

Open Source Voice over IP (VoIP) at Penn

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The University of Pennsylvania is in the midst of a multi-year deployment of a campus-wide Voice over IP system based on open source components on the server side of the infrastructure and open protocols (SIP). This talk will review the architectural details, progress to date, future plans, and touch on some of the specific technical challenges we've faced.

Brief background

- Analog Telephone system:
 - Verizon Centrex, over 20K lines
 - Old copper infra, outages, long prov time
- Protocol research & testing in late 90's
 - H.323 initially, later SIP (Session Initiation Protocol)
- Formal VoIP project began 2005/2006
- 6,500 VoIP lines so far (production)

Server Infrastructure

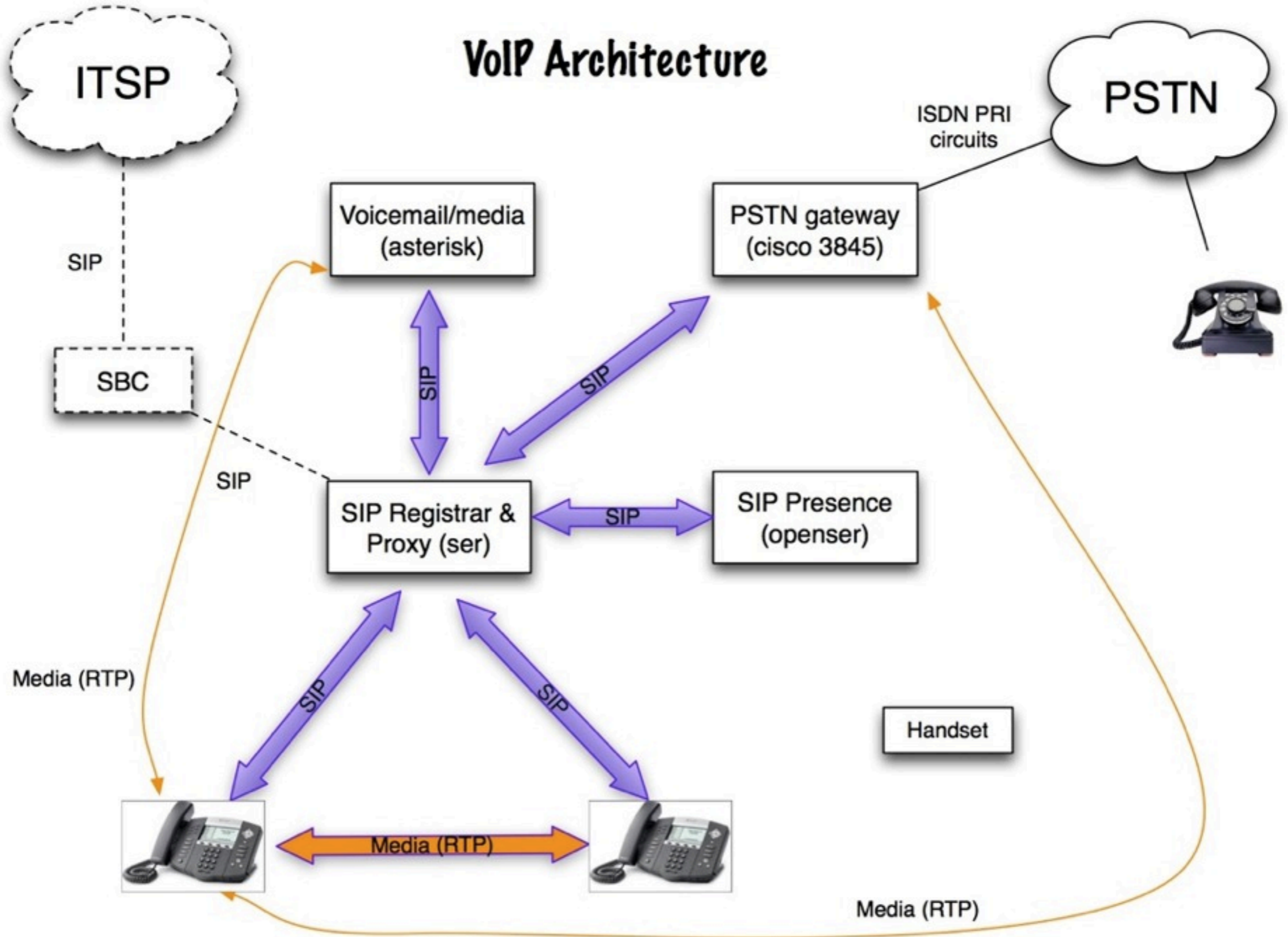
- SIP Registrar & Proxy servers (iptel SER)
- Voicemail servers (Asterisk)
- SIP Presence servers (OpenSIPS)
- PSTN gateways (cisco 3845 routers + voice cards)
- *In-trial: SIP Trunking (Verizon ITSP)*

Clients

- Handsets from Polycom (Soundpoint IP 321/550/650, Soundstation 6000)
- Have previously used Cisco handsets (7940 and 7960)
- Soft Clients: experimental, small number of users; not supported in production



VoIP Architecture



Sampling of Features

- Basic Single Line
- Ring Groups
- Call Hold & Transfer
- Call Forward All
- Call Forward Busy
- Call Forward No-Ans
- Call Hunt
- Music on hold
- Staged/timed services
- Do Not Disturb
- Per extension VM dest
- Caller ID block
- Anonymous Rejection
- Out-call notification
- Distribution messages
- Advanced Caller Menus

Web Feature Management

Computing : Menu ... A to Z SEARCH Home ISC Penn

Automatic timeout in: 59E minutes

Main Menu

- Home Screen
- User Guides and FAQ
- Log Out

Personal Settings

- Features and Voice Mail**
- Mailbox Management
- Phone Set & Lines
- Contact Directory Back Up
- Proxy Access
- LSP Access
- Owner Access
- Phone Set Location
- Distribution Lists

Registration

Enter Keyword Search

- View Phone Numbers
- Create Phone Number
- Create ACD Number
- Create Phone Set
- Create Distribution List
- Ring Group, BLA Group, & Sets
- Permissions & Restrictions
- Edit Phone Set

Group Management

- View Users
- Manage Groups

Special Tools

- View Handsets
- Billing Tools
- Manage Staged Numbers
- Scheduler Logs

Features and Voice Mail Settings - 215-898-2623

Your current PennNet Phone services are listed below. You can change your selections at any time. Changes will take place immediately after clicking the submit button unless the setting is marked as "Handset restart required".

Phone Number to View or Update Information
82623 - tomo

PennNet Phone Settings

Advance One

Advance One: on off * When on, Call Forward on Busy & No Answer will not work.
Destination Number: 37471 * 5 digit PennNet Phone Number

Call Forward All

Call Forward All: on off scheduled

* Call Forward All will be off unless enabled by an entry below.
* Each entry overrides all entries above it for overlapping time spans. [Scheduler Help]
* The call forward all destination number may be displayed to other PennNet Phone subscribers when this feature is enabled.

Action	Destination	Date	Start Time	End Time	All day
[-] 1. Forward to	9-215-833-7566	everyday	from All Day	to All Day	<input checked="" type="checkbox"/> All day
[-] 2. Disable	9-1-XXX-XXX-XXXX	on weekdays	from 09:00 AM	to 05:00 PM	<input type="checkbox"/> All day

[+] Add a new schedule entry

Call Forward on No Answer

Call Forward on No Answer: on off * Incoming calls are forwarded if your number doesn't answer.
Call Forward on No Answer Destination: 9-215-123-4567 (see valid formats...)

Caller ID

Blocked Caller ID: on off * When on, your caller ID is not sent when you place calls.

Voice Mail Settings

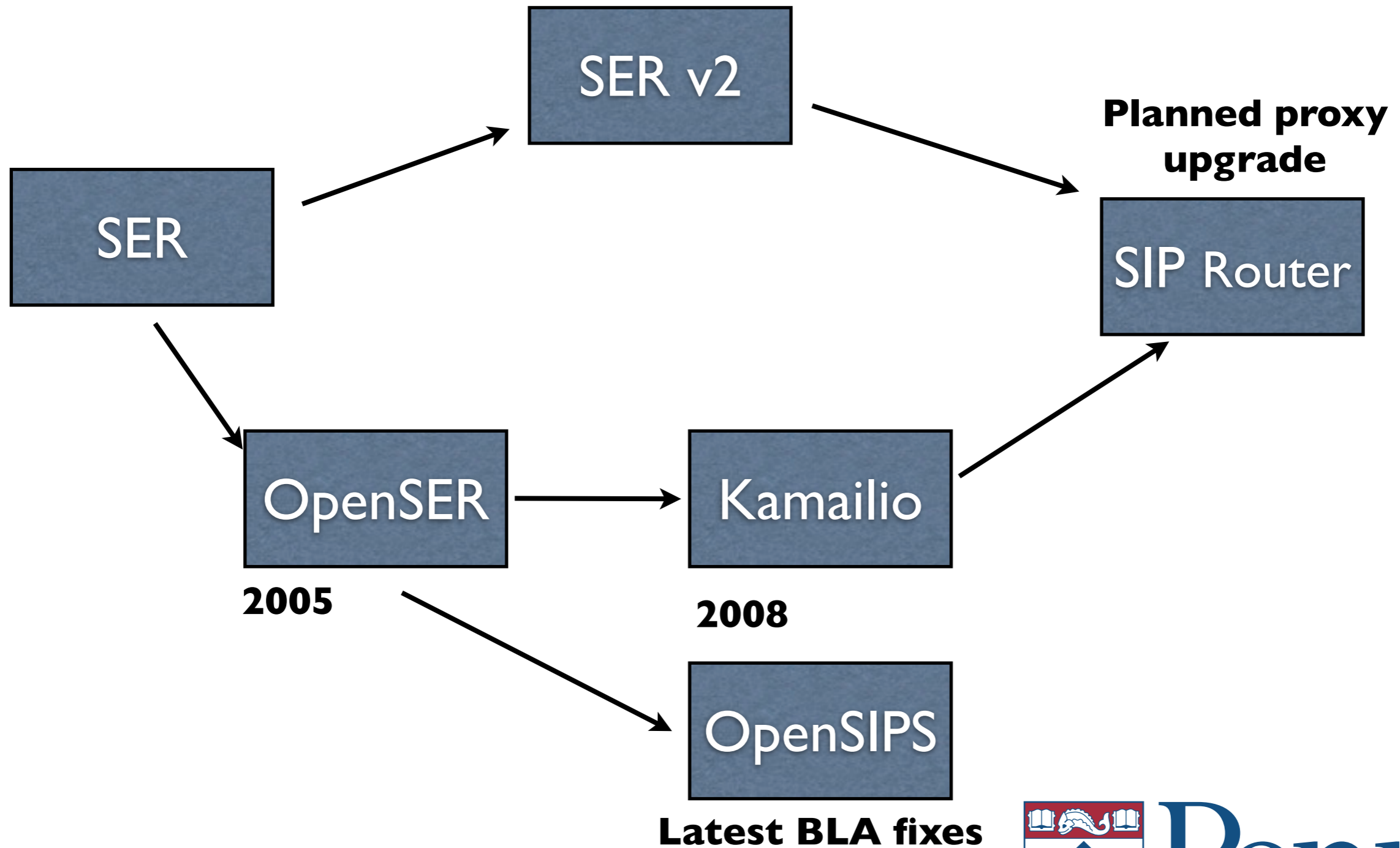
Voice Mail Delivery Method

1 - Telephone only.
* Notification of messages via indicator light on handset an icon on telephone display and stutter dial tone is heard when the handset is lifted. Messages managed by telephone.

Challenges/Issues

- Many bugs and interoperability issues
 - Timer issues, call loops, call transfer, forward, phone crashes
- System tuning and scaling issues
- IMAP storage of voicemail messages (for UC)
- Keeping up with SER community development
- BLA/SLA (Bridged/Shared Line Appearance)

S.E.R. Evolution



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BLA Issues

- **Bridged Line Appearance:** multiple sets share a number; call can be picked up at one set; held; transferred to another set etc
- Bugs and Interoperability issues with presence server (OpenSIPS) and handset (Polycom)
- Unclear (and unfinished) technical specifications for BLA (expired Internet-drafts etc; new BLA “requirements” draft)
- Deployed; backed out; debugging & repairing work going on for past 2 years
- Early Jan: working reliably in our lab

BLA Issues

- Dialogs stuck in various states (early, confirmed)
-- stuck or incorrect lights on UI
- Stability issues with OpenSER
- Subtle interaction issues with other features
(eg. call transfer, call forward, etc)
- Many rounds of fixes by various involved parties
(us, opensips, polycom, etc)

Future Enhancements

- ITSP (SIP Trunking)
- Security Enhancements
 - Secure Signalling (SIP over TLS, etc)
 - Secure Media (SRTP, ZRTP, etc)
- Production support of Soft Clients
- Automatic location tracking (public safety)
- Proxy server update: “SIP Router” 3.x

Assessment

- OpenSource VoIP works and at large scale
- But, implementing certain advanced business class telephony features is challenging
- Need to be closely involved in open source development community and participate
- State of maturity of protocol specs is lacking
- Need strong relationships with other vendors

Assessment

- Cost savings: no purchase or license fees
- Vendor neutrality
- Locally customizable, locally fixable
- Ability to troubleshoot and debug better
- Shared community of knowledge
- Developers interested in open-standards and compatibility

Questions?

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Didn't address

- Organizational/Staffing issues
- Project management structure
- Local IT and user support issues
- etc