Public Wireless Internet
- An Introduction to MIAKO.NET
http://www.miako.net

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MIAKO.NET Overview

- MIAKO.NET (Mobile Internet Access in KyotO) is a public wireless Internet service project in Kyoto Pref. Japan
  - Based on IEEE802.11b
  - `MIAKO' is also a Latin spelling of a Japanese word ``都''
    - a specific meaning of the ancient Japanese capital Kyoto (京都)}
  - Has already set up more than 300 access points in Kyoto
    - Some of them are outdoors
  - MIAKO.NET is its volunteerism business model
    - This is the most unique point

MIAKO.NET Purposes

- Provides Global Fixed IP Addresses and the real Internet to everyone, everywere
- With pretty good security
  protected from
  - Tapping,
  - Illegal users (they may send SPAM or virus mails)
  - Man-in-the-middle attacks utilizing bogus APs

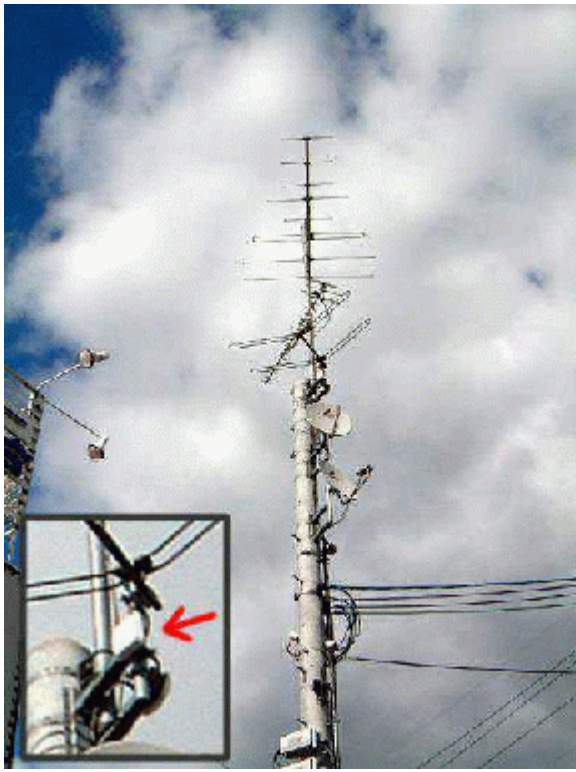
History of MIAKO.NET

2001.11.30	SCCJ Kyoto Research Meeting 2001
	The basic plot is designed after the all-night discussion.
2001.12	The first nucleus meeting at Kyoto University
	The project is named as ``MIAKO.NET''.
2002.1-2	Call for contributers and donaters for the first-stage 100 access points.
2002.3.26-28	Exhibition at the 1st international KEITAI forum in Kyoto.
2002.5.10	MIAKO.NET opened and started user service.
2002.7	Location dependent contents delivery service using IP anycast
	during GION MATSURI summer festival.
2002.11	Call for contributors for the second-stage 200 access points.
2003.2	The new connection method MIAKO2, based on PPTP, has been supported
2003.4	All access points support IPv6
2003.5.10	The first anniversary

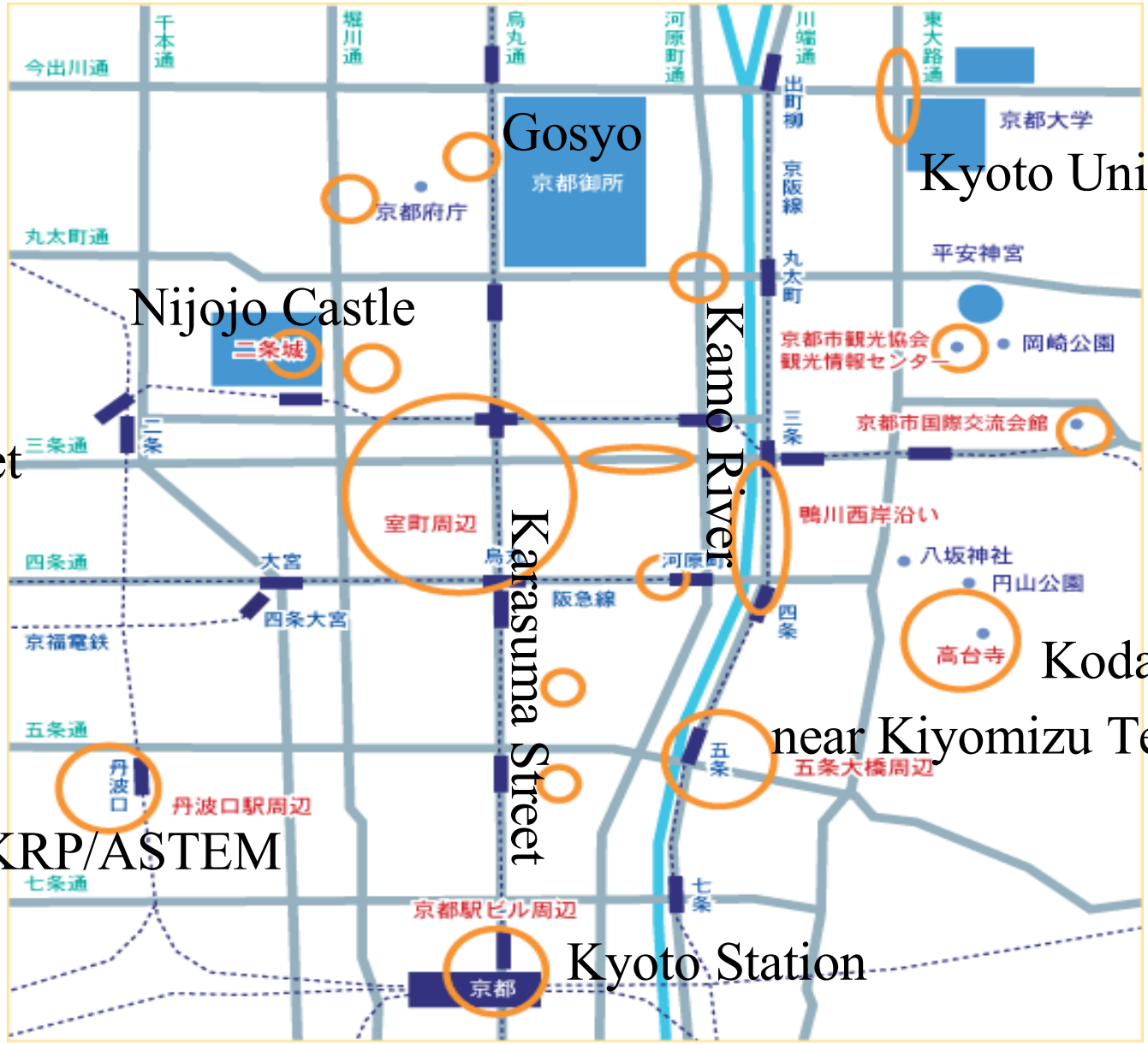
Basic Principles of MIAKO.NET

- MIAKO.NET is intended to attract visitors and tourists in large areas
- Many APs are equipped with outdoor long-range antennas
- Our service is intended to be used not only by notebook PC users, but also by advanced PDA
  - PDA users try to get information via Internet even when walking.
- List of representative service areas

AREA	description	# of APs
Kyoto St.	Buildings and squares around JR Kyoto Station	9
KRP	Kyoto Research Park, ASTEM, JR Tanbaguchi St.	11
Kodaiji	Kodaiji Temple, the Museum and walks	12
Kamo Riv.	Riverbed walk of the Kamo River	12
Muromachi	HOKOCHO area the prade floats (HOKO) stands)	51

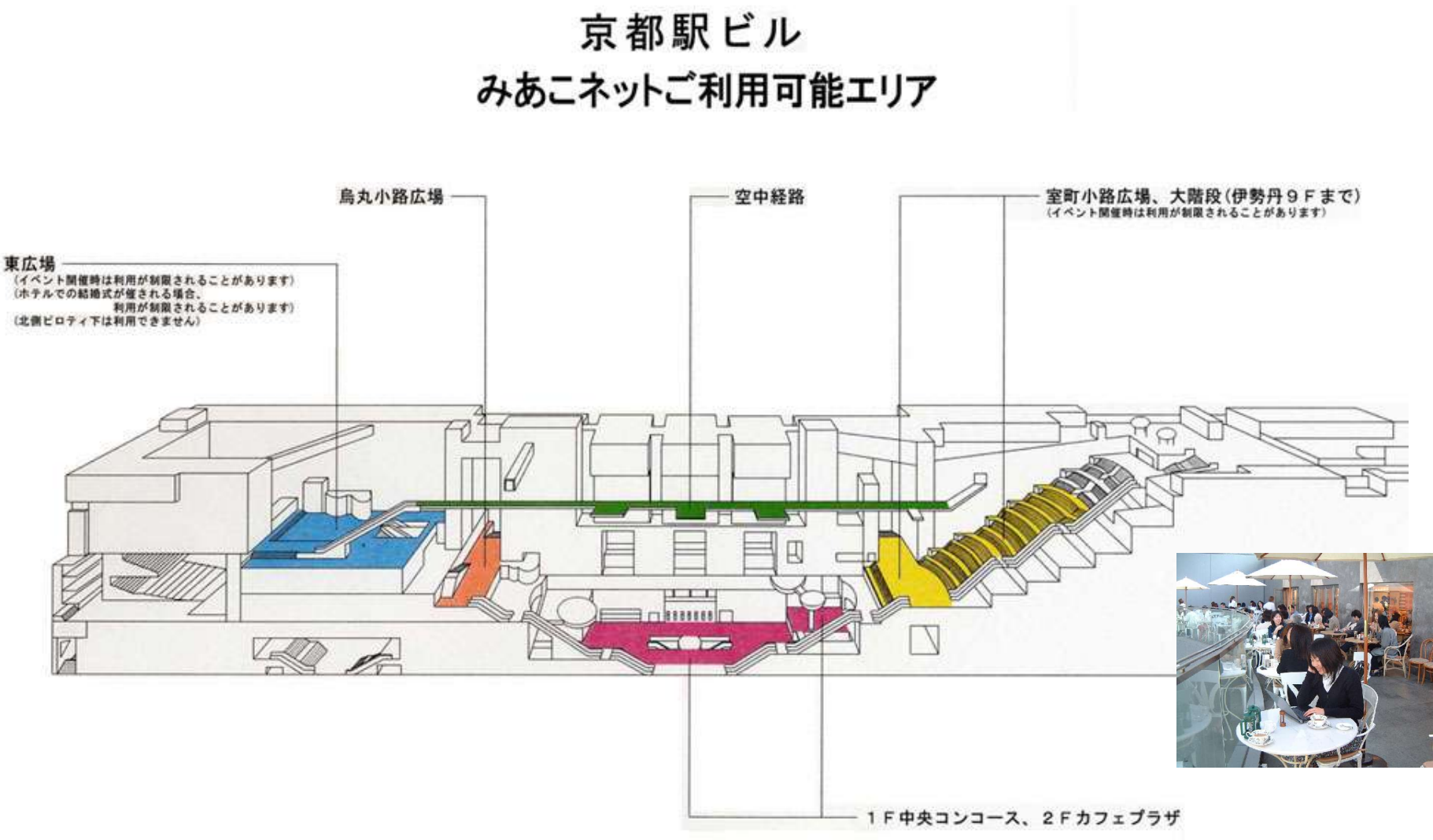


MIAKO.NET Area Map in Kyoto City



Kyoto Station

Three APs seamlessly covers the entrance hall of the Kyoto Station Building



Tee room at KITAZA nearby the KAMO Riv.; not only residents but also tourists enjoy MIAKO.NET

Temples (Nene-no michi)

Temples (Kodaiji)

Open Cafe

Kamo River

Free Service and the Business Model

- MIAKO.NET is a joint project by
  - The Sustainable Community Center Japan (SCCJ; an NPO)
  - Kyoto University (a national university)
  - The Advanced Software Technology and Mechatronics Research Institute of Kyoto (ASTEM RI; a municipal third sector research organization)
- MIAKO.NET is supported by many citizens, some universities, local governments and industries
- The initial cost of buying hardwares (APs and servers) is supported by governmental research funds
- While the running cost of operating servers, serving broadband uplink, issuing user accounts and all other management issues are supported by volunteers

GION MATSURI (祇園祭) Business Model

- Spreading the service area of MIAKO.NET attracts people in Kyoto and reinvigorates the local economies, and this gives something to the volunteers in return;
- We have named this model as ``GION MATSURI (祇園祭) business model", after the famous summer festival in Kyoto, in joke.

Assigning Global IP Addresses

- MIAKO.NET assigns all our registered users their own fixed global IPv4 addresses each, without any fee
  - Free from evil NAT!
- Assigning a global fixed IP address for each node is valuable rather in mobile situation
- It makes drastically easy for the mobile node user to have a mobile server
  - such as live-video stream server, and VoIP phones

Security Considerations

- We have to prevent from
  - Tapping,
  - Illegal users (they may send SPAM or virus mails)
  - Man-in-the-middle attacks utilizing bogus APs.
- The secret key of WEP is shared by all users, and it gives no protection against tapping by another user who has the key
- IEEE802.1x (or ongoing IEEE802.11i standardization) might be a good solution, but APs and RADIUS servers cost much

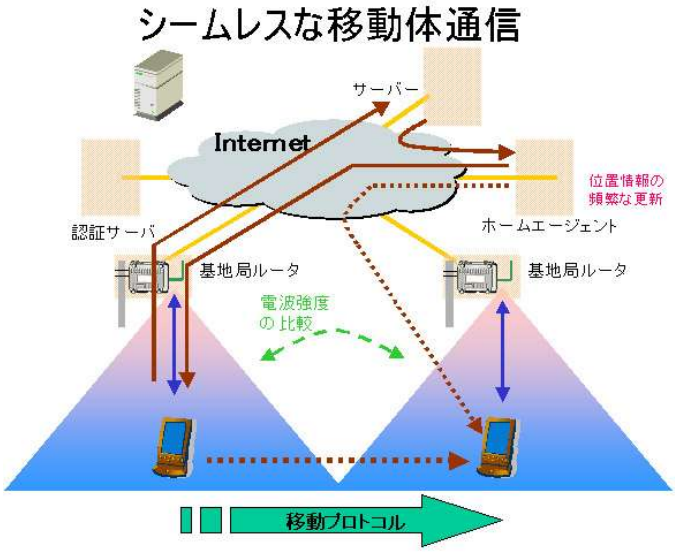
Insted we adopted VPN solutions

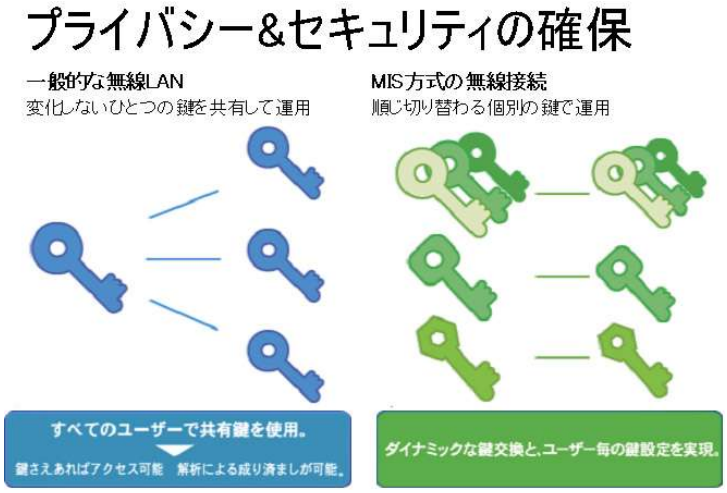
Adopted Two Techniques of Assingning Global IP Addresses

- MIAKO.NET I (Mobile IP and MBA protocol)
  - IETF Mobile IP
  - MBA (Mobile Broadband Assosication) authentication protocol
    - Originally designed by MBA, using RADIUS
  - Provides real mobility
  - Mainly on PDA clients
- MIAKO.NET II (Microsoft PPTP)
  - Advantage in easiness of initial setting up
  - PPTP is shipped as a standard component with client OS like Windows98/Me/2000/XP and Mac OS X

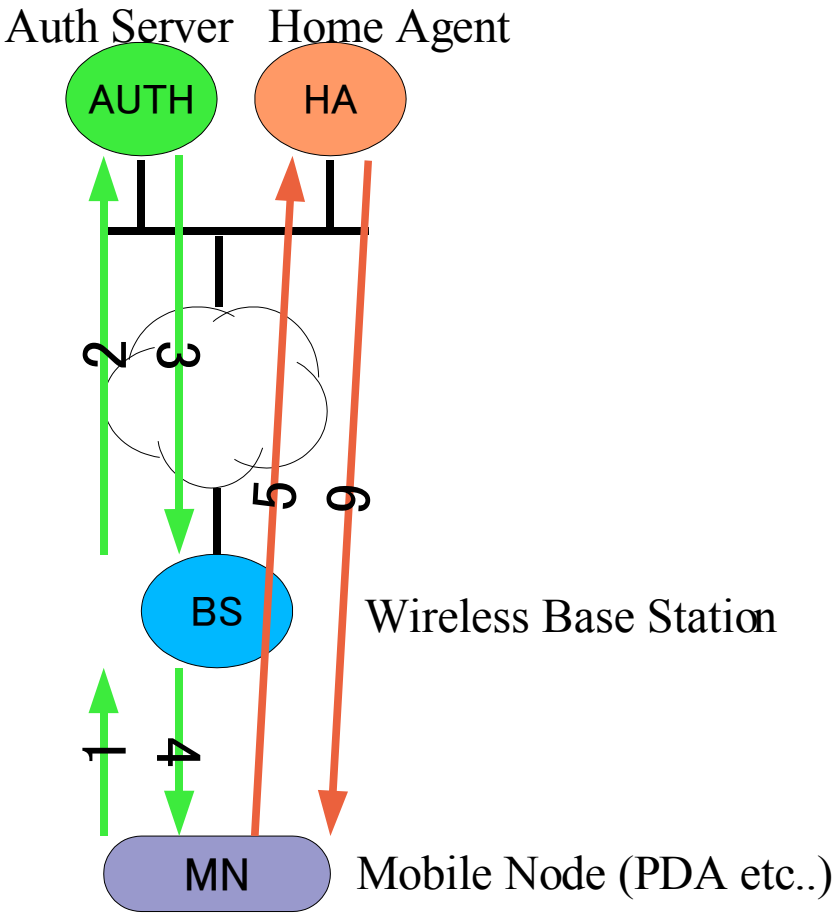
MIAKO.NET I Technologies

- Mobility
  - MobileIP+MBA Fast Authentication Protocol
  - A fixed global IP address is assigend to mobile terminals
- Security
  - Haigh-level securty that dinamically changes keys different to each user
  - Two levels of authentication by base station and home agent
    - Tapping
    - Illegal users (they may send SPAM or virus mails)
    - Man-in-the-middle attacks utilizing bogus APs





MIAKO.NET I Protocol Sequence



MBA Authentication Protocol

- Scan available wireless channel
- Authentication
- Registration to HomeAgent (HA)
  HA manages HomeAddress (fixed IPv4 address) of MobileNode(MN)

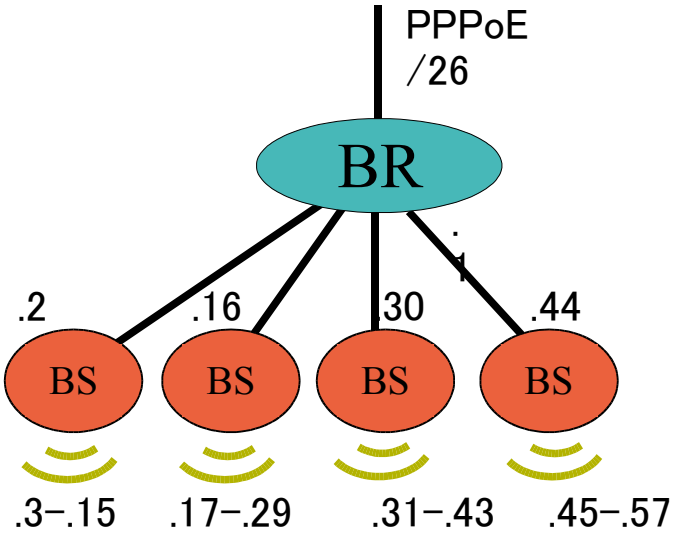
- 1-4 MN and WR(Wireless Router) are authenticated by AUTH server and RW assigns CoA (Care of Address which depends on location) to MN
- 5-6 MN registers own CoA to HA

After that.. MN communiate other hosts via Home Address

Settings of MIAKO.NET I Base Station

- Assign more than 10 fixed global IP addresses to a wirelss base station for CoA (Care of Address)!!
- Assign /26 or /27 global IP address to a broadband router (BR) using PPPoE (PPP over Ethernet)
- 1～4 base stations are set up under a BR
  - /27 global address for 1～2
  - /26 global address for 3～4

→Very complicated setting process because of varios setting patterns



Problems of MIAKO.NET I

- A lot of costs of base station settings
  - No auto-configuration
  - Have to go to actual places for setting BS's
- PPPoE is restricted in Kyoto Pref. (because of dependence of regional ISP in Kyoto)
  - Need a broadband router (in addition to a base station)
  - Require a new Internet line (even if the line is already installed)
- MobileIP and MBA Protocol is over spec.
  - May be suitable for Internet cellular phone or etc.
  - Few peaple walk using note PCs
  - Require a specific driver software, and only supports Winodws (Not MacOS)

Design of MIAKO.NET II

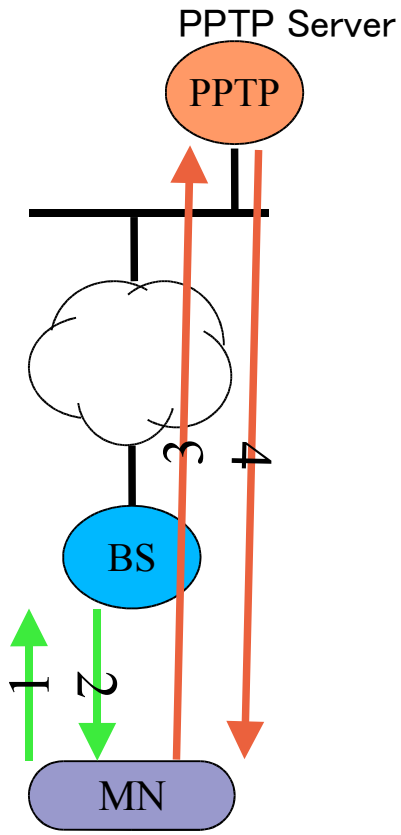
- Principles
  - Security is the most important
  - Fixed IP address for every user
  - More easilly use
    - Not requires a specific driver software
    - OS-free, and open protocol (Windows, Mac, UNIX)
  - No fast hand-over (not required for note PCs)

⇒ New Method using VPN (MS PPTP)

  - However, MIAKO.NET I can be also used

- Reduce BS's setting costs
  - Deliver already-set-up BS's
  - Not required for a broadband router
  - BS's can be set up under already-installed Internet line
- On-line account issuance

Authentication technology of MIAKO.NET II



1～2

A BS assignes an IP address to a MN by DHCP

Filtered to the connection to the Internet, only can connect to VPN (PPTP) Servers.

3～4

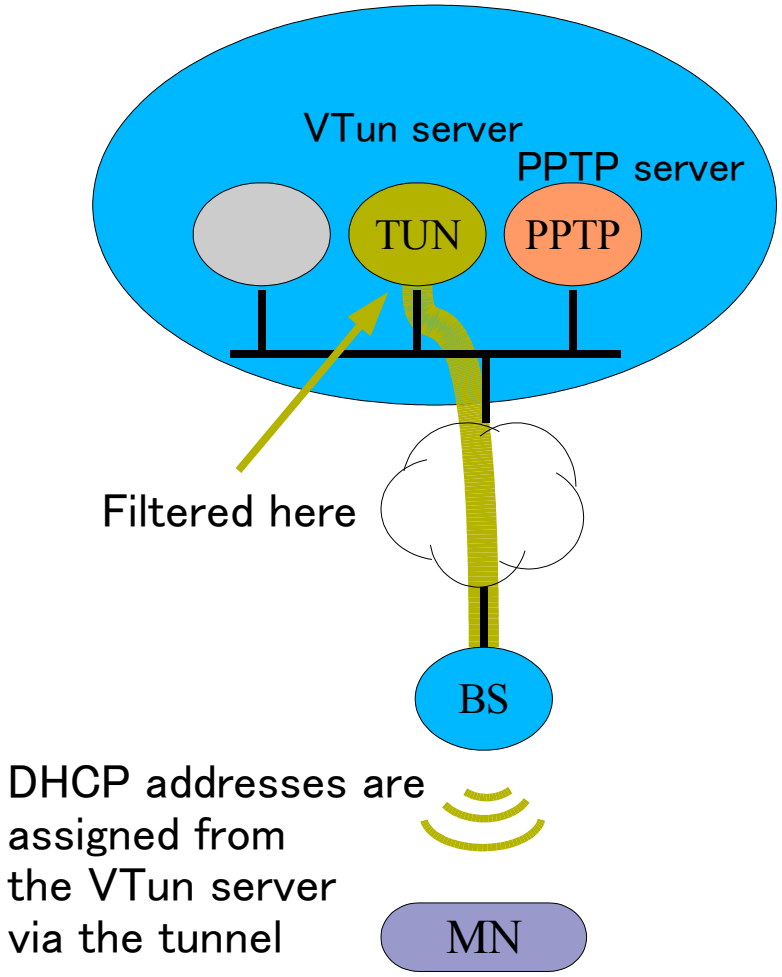
The MN requests authentication to the PPTP Server with the assigned IP address, then making a VPN tunnel, and is assigned the fixed IP address of the MN

After this, the MN connect to the Internet via the VPN tunnel

※When a MN moves from a BS to another, another DHCP address is assigned, so PPTP session is once cleared, and the MN has to re-start PPTP session

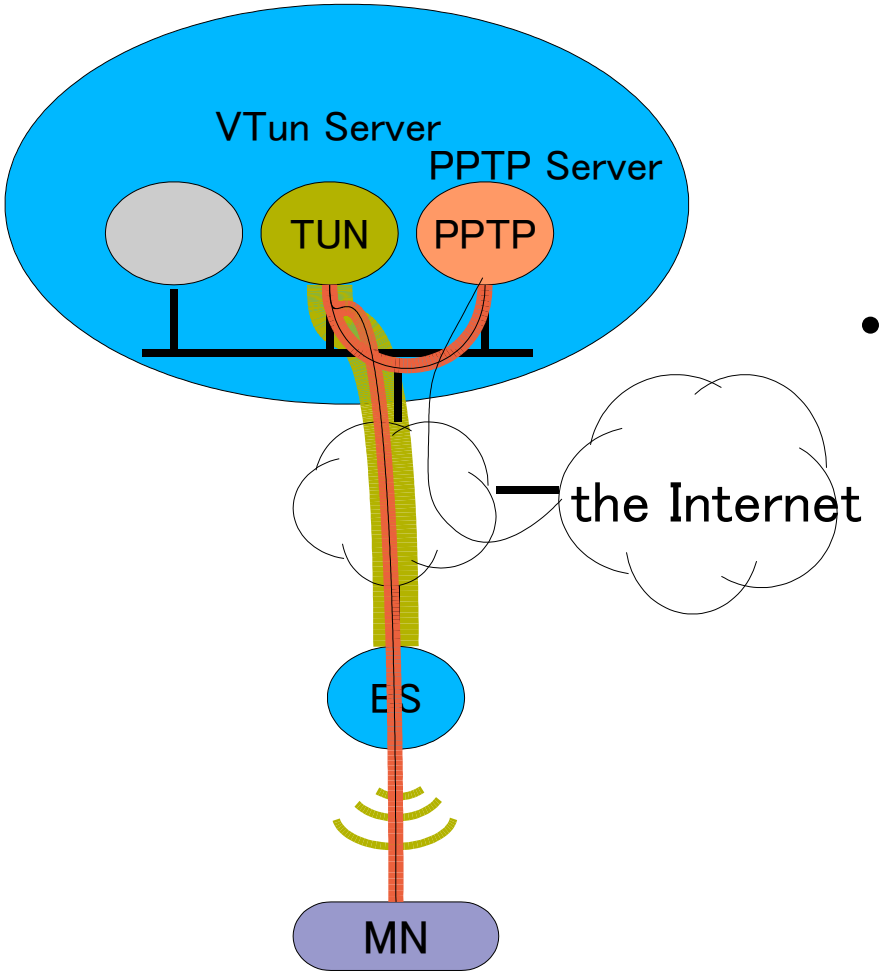
(Note that BS's do not share the Internet Line)

How to connect to the Internet for BS



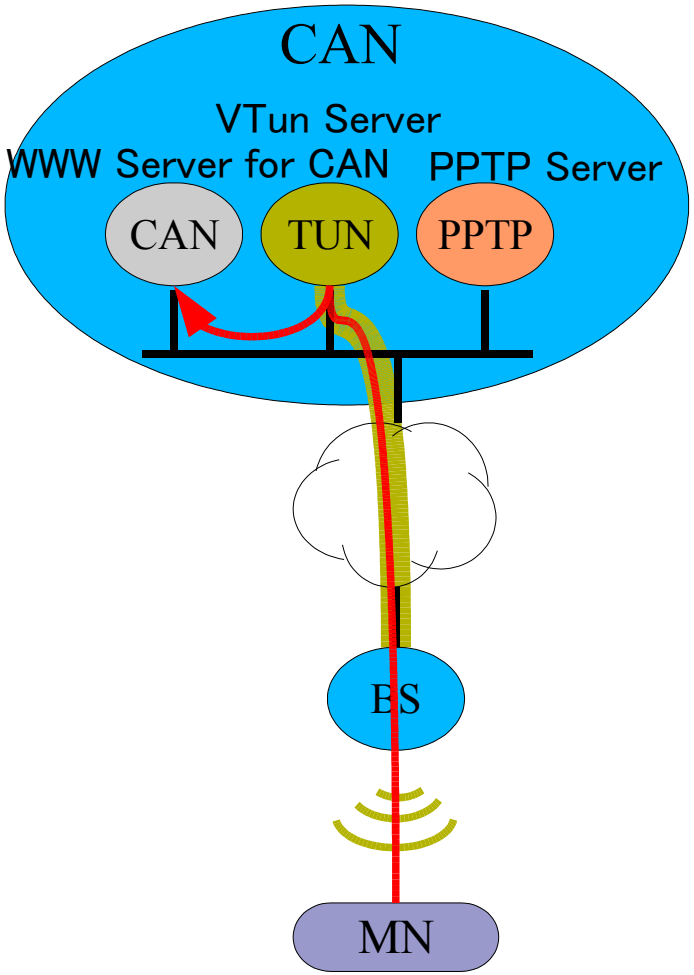
- In a base station, the VTun(IP overTCP)tunnel function is installed.
- A BS makes a tunnel to the Vtun tunnel server (TUN), and obtains address for DHCP delivery
  - Tunnels of TCP →Can set BS's under various Internet environment, including NAT.
  - Deliver VTun pre-install BS's
- Can set various filters on the VTun Server
  - Prohibit Internet connection from DHCP addresses
  - Allow connecting PPTP servers

Communication to the Internet on MIAKO.NET II



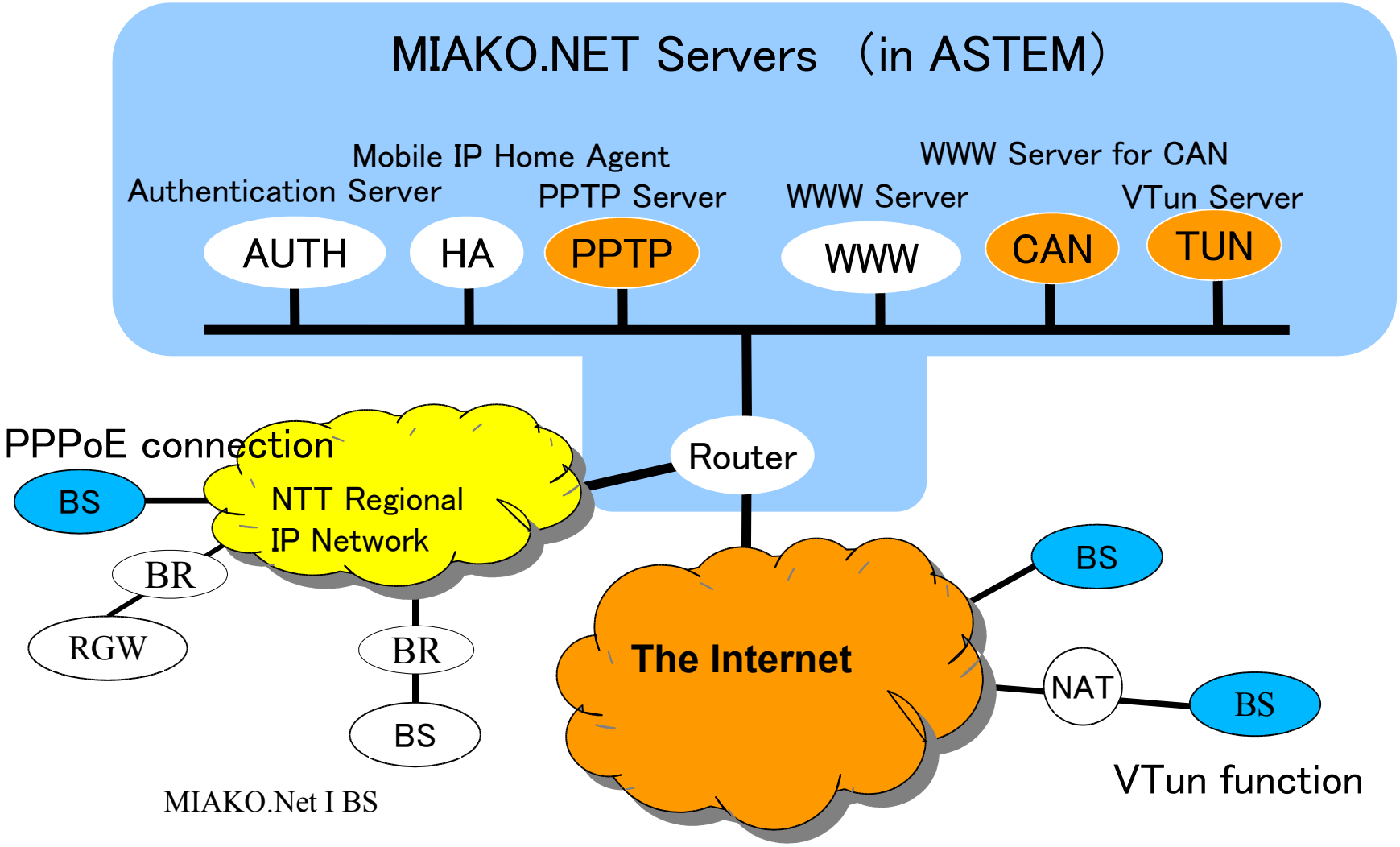
- Use VPN (PPTP) anytime
  - Encryption of all the communication
  - MS CHAP 2 supports mutual authentication
    →Free from bogus BS's
- IP over PPTP over VTun
  = IP over IP over TCP over IP

Mechanisms of CAN



- Community Area Network (CAN)
- Allows connection from not-authenticated clients
  - WWW server
    - How to use PPTP is written
    - BBS closed to CAN
- Without any special setting, releaves users "We are connected"
  - better than MIAKO.NET I
- All the not-authenticated clients are redirected to CAN
  - Easy setting because all the connection passes through the VTun server

Network Configuration of MIAKO.NET I/II



Update Method of Base Stations

- A BS is based on NetBSD (ease additon of new features)
- Contents of Updates(the actual cases belov
  - Changes of filter settings
  - Kernel updates
    - Inhivited communication of clients under the same I
    - Driver updates for supporting a specific clients drive
  - Improve restoration of VTun
  - Adding experimental functions (IPv6, Multicast)
  - Altering a wireless channel
- Made setting script for remote updates
  - All the updates is done within a hour or less

Account Issuance

- Issue accounts without payment,
  but register to whom accounts are issued
- Issued to general users at the issuance window
  (from the time of MIAKO.NET I)
- Issude specific users on-line
  (cost-down by automation)
  - Students/Staff of University attending the MIAKO.NET Project
  - Users of ISP's addending the project
  - Users are guarantee by using mail accounts including domains of the universities or the ISP's

On-line Issuance Procedure

Connects with HTTPS to the temporary registration page,
and inputs name, mail address, and temporary pass phrase
Access restriction by the range of IP addresses

User

Sends URL for the registration page
and temporary password

Connects with HTTPS to the URL,
and inputs temporary pass phrase and
temporary password

On-line
Accaount Issuance Server

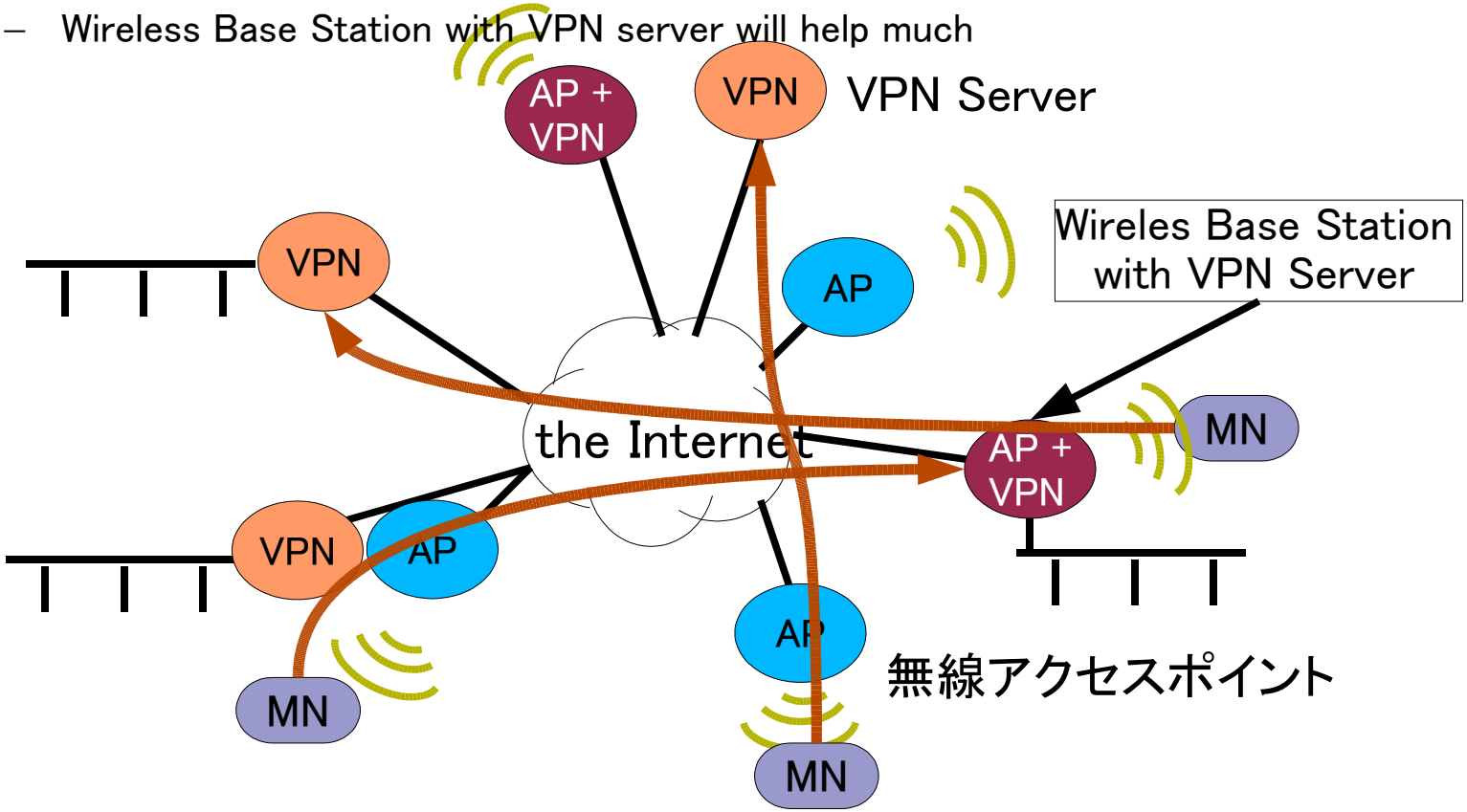
Shows PPTP account and passwd with HTTPS

Problems of MIAKO.NET II

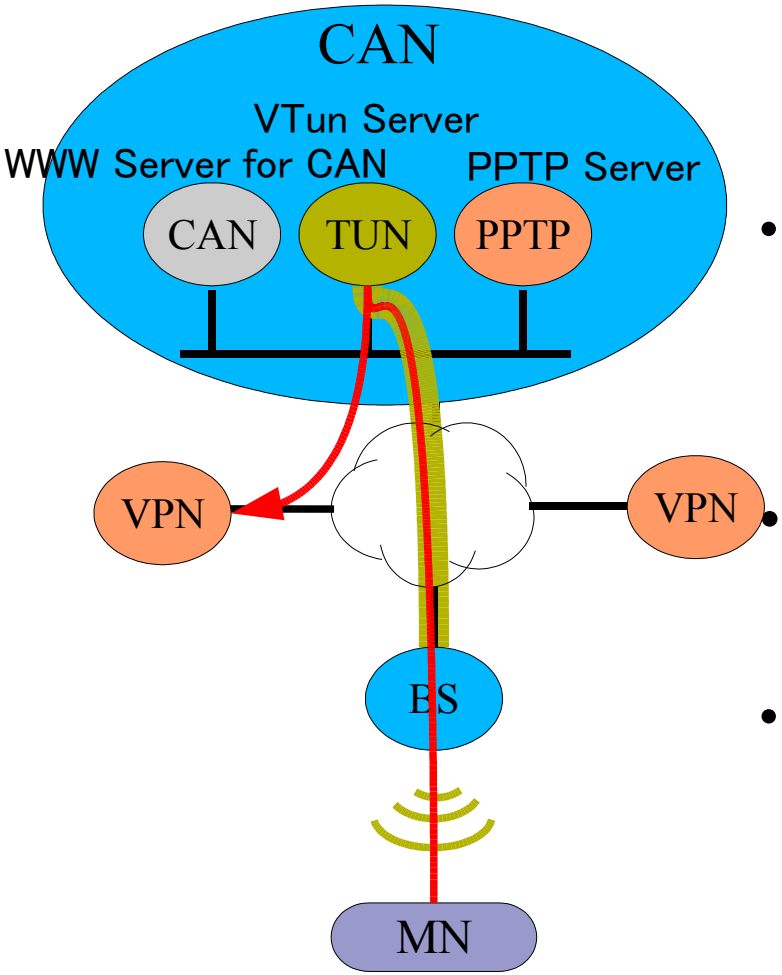
- All the communication passes through the central servers, this costs much
  - Load and bandwidth of the VTun server
  - Communication speed of the VTun server is low
  - Load and bandwidth of the PPTP Servers
  - Many tunnels
- We annot manage so many accounts when the users increase more because we are an NPO
- Cannot manage wireless base stations when they increase more

MIAKO.NET III (Preparing)

- Do not have central servers
- Wireless BS's are located widly, which only allow VPN protocols
  Do not necessarily have to manage BS's
- Users connects to a certain VPN server somewhere, then connect to the Internet
- Not only campanies, but also individuals can run VPN servers
  - Wireless Base Station with VPN server will help much



MIAKO.NET 2.5 (Current Status)



- A MN can access VPN servers with specific protocols with a DHCP address assigned by BS's
  - PPTP, L2TP, IPsec, SSH, etc.
- MN's can use VPN servers outside MIAKO CAN
  - If you already have a VPN server, you do not need a MIAKO account
- THE MOST IMPORTANT THING is that a user uses his own IP address (provided by his own VPN server) to connect to the Internet
- Even if a user execute crime, we do not have owe responsibility because our IP address is invisible to victims

MIAKO.phone overview

- As a research work by ourselves, we provide the "MIAKO.phone" wireless mobile Internet phone service experimentally.
- The service is based on the peer-to-peer VoIP protocol (NOTASIP)
  - Note that in MIAKO.NET all mobile node has its own fixed location-independent global IP address!
- Prototype client software works on small WindowsCE PDAs
- We also serve gateways so that our clients can get phone calls from PSTN system with ordinally dial-in phone numbers.

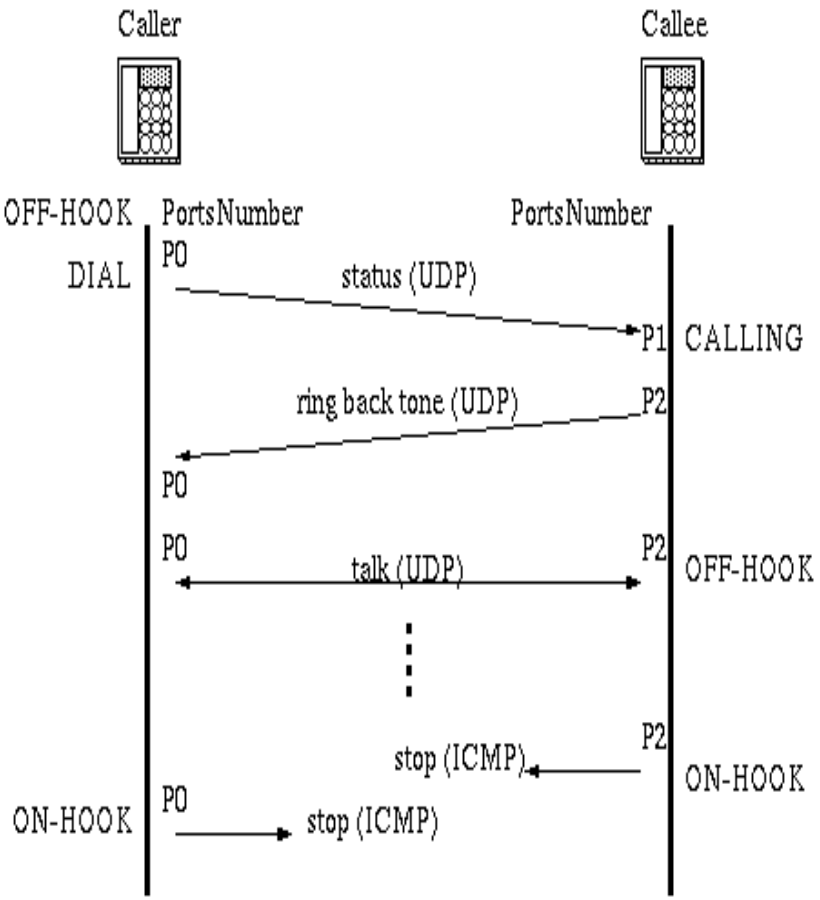
NOTASIP implementations

(Nothing Other Than A Simple Internet Phone)

- MIAKO.phone
  - WindowsCE on PDA, wireless network
- EMON system
  - Implementation for unix (FreeBSD/Linux)
- NOTASIP terminal adapter
  - Hardware
  - connecting existing PSTN phone terminal and make it to use as an Internet phone terminal
- NOTASIP gateway
  - Hardware
  - interconnecting PSTN (INS64 * 2) and Internet (10BaseT)
- Yucca
  - Windows98/Me/2000/XP, Wireless and Wired network
  - shareware

NOTASIP protocol

- Caller send voice stream of UDP packets from P0 (random) to P1 (well known)
- Callee return UDP stream consisting of a ringing tone from P2(random) to P0
- If the callee's handset is picked up, the callee starts to send a voice stream
- A busy tone will be locally generated upon receiving ICMP_PORT_UNREACH

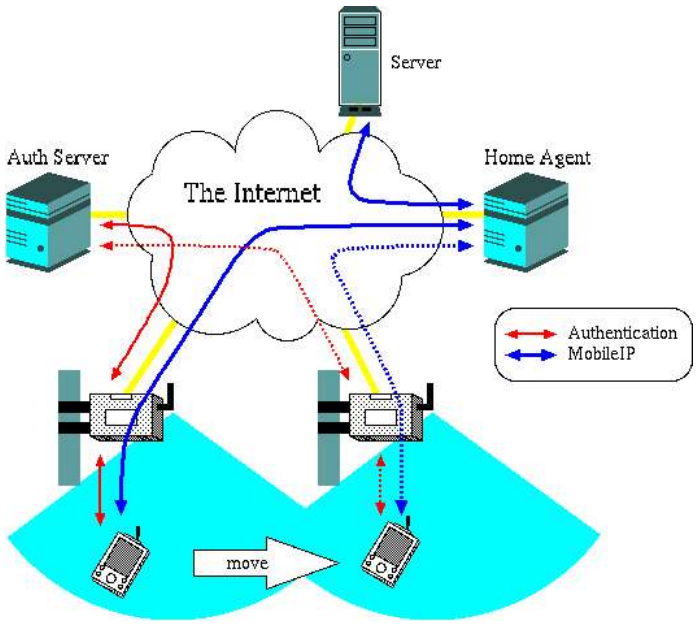


MIAKO.phone Experiment (in preparation..)

- Setup NOTASIP Gateways
  - INS64 * 4 = 8 lines
  - 100 additional subscriber's numbers for each PDA (dial-in service by NTT)
  - Transfer call from PSTN to PDAs
    only dial a phone number, you can call a PDA
  - Reject call from PDAs to PSTN because it needs telephone charges
- We are preparing 100 PDAs
  - Distribute to an ordinary person in Kyoto
  - They can call each other without any charge

Handover and Blackout Time of Voice

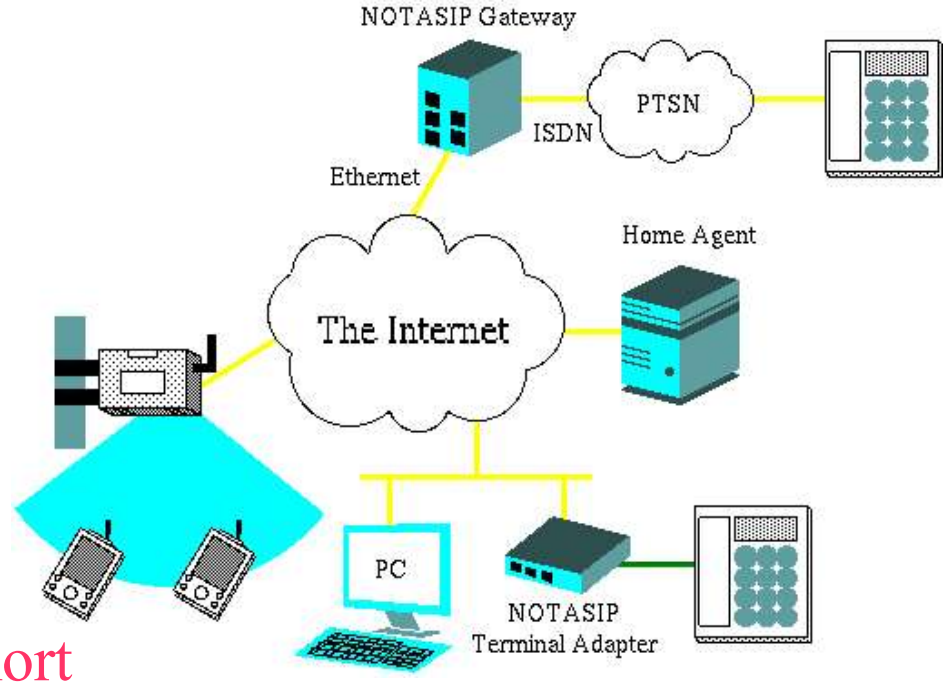
- PDAs can handover among access points when moves out of a cover area
- Handover Scheme
  - Scan new wireless channel
  - Re-authentication
  - Re-registration to HomeAgent



- Experiment
  - Blackout time of voice was 1.33sec (average)
  - Dual wave wireless LAN device can make it faster

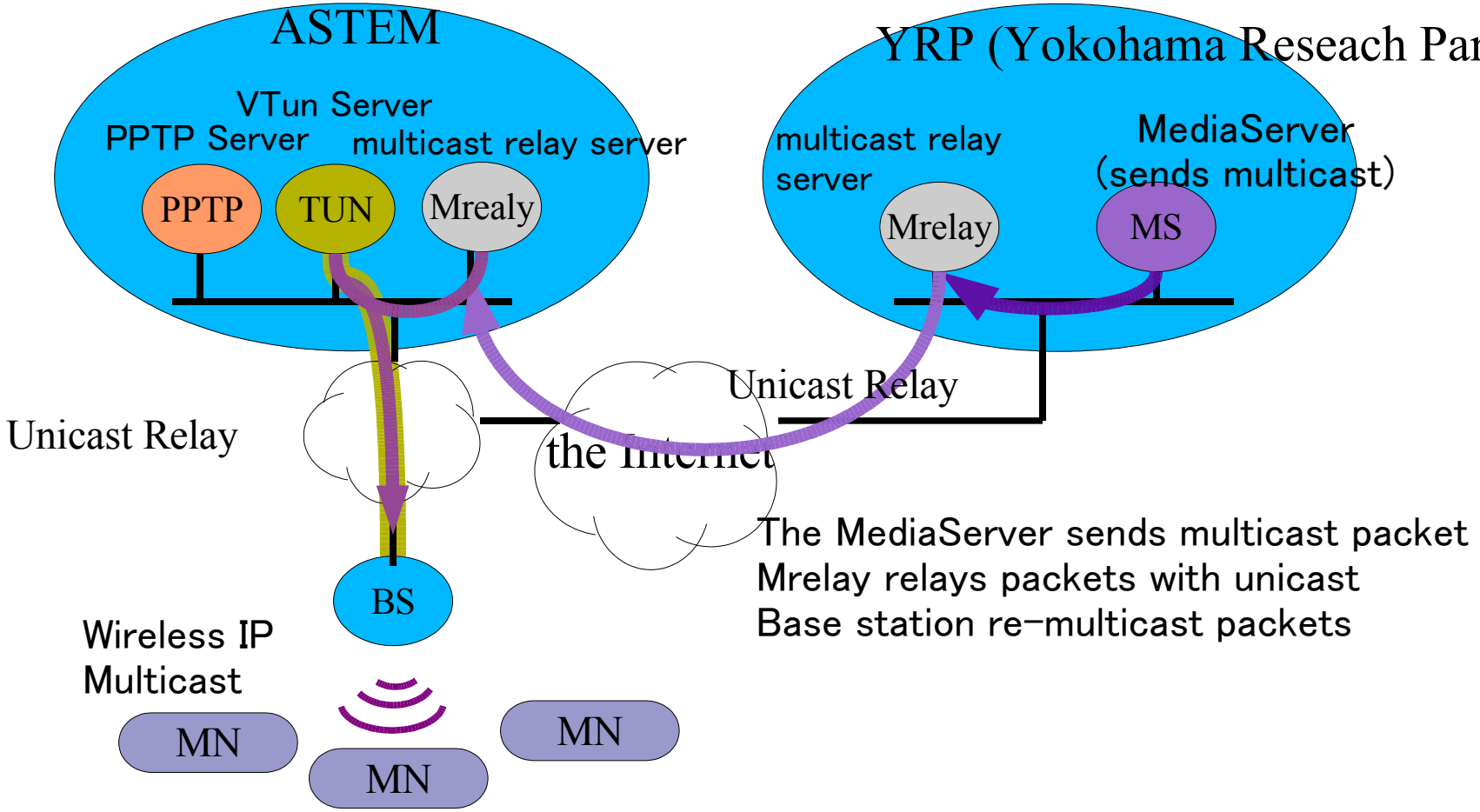
Voice Delay

- Experiment
  - Measure voice delay
  - All PDA's call passes through the HomeAgent
- Evaluation
  - Delay is asymmetric
  - MIAKO.phone's recording delay is very short
  - MIAKO.phone's playing delay seemds be longer than other implementations

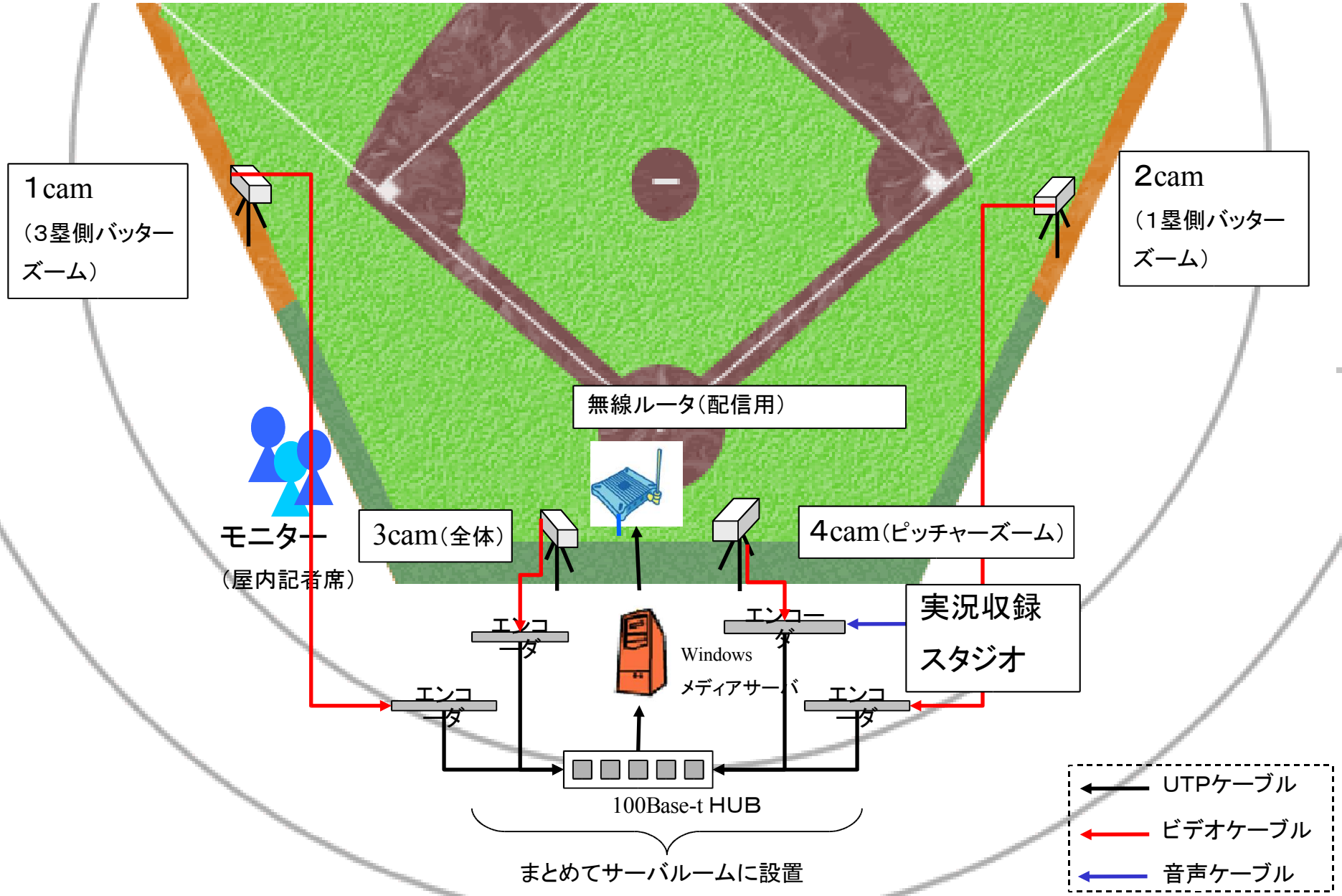


caller(A)	callee(B)	delay (A->B)	delay (B->A)	ping RTT
PDA	PDA	315	340	38
PDA	Yucca (PC)	142	250	17
PDA	TA	283	278	28
TA	PDA	313	111	28
PSTN	PDA	344	110	24

MIAKOCAST (Wireless IP Multicast)

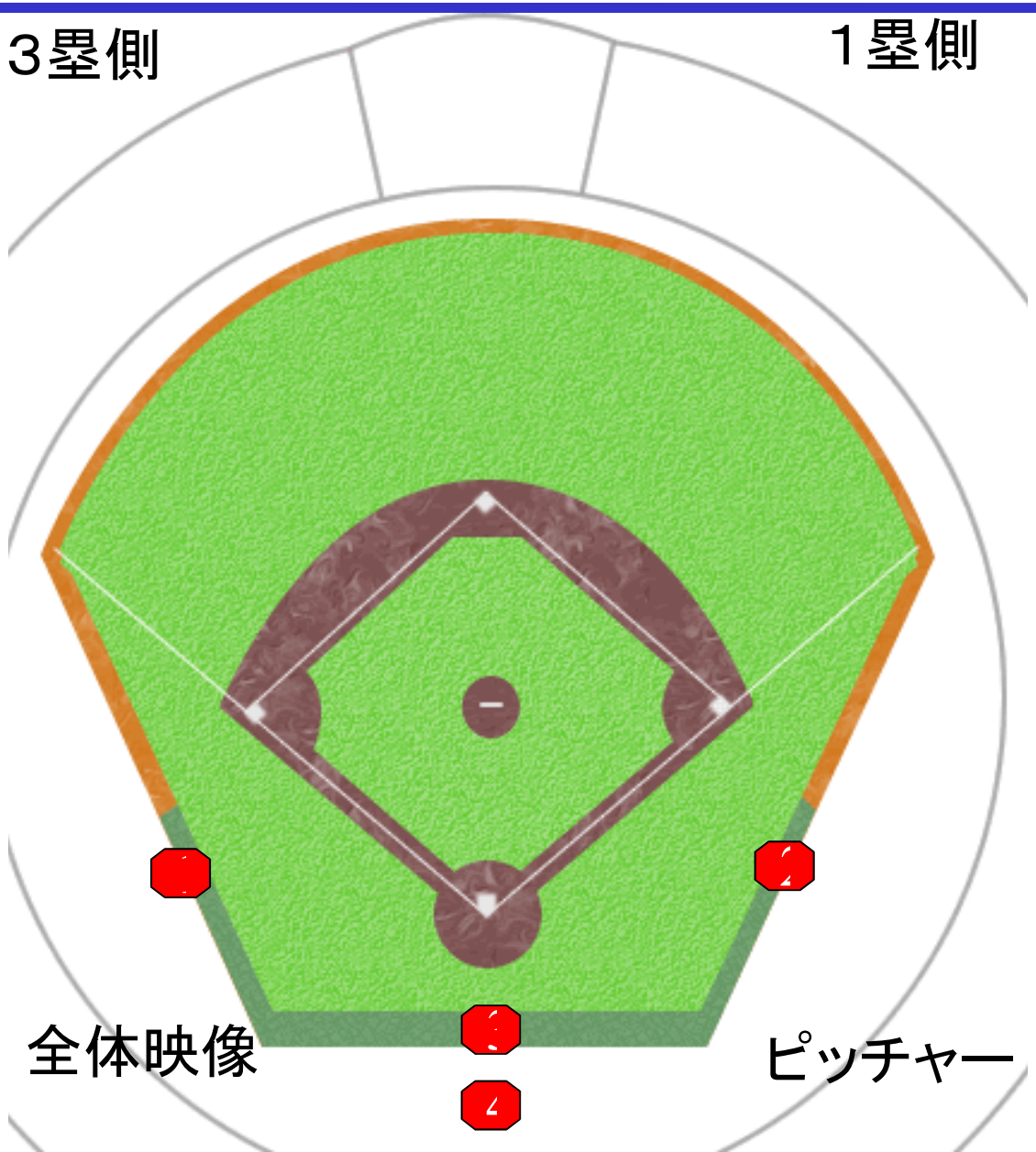


Configuration of Network and AV Equipments



Camera locations and views

3塁側



全体映像

1塁側

ピッチャー

Equipments

配信用機材

・サーバ　Windows2003server Enterprise Edition　1
・エンコーダ　WindowsMediaEncoder9 Series　4
（マシンOSは機材の関係上、Windows2000server）
・ブロードバンドルータ　汎用製品　1
・無線ルータ　RGW　1
・スイッチングHUB　汎用製品　1
・miniDVデジタルビデオカメラ　4
その他ケーブル類


（サーバとエンコーダマシン）


（ビデオカメラ）

受信用機材

・PDA　PocketPC2003　13
その他イヤホン


（使用PDA）

Results

- 本番実験中、一度もダウンすることなく配信

  ９日当日、常時１３台＋αの端末からのアクセス数があったが、特にサーバ、エンコーダともダウンすることなく配信できた。

- 配信データ概要

  マルチキャスト配信数：1台のマルチキャスト対応無線ルータ（RGW）
  に対し、４つの映像ソースを各1chとし、計4ch配信。

  配信レート：　123kbps

  配信端末数：13台のPDA＋検証用PC数台

  配信時間：　3時間24分

  遅延時間：　約10秒～20秒

バックアップ体制

エンコーダマシン１機に、Windows2003serverをDualブート可能にし、本来のサーバ機がダウン時にも対応可能にし、事前のリハーサルも実施。

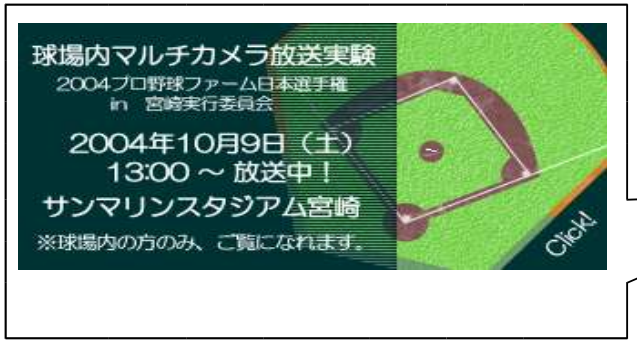
Design of PDA Browser

操作を簡単に、モニターを対象物へ誘導

- PDAの起動時、リセット時に、カメラの選択画面を強制的に表示。
- 利用マニュアルを配布し、サポートの負担を軽減。
- みあこCAN接続時に実験ページを表示。

（PDA画面。マニュアルより抜粋）

→クリックで、PCでもPDAと同画面に切り替え。



（みあこCAN表示画面）

- 電波は1つのみ送信

→球場内ではアンテナ1機のみとし、電波の混信、PDA側での電波の切り替えが起こらないよう配慮。

- 音声実況アナウンスはピッチャーズーム映像のみに配信。機材の関係から、1つのエンコーダに限定

（1機のアンテナで球場をカバー）

Experiment in Nippon Professional Baseball Final Game (Minor)

・今回の実験では、13台のPDAを球場内のプレス関係記者に配布し、業務内でのモニターを実施した。

（屋内記者席の様子）

（利用時のピッチャーズーム画面）

（モニター利用の様子）

・感想を得るため、紙でのアンケートを実施。

結果

・ ４つの異なる映像が存在したが、どの記者も「ピッチャーズーム」を選んでおり、他の映像を選択した人は少なかった。

・サポートの必要はほとんど無く、開始時のレクチャとマニュアルで間に合った。

・残念ながらアンケートは回収できなかった。