telephone JJY Service Statistics



# Leap Second Adjustments in 2006 and 2009

- No problem in the JST Dissemination Services from NICT.
- Carefully prepared the operations and hold a lecture to improve the awareness of the leap second insertion.
- Time Stamp Authorities determined to stop operations for about two hours.





# Leap Second Adjustment in 2012

- No problem in the JST Dissemination Services from NICT.
- Carefully prepared the operations and hold a lecture to improve the awareness of the leap second insertion.
- Time Stamp Authorities determined to stop operations for about two hours.
- It was found that there is a bug in certain versions of Linux kernels. It caused malfunction of computer systems. Because of this malfunction, a well-known Social Network System service and Internet Service Providers reported delays or failures in their services.



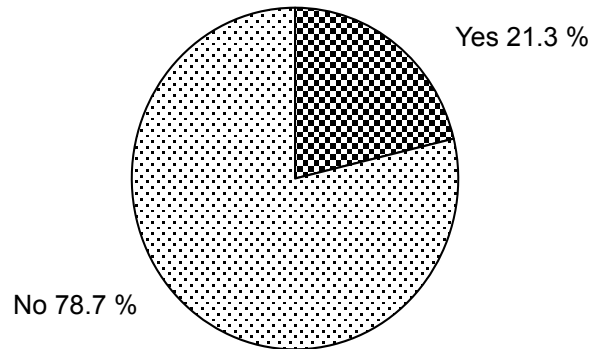
# Leap Second Adjustment in 2012



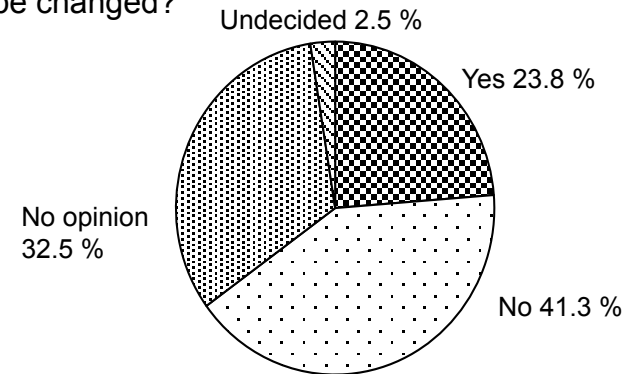
# Questionnaire 2001

Conducted by Communications Research Laboratory (former NICT).

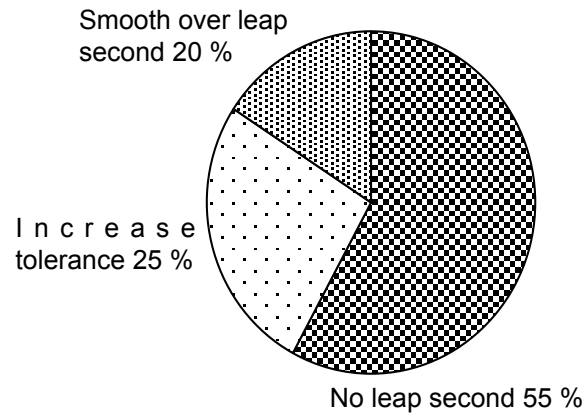
(1) Does the present UTC determination method cause any inconveniences?



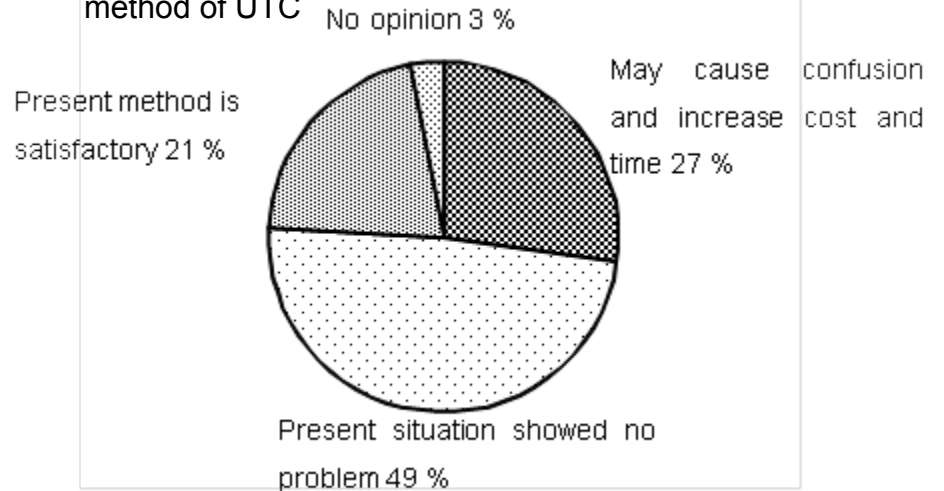
(2) Do you think the determination method of UTC should be changed?



(2-1) If "yes", which solution do you prefer?



(2-2) Reasons for not changing the determination method of UTC



# Questionnaire 2007

Conducted by Ministry of Internal Affairs and Communications.

Field	Effect of past leap second adjustment	Effect of future change to UTC	Agree or disagree with future change
Broadcasting carriers	None	None (Find the merit in disappearing in an irregular leap second adjustment)	Agree
Telecommunications carriers	None	None (Find the merit in disappearing in an irregular leap second adjustment)	Agree
Time stamp authorities	Operation stopped	None	Agree
GPS receiver manufacturers	None (Problem with bit length of the navigation message of the GPS in the future )	None in near future (New adjustment method may involve the possibility of significant problems)	Both agree and disagree
Geographical Survey Institute	None (Manual adjustment)	Need to adopt some changes to the control programs	-
Satellite launching enterprise	Made some changes to the control programs	Need to adopt some changes to the control programs	-



# Summary

- Leap second adjustment operations at a dissemination institute may not be very difficult tasks, but they require careful preparations and repeated announcements to users.
- It is becoming difficult to expect ALL services by ALL providers are not suffered by leap second adjustment.
- There are strong demands for eliminating leap seconds from time stamp authorities.

