Expected Technology for Mobile eHealth

< User-oriented technology development of in-ambulance devices >

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Today‘s Agenda

0. Focus point
1. Who we are.
2. Classification, Background
3. Misunderstanding
    - Problems of the 3G
    - HEOs
4. Development of in-ambulance devices
    - A: 12-lead electrocardiogram
    - B: Light reflex image (Pupillometer)
    - C: Macintosh with integrated type of CCD camera (Pharyngoscope)
5. Considerations

Today's Focus Point

User-oriented technology development related in-ambulance devices

Merits

1. **These advanced technology will bring new solution of ambulatory system, performing triage and pre-hospital-care on the road.**
2. **Patients' outcome will be improved.**
3. **Reduce the medical expense.**

Unsolved problems

1. **Lack of the policy like Homeland Security of the U.S.**
2. **Lack of the nationwide broadband wireless telecommunication infrastructure for moving vehicles**

Who we are;Tokai University : ITU-D Sector member
Isao Nakajima: Vice Rapporteur for eHealth of ITU-D

ITU eHealth Expert Training Course

Tokai University

The Telemedicine Expert Training Course, jointly launched by the ITU/BDT and Tokai University in Japan, offers an excellent opportunity for medical and health care workers from developing countries to understand the current trends and technologies in telemedicine and e-health. It provides the foundation to introduce telemedicine in developing countries.

Tokai University Shonan Campus
Hiratsuka Kanagawa Japan

Tokai University Hospital
Isehara Kanagawa Japan

http://www.tsj.gr.jp/tsj/tumri/nakajima/index.htm

EMS at Tokai University Hospital

Doctor Heli: 400/y flights, Ambulances: 7000/y

4Ts in the field of emergency medicine

Telecommunications
Transportation
Triage
early Treatment

Classification of mobile eHealth

- Mobile eHealth is often used to describe telemedicine solutions that are wirelessly connected, and thus not fixed in place, either at the point of patient interface or at the point of provider interface.

1. Vehicle Application

   Ambulance, Caravan style mobile hospital,

   Mobile specialty vehicles

2. Specialists application

   PDA for EMTs, mobile phone for physicians (Pocket MIMAS Ⅱ)

3. Telehomecare application

   Long term monitoring system by Registered Nurses

Investigations

There is increasing need to transmit medical data (including video) from moving ambulances. This information facilitates and improves pre-hospital care for the patients. To implement this vital medical care service, we have studied two options: building nationwide the 3G(3rd-Generation) on the ground, and launching three HEOs satellites over Japan.

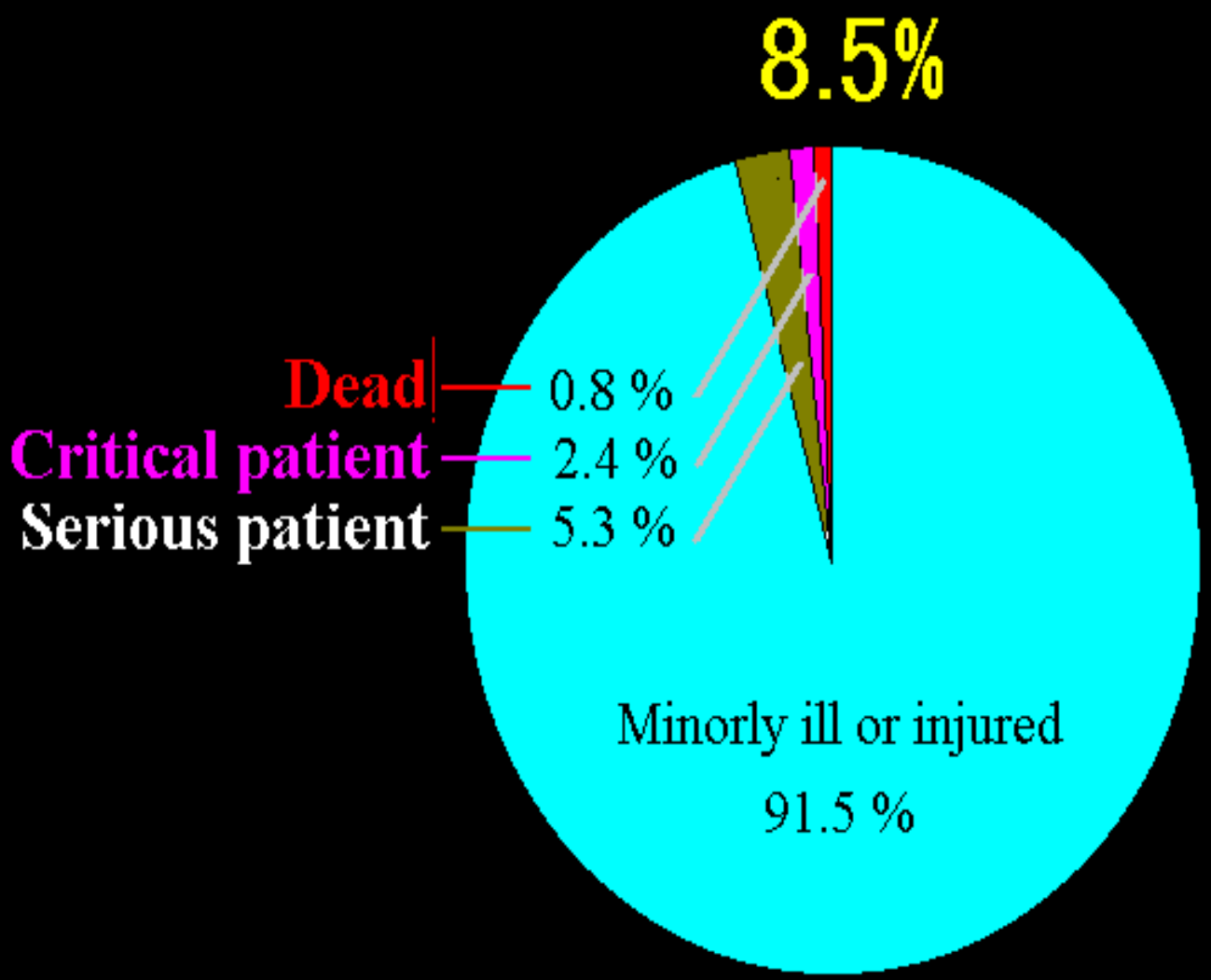
Air way


Light reflex

ECG monitor

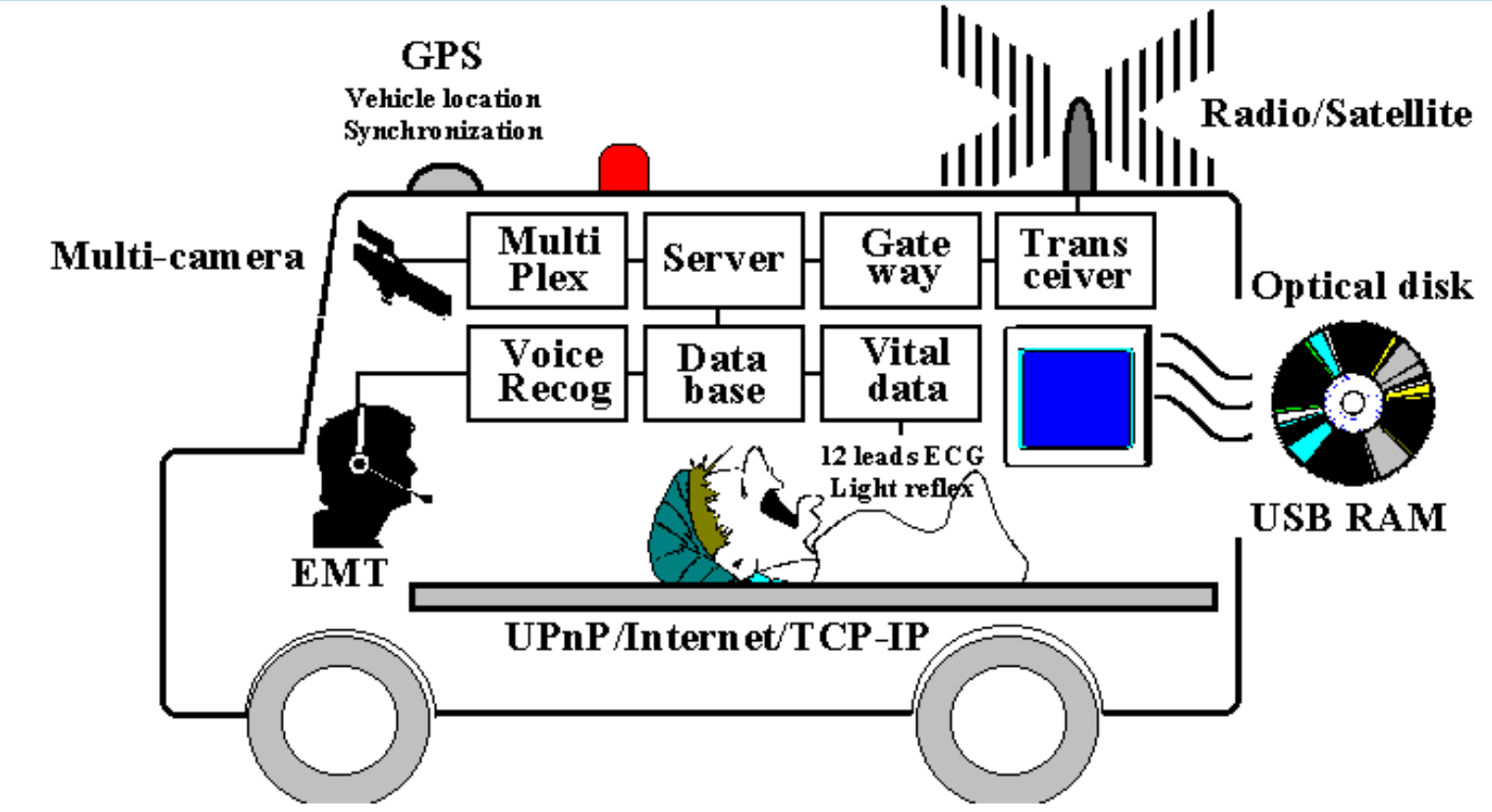

Abd. Echo

Serious medical conditions

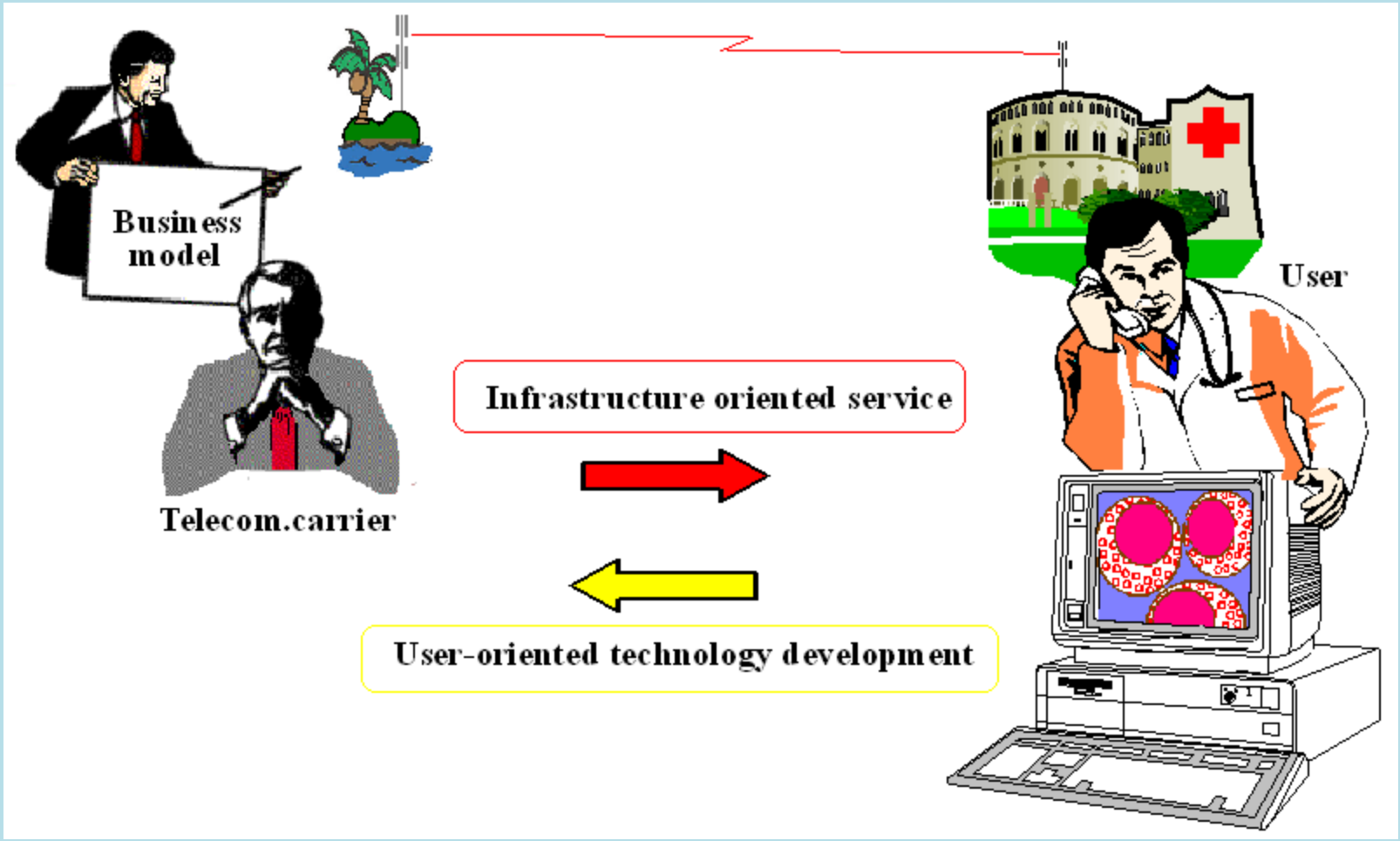


Emergency trips
434,206 patients/year

Advanced ambulance



Don’t you misunderstanding eHealth ?



Don’t you misunderstanding the EMTs?

Users

The EMTs are indifferent to medical matter

1. **Survival rate & pt's outcome**
2. **Advanced physical examinations**
3. **Medical cost**

My personal opinion:

EMTs can’t make a revolution for the prehospital care.

Only EMS doctors know the new solution!

Don’t you misunderstanding eHealth ?

Problems of public mobile phone

- **Frequency selective fading => suitable for data transmission from moving vehicle?**
- **Coverage => nationwide ?**
- **Call congestion after major disaster =>Independent circuit from the viewpoint of Homeland Security**

Frequency selective fading

S-band (2.4GHz propagation of suburban area)

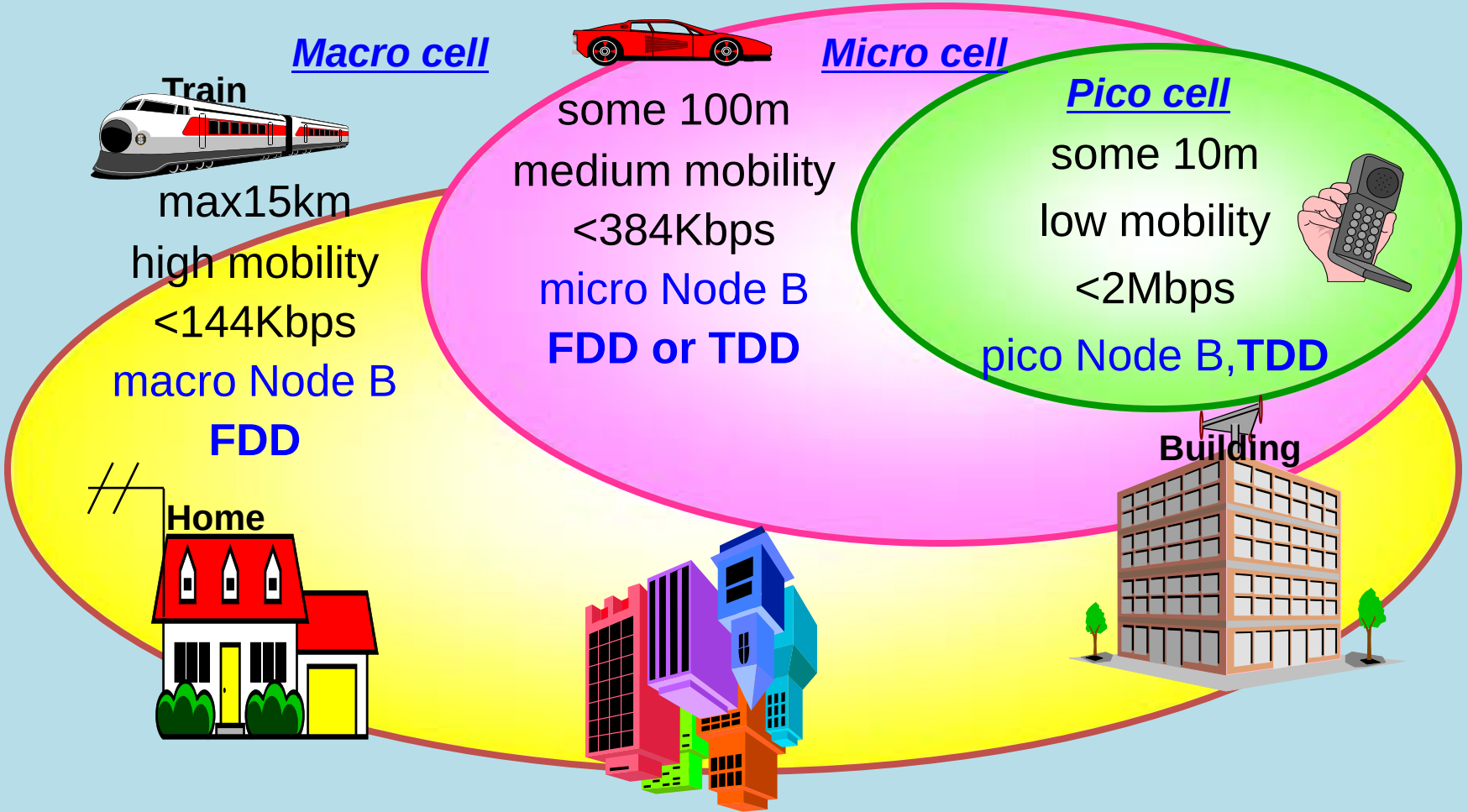
X: frequency(Width:20MHz) Y: receiving power

GPS data: N36.47360 E137.03308 Takaoka City Toyama

Direction of the vehicle 7 degree. On board antenna: Helical antenna

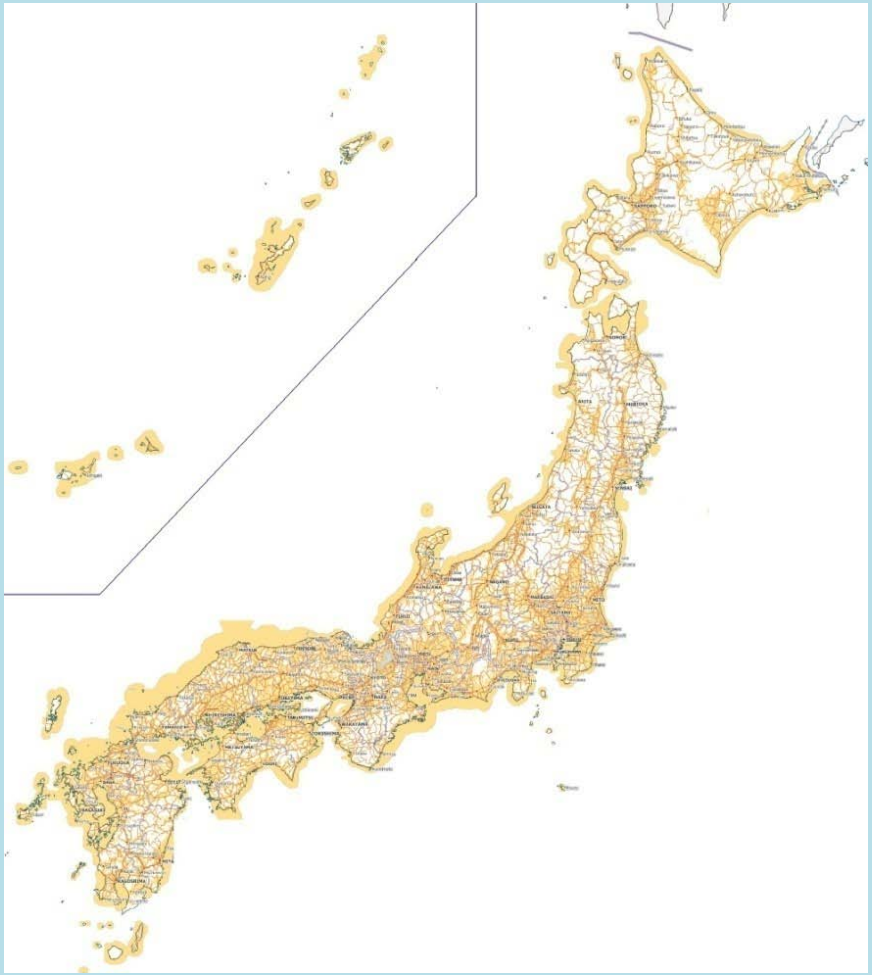
The 3G(IMT2000)

Data transmission at 2Mbps from moving cars is impossible with IMT2000 public lines. Then we assumed that 14x144kbps (FDD) lines will serve as the dedicated line of 2Mbps from ambulance. However, usually 256 kbps-terminal are provided.

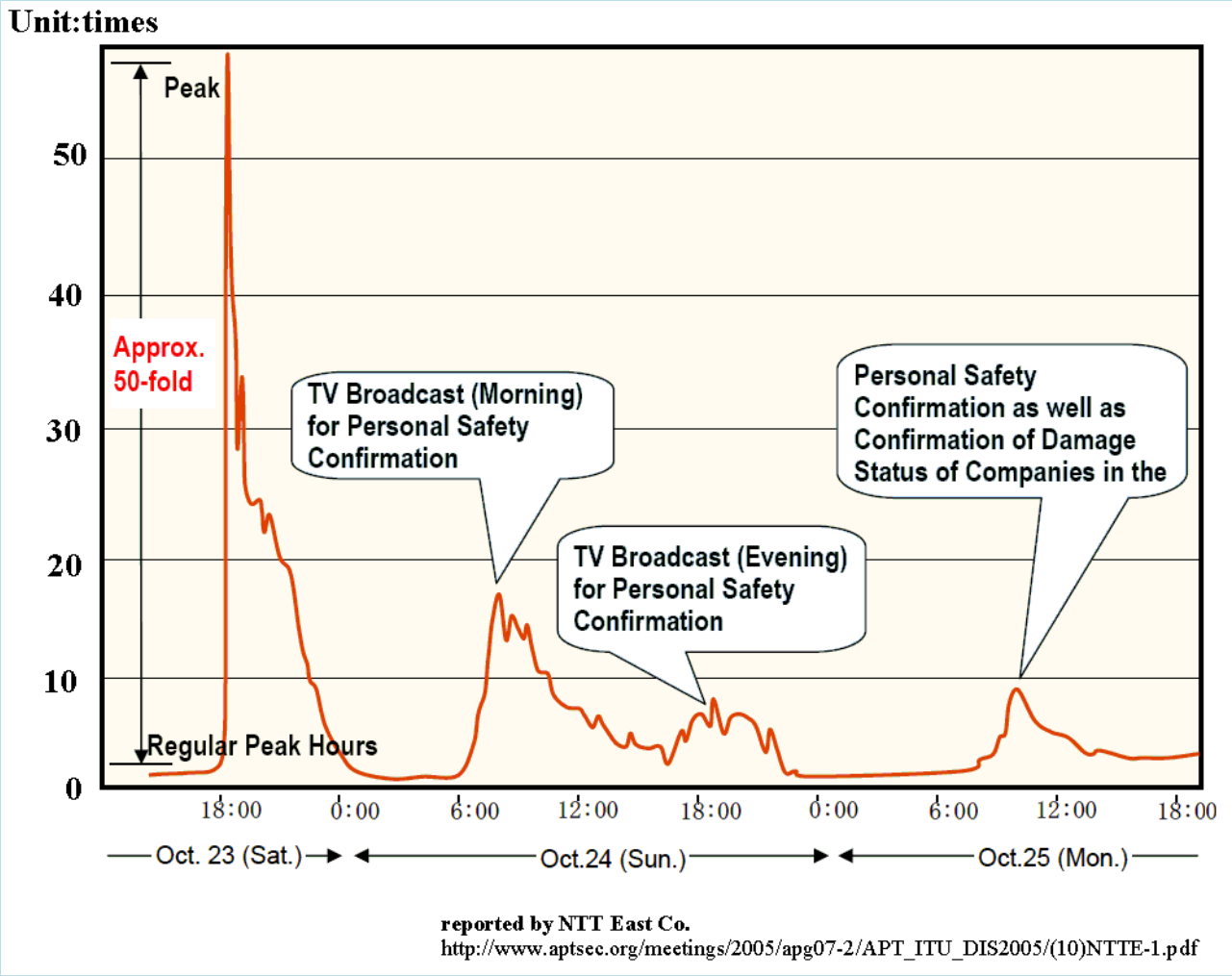


The coverage of 3G(FOMA）2009

With this, 98% of Japan's population was covered by the service at the end of December 2003. According to NTT DoCoMo North, NTT DoCoMo Hokkaido has achieved 100% **population coverage**.

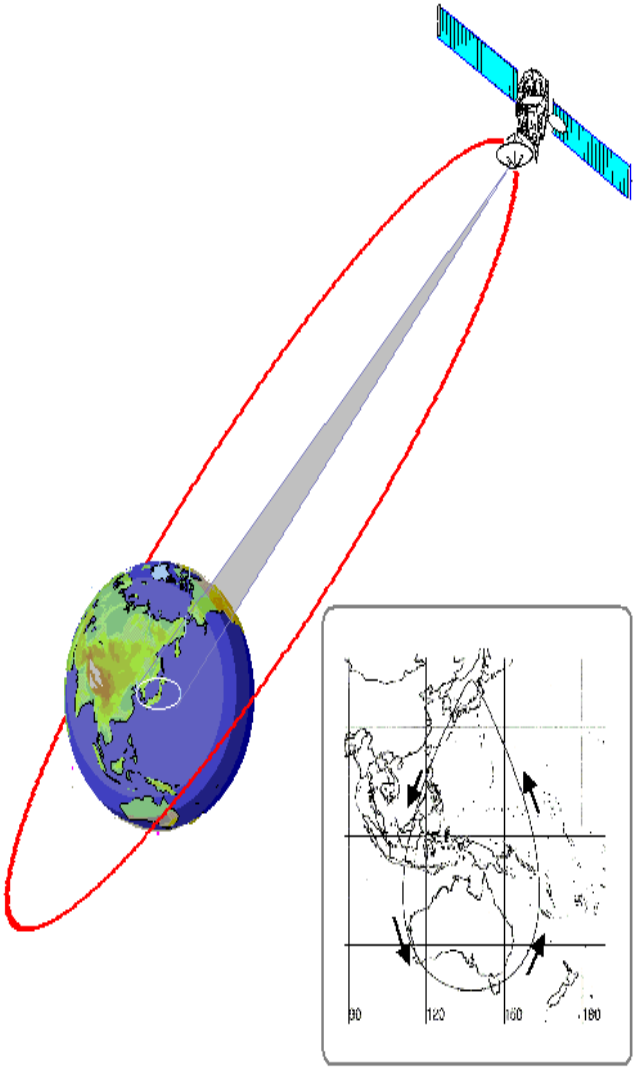


Traffic congestion after major disaster



reported by NTT East Co.
http://www.aptsec.org/meetings/2005/apg07-2/APT_ITU_DIS2005/(10)NTTE-1.pdf

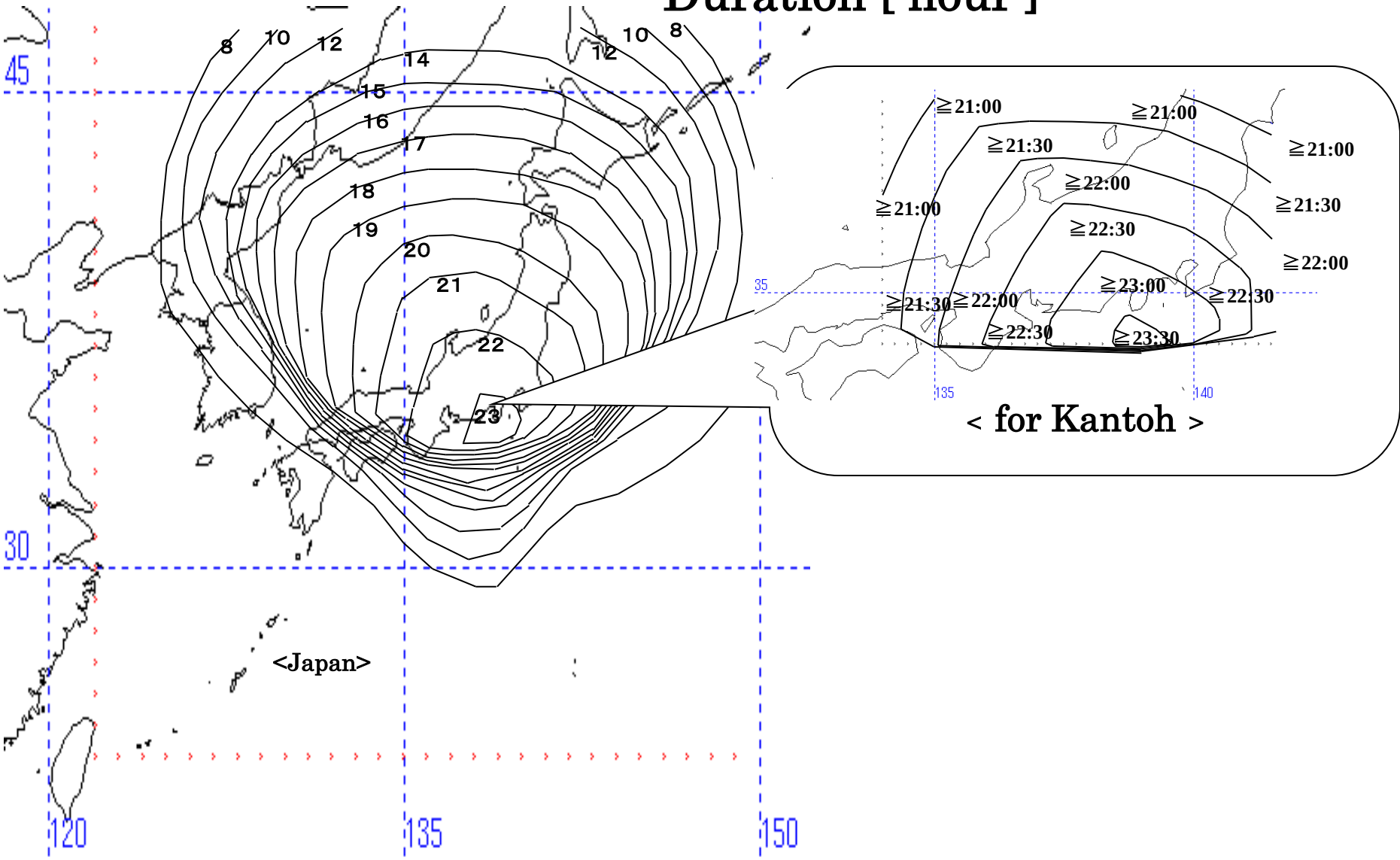
HEO tracking system on ambulance



GEO tracking from moving vehicle 80-100km/h

Calculated by T. Maeda, Hitachi

Elevation > 80 deg.
Duration [hour]



User-oriented technology development
< in-ambulance devices >

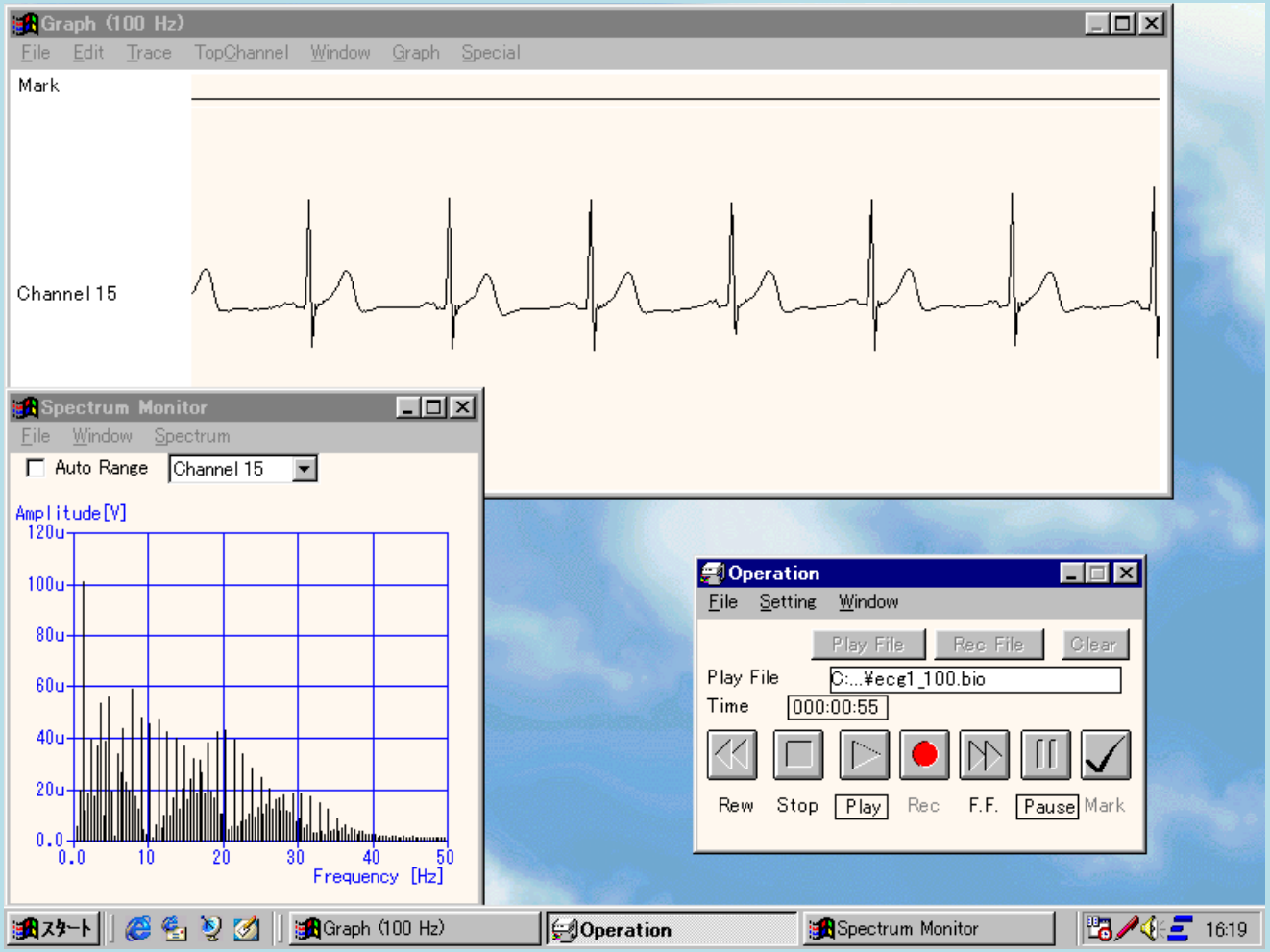
A: 12-lead electrocardiogram

B: Light reflex image (Pupillometer)

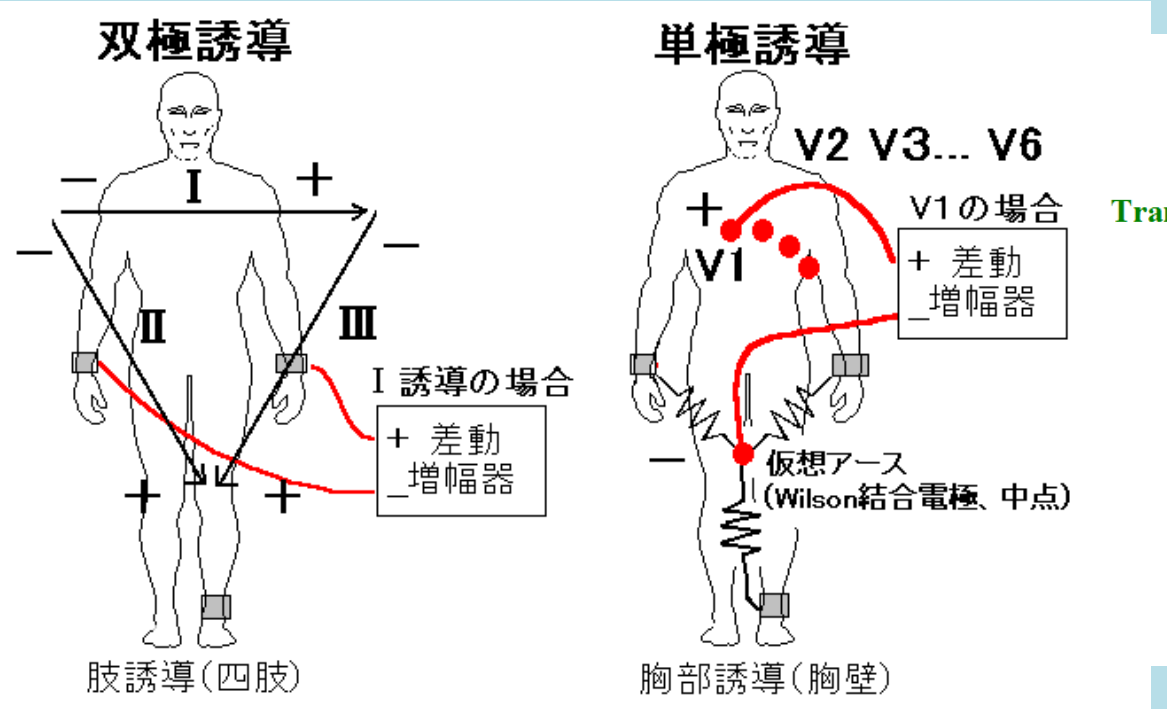
C: Macintosh with integrated type of CCD camera (Pharyngoscope)

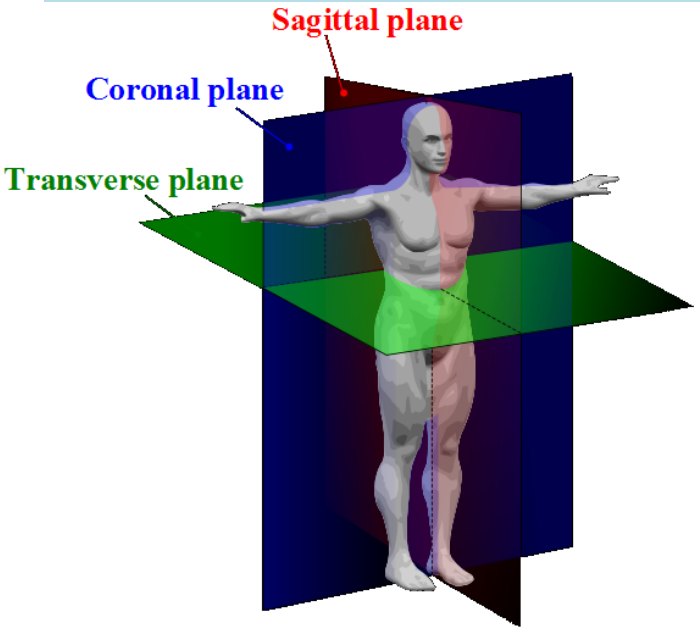
A: 12-lead electrocardiogram

Electrocardiogram of the limb-lead



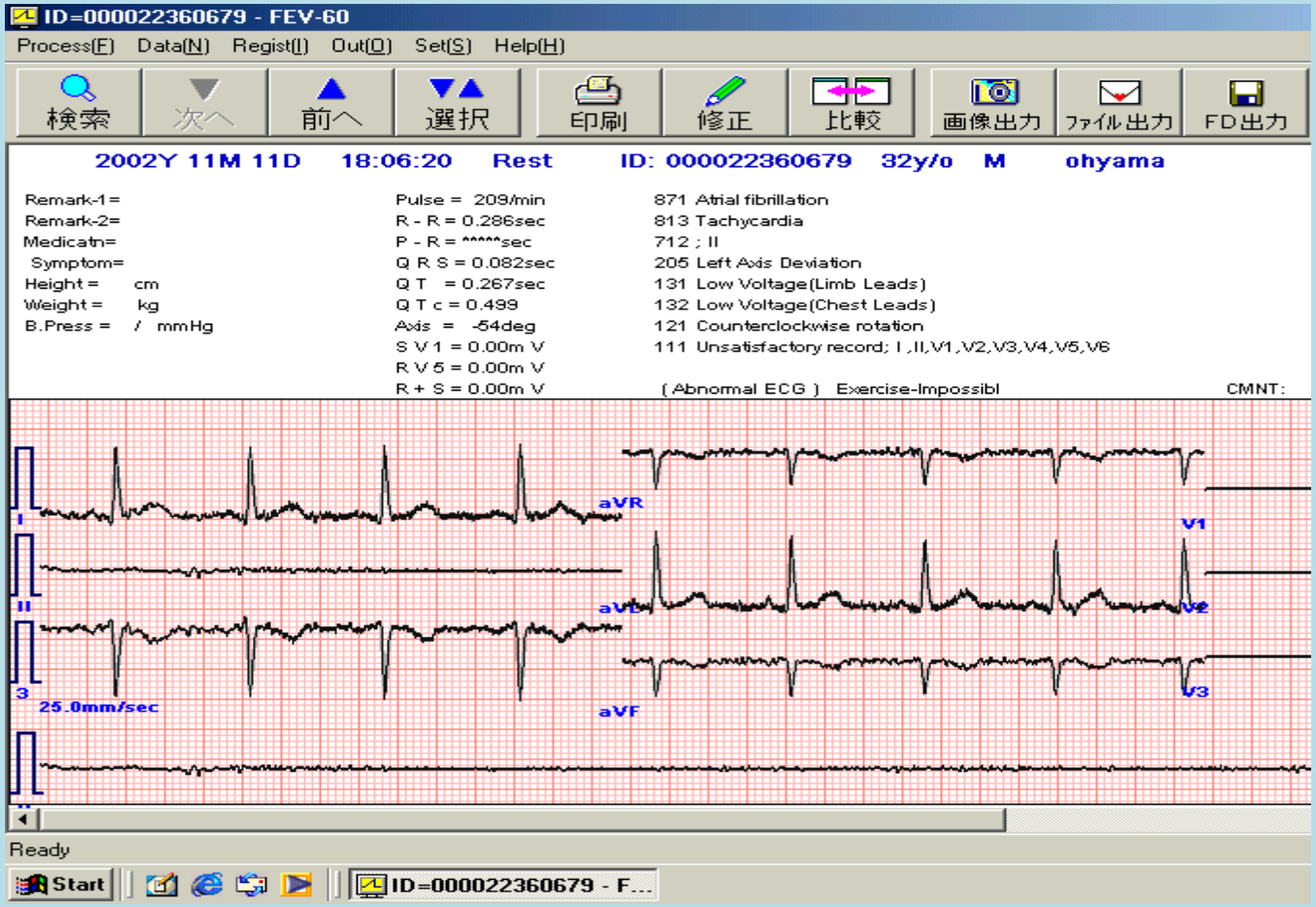
12-lead ECG



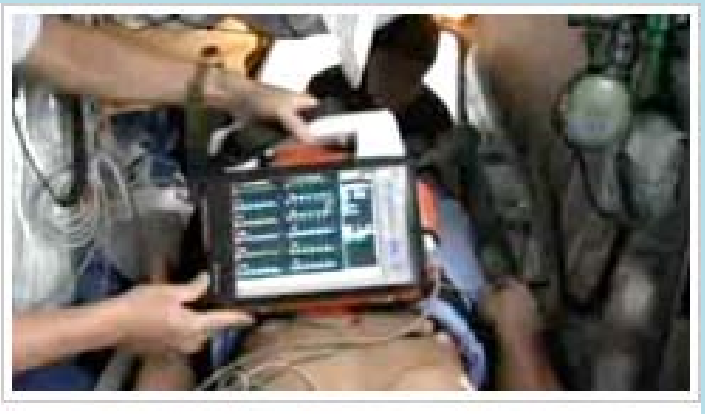


Coronal plane **Transverse plane**

12-lead ECG


ID=000022360679 - FEV-60
Process(P) Data(N) Regist(I) Out(O) Set(S) Help(H)
検索
次へ
前へ
選択
印刷
修正
比較
画像出力
ファイル出力
FD出力
2002Y 11M 11D 18:06:20 Rest ID: 000022360679 32y/o M ohyama
Remark-1 =
Remark-2=
Medicatn=
Symptom=
Height = cm
Weight = kg
B.Press = / mmHg
Pulse = 209/min
R - R = 0.286sec
P - R = *****sec
Q R S = 0.082sec
Q T = 0.267sec
Q T c = 0.499
Axis = -54deg
S V 1 = 0.00m V
R V 5 = 0.00m V
R + S = 0.00m V
871 Atrial fibrillation
813 Tachycardia
712 ; II
205 Left Axis Deviation
131 Low Voltage(Limb Leads)
132 Low Voltage(Chest Leads)
121 Counterclockwise rotation
111 Unsatisfactory record; I ,II,V1,V2,V3,V4,V5,V6
(Abnormal ECG) Exercise-Impossibl
CMNT:
I
II
3
aVR
aVL
aVF
V1
V2
V3
25.0mm/sec
Ready
Start
ID=000022360679 - F...

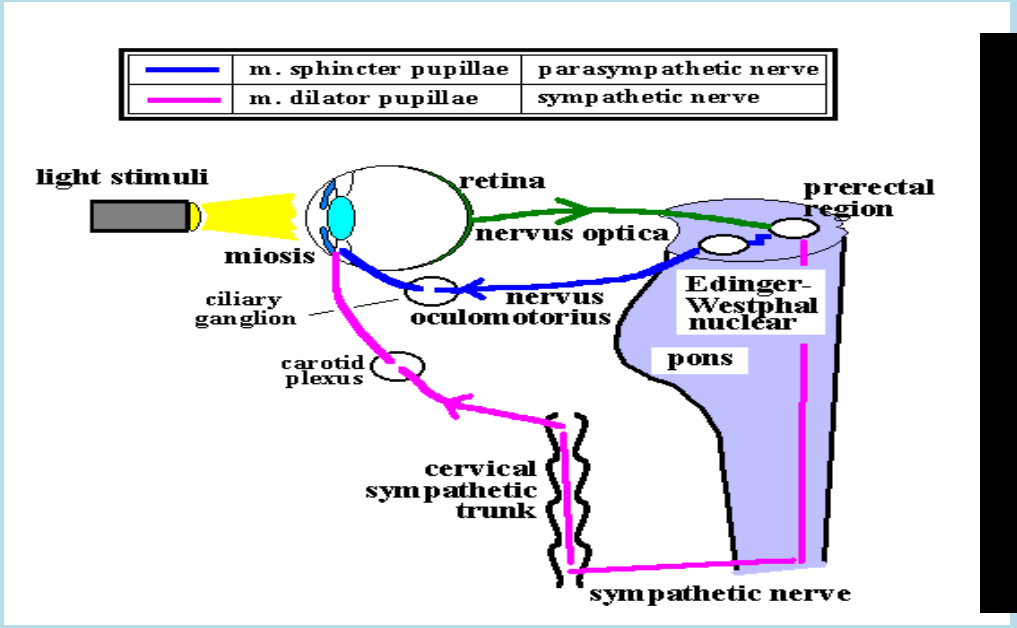
RadarCirc

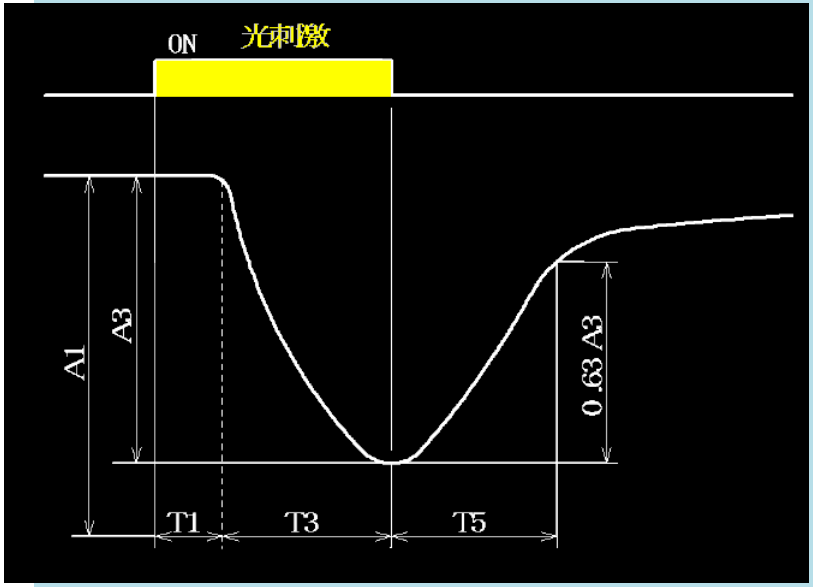


B: Light reflex image (Pupillometer)

Anatomy of the light reflection

light stimulation and the shrinkage curve





Laplacian filter

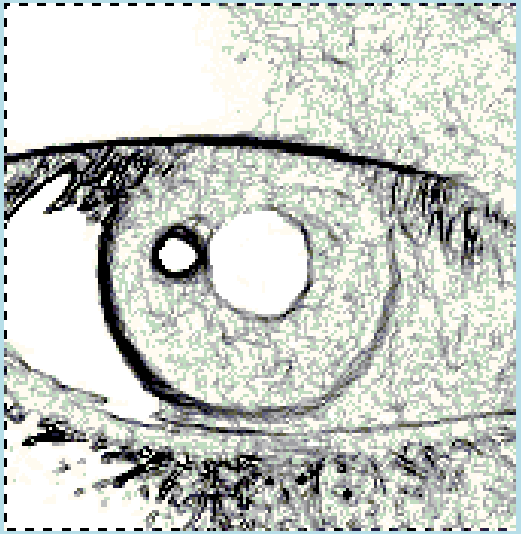
$$H(e^{j\omega 1}, e^{j\omega 2}) = 1 - H(e^{j\omega 1}, e^{j\omega 2})$$

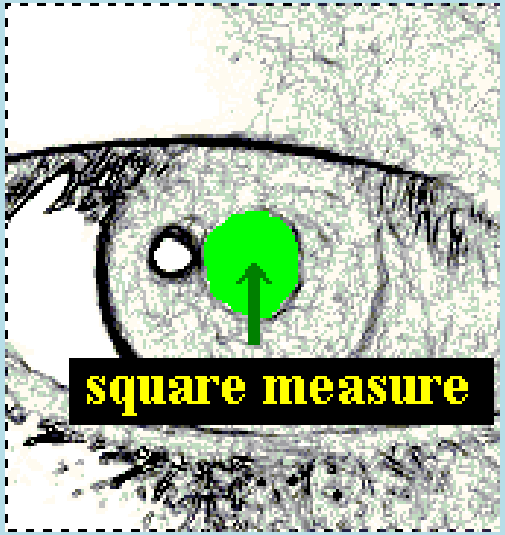
$$H(n1, n2) = \begin{pmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{pmatrix}$$

$$H(e^{j0}, e^{j0}) = 0$$

From the above, edge detection is possible.

Further, we varied the threshold gradation to extract the optimal edge as desired.



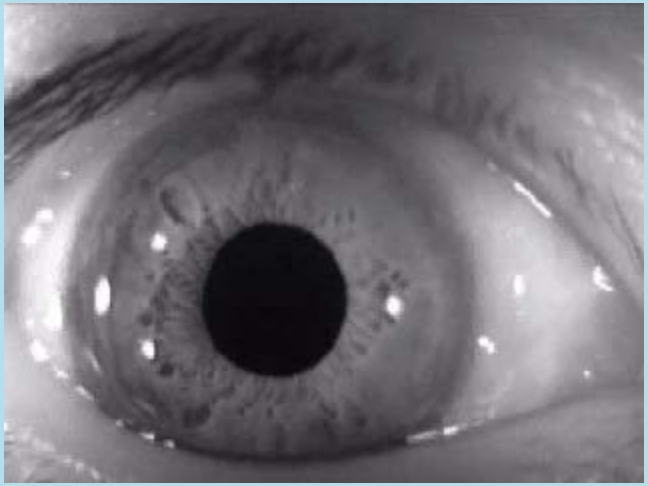


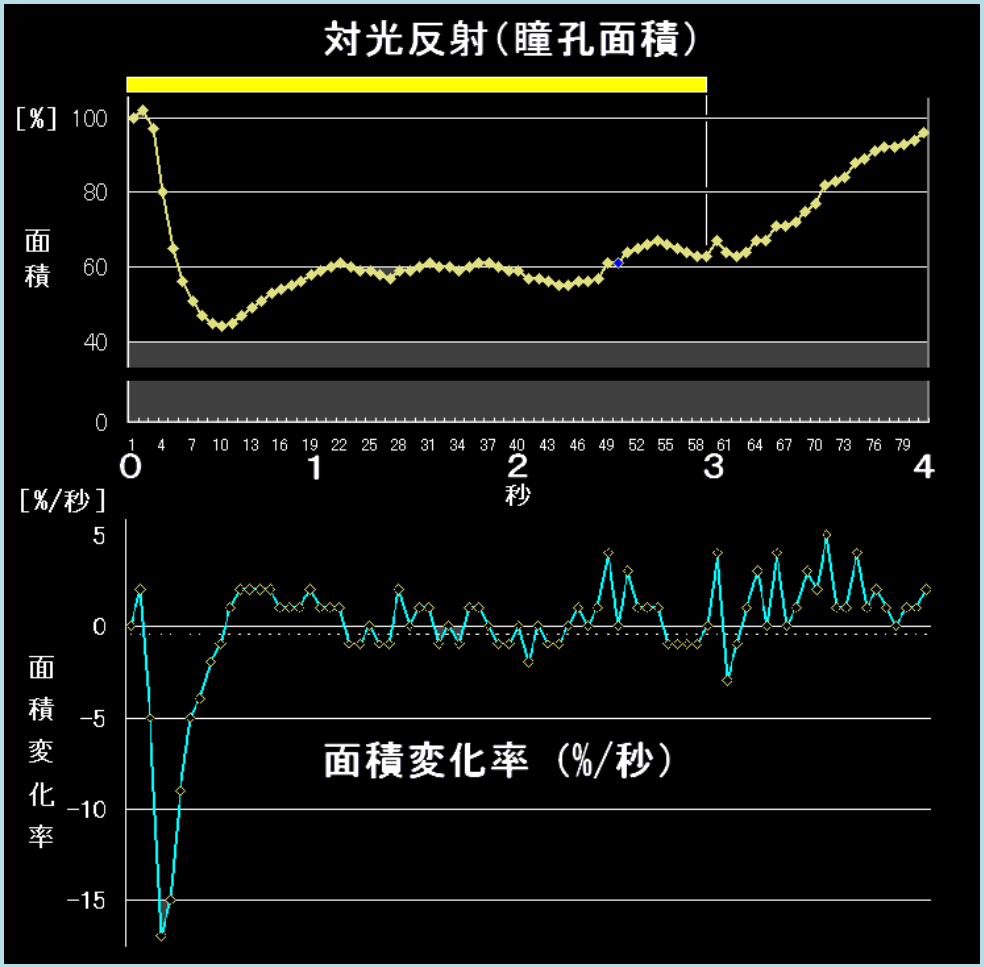
prototype

OS: Linux

measuring result

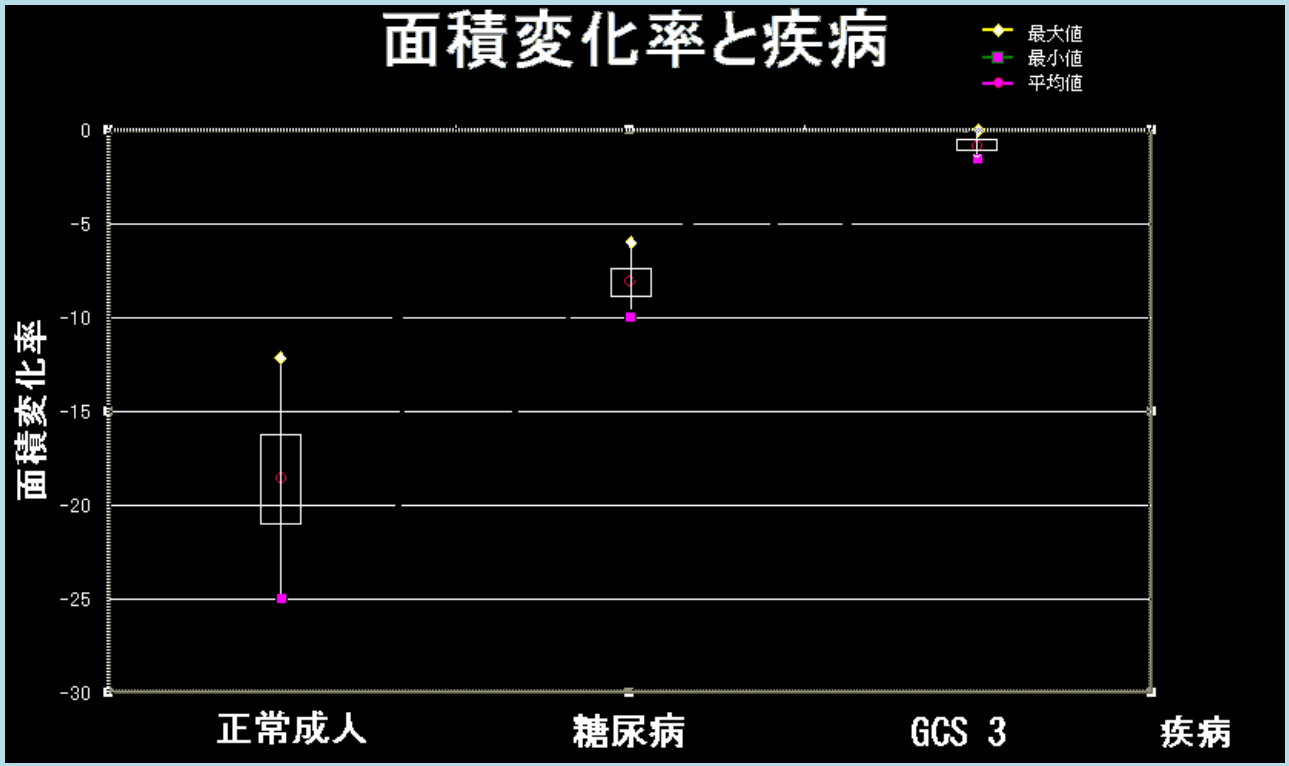
areal-velocity of the pupil



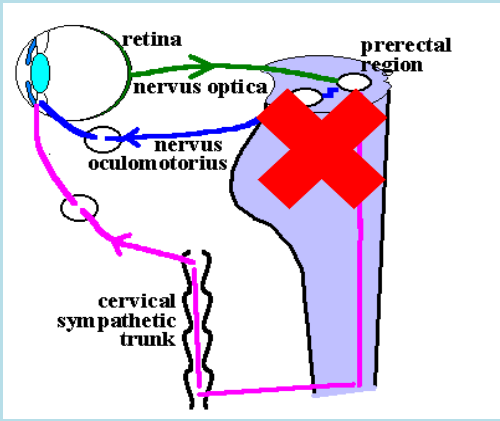


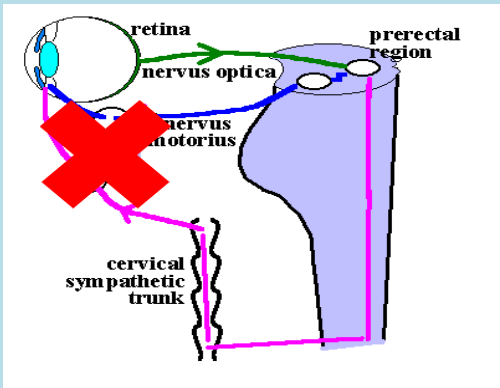
maximum velocity of change[%/sec.]

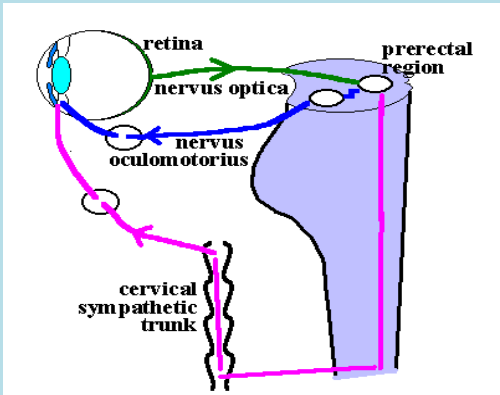
normal 20, DM 5, GCS3 5



normal Diabetes Mellitus GCS-3







C: Macintosh with integrated type of CCD camera (Pharyngoscope)

PENTAX
Airway Scope AWS-S100

- **Built-in LCD Monitoring Permits Fast and Accurate Tracheal Intubation**

output: NTSC

Considerations

1. **Listed advanced technology (user-oriented technology development A,B,C) makes a revolution of pre-hospital care system, improves the outcome of patients, and reduce a medical expense as the result.**

   A: 12-lead electrocardiogram
   B: Light reflex image (Pupillometer)
   C: Macintosh with integrated type of CCD camera (Pharyngoscope)

2. **Based on the policy of nationwide public service after major disaster(such as the Homeland Security of the U.S.), the suitable broadband wireless/satellite circuit shall be covered nationwide.**