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

Graduate School of Informatics, Kyoto University
FUJIKAWA Kenji
<fujikawa@i.kyoto-u.ac.jp>
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, everywhere
• 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

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

Instead we adopted VPN solutions
Adopted Two Techniques of Assigning Global IP Addresses

- MIAKO.NET I (Mobile IP and MBA protocol)
  - IETF Mobile IP
  - MBA (Mobile Broadband Association) 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
• Mobility
  – MobileIP+MBA Fast Authentication Protocol
  – A fixed global IP address is assigned to mobile terminals

• Security
  – High-level security that dynamically 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
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 communicate other hosts via Home Address
Settings of MIAKO.NET I Base Station

- Assign more than 10 fixed global IP addresses to a wireless 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 various 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 people walk using note PCs
  - Require a specific driver software, and only supports Windows (Not MacOS)
Design of MIAKO.NET II

• Principles
  – Security is the most important
  – Fixed IP address for every user
  – More easily 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 assigns 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 over TCP)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

Diagram:
- VTun server
- PPTP server
- TUN
- PPTP
- BS
- MN
- DHCP addresses are assigned from the VTun server via the tunnel
- Filtered here
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, releases 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

MIAKO.NET Servers (in ASTEM)

- Authentication Server: AUTH
- Mobile IP Home Agent: HA
- PPTP Server: PPTP
- WWW Server: WWW
- WWW Server for CAN: CAN
- VTun Server: TUN

Router

PPPoE connection

NTT Regional IP Network

The Internet

MIAKO.Net I BS

VTun function
Update Method of Base Stations

- A BS is based on NetBSD (ease addition of new features)

- Contents of Updates (the actual cases below)
  - Changes of filter settings
  - Kernel updates
    - Invited communication of clients under the same BS
    - Driver updates for supporting a specific clients driver
  - 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)
• Issue 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

Sends URL for the registration page and temporary password

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

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
Do not have central servers

Wireless BS’s are located widely, which only allow VPN protocols. Do not necessarily have to manage BS’s

Users connect to a certain VPN server somewhere, then connect to the Internet

Not only companies, 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
• 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 seems longer than other implementations

<table>
<thead>
<tr>
<th>caller(A)</th>
<th>callee(B)</th>
<th>delay (A-&gt;B)</th>
<th>delay (B-&gt;A)</th>
<th>ping RTT</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDA</td>
<td>PDA</td>
<td>315</td>
<td>340</td>
<td>38</td>
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<tr>
<td>PDA</td>
<td>Yucca (PC)</td>
<td>142</td>
<td>250</td>
<td>17</td>
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<tr>
<td>PDA</td>
<td>TA</td>
<td>283</td>
<td>278</td>
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</tr>
<tr>
<td>TA</td>
<td>PDA</td>
<td>313</td>
<td>111</td>
<td>28</td>
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<tr>
<td>PSTN</td>
<td>PDA</td>
<td>344</td>
<td>110</td>
<td>24</td>
</tr>
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</table>
MIAKOCAST (Wireless IP Multicast)

The MediaServer sends multicast packets to the Internet. The MediaServer acts as a multicast relay server. When a Base station receives these packets, it re-multicasts them to MNs. The VTun Server and PPTP Server are components within the network that facilitate these processes.

Unicast Relay

Wireless IP Multicast
Configuration of Network and AV Equipments

1 cam (3rd base side zoom)

2 cam (1st base side zoom)

Monitor (pressing room)

3 cam (all)

4 cam (pitcher's zoom)

Wireless router (for distribution)

まとめてサーバルームに設置

実況収録スタジオ

ビデオケーブル

音声ケーブル

UTPケーブル

Windows media server

エンコーダ
Camera locations and views
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

受信用機材

・PDA  PocketPC2003   13
その他イヤホン
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。

→クリックで、PCでもPDAと同画面に切り替え。

- 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

（PDA画面。マニュアルより抜粋）
（みあこCAN表示画面）
（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。

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、開始時のレクチャー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。

（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）