Network Monitoring and Handoff in Daedalus

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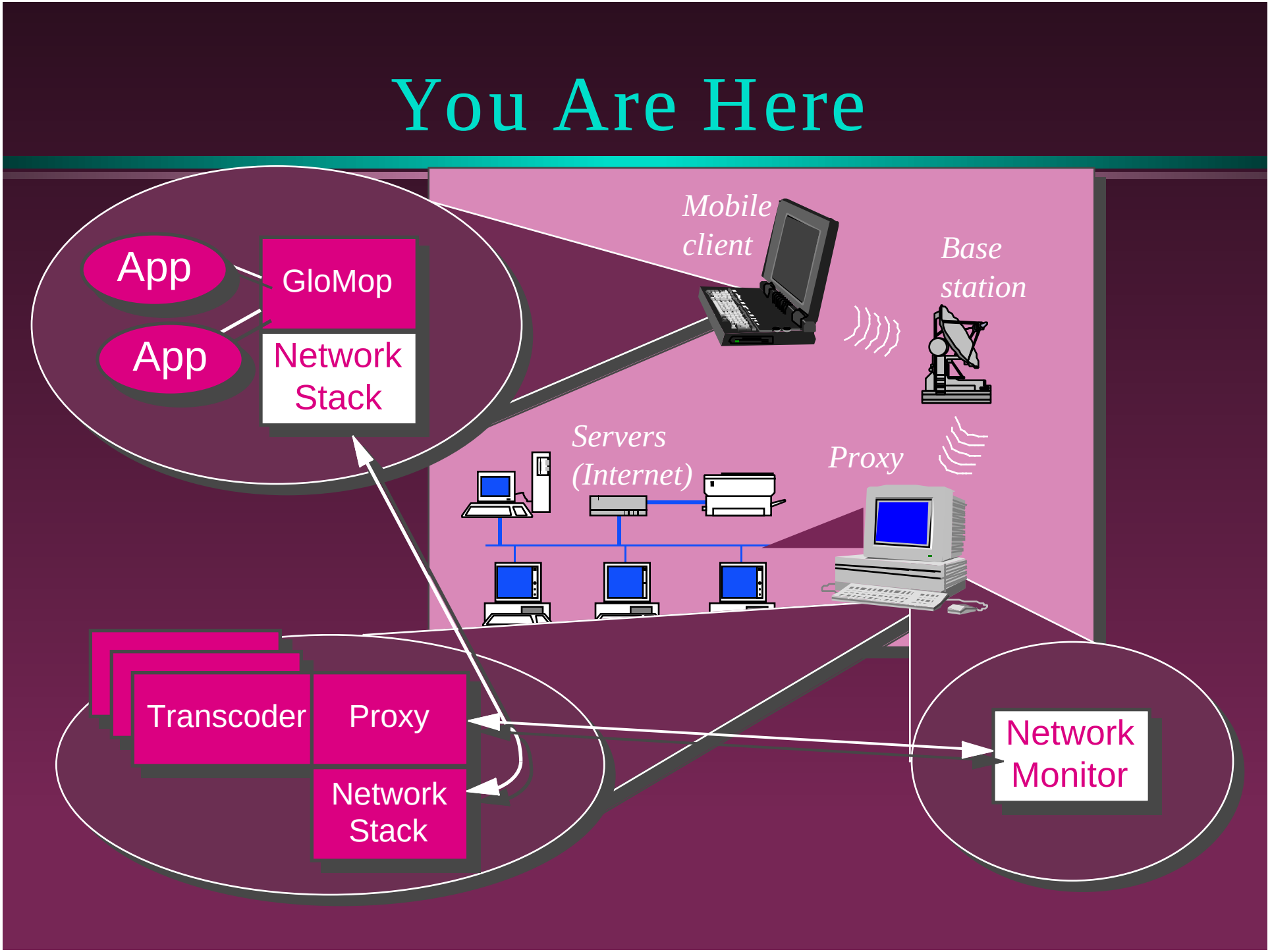
You Are Here

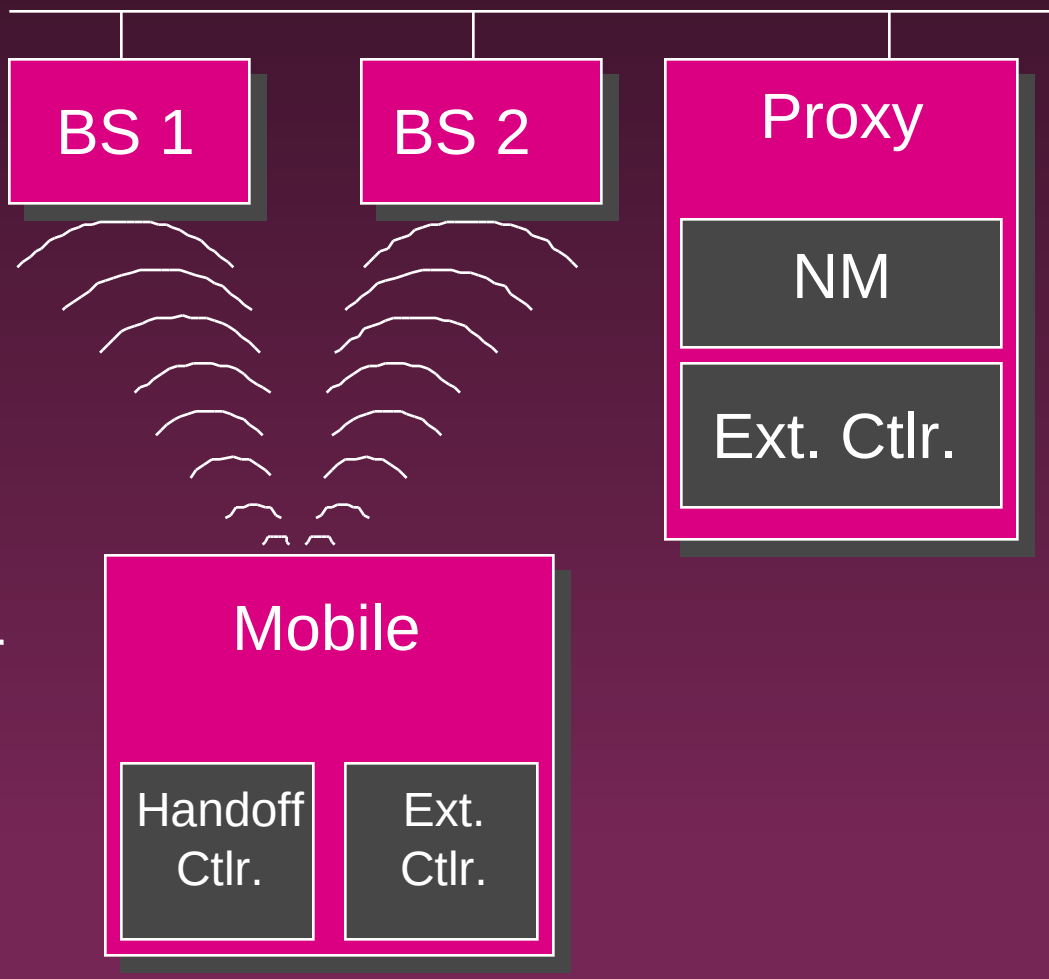

App
App
GloMop
Network Stack
Mobile client
Base station
Servers (Internet)
Proxy
Transcoder
Proxy
Network Stack
Network Monitor

Motivation

- All about management of network state:
  - Proxy needs to know network state to perform the right amount of distillation.
  - User needs a way to have ultimate control over and find out about network state.
- Need to choose the active network/base station due to:
  - Mobility.
  - Network QOS parameters, (dollar and power) cost constraints.

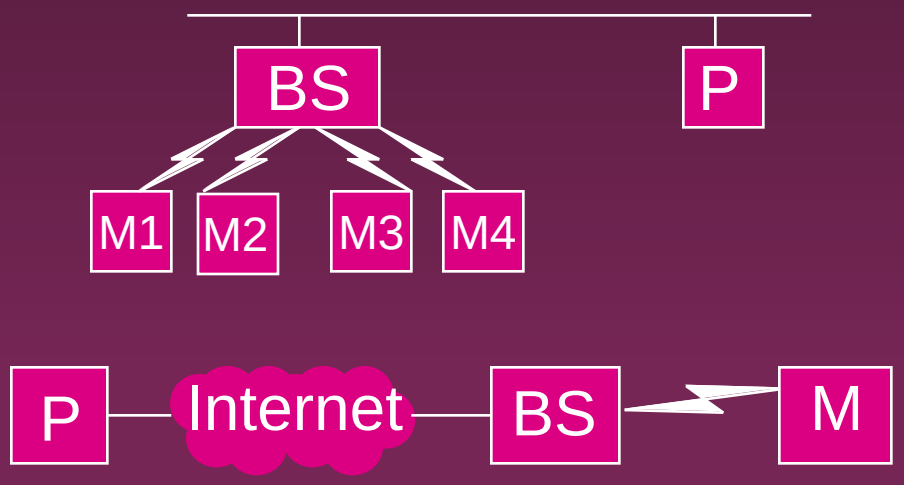
The Components

- Handoff Controller: decides when to hand off.
- External Controller: mechanism for user control.
- Network Monitor: collects data and acts as repository for network statistics.



Where do they live?

- Handoff Controller at mobile.
- External controller at proxy or mobile.
- Network Monitor at proxy(not at mobile, not at basestation). Why?
  - Not at mobile because all information has to get back to proxy anyway(waste of bandwidth).
  - Not at BS because not end-to-end(Proxy may be far away).



Details

- Network Monitor
  - Makes measurements for each interface.
  - Acts as data repository, serves data to others.
  - Can register callbacks for when things change.
- Handoff Controller
  - Makes decision of when to make horizontal and vertical handoffs.
  - Can take *advice* from an external controller, uses this when making handoff decisions.

Details(cont.)

- External Controller
  - » Acts as a tool for user-assisted handoff.
  - » Allows the user or proxy to provide advice in making handoff decisions.
    - “Don’t use CDPD for web browsing--costs too much”
    - “Only Use Metricom--I’m low on power and Wavelan uses too much. I’m only reading mail, anyway.”
  - » Can be more than one at a time.
  - » Can be of different types (text-based vs. Tcl/Tk).

Constraints

- Portability
  - All communication via sockets. Allows components to move.
- Unreliability of components
  - If one component crashes, other components should still act sanely.
- Unreliability of messages
  - Any message can be lost.
- Avoid sending info over the low-bandwidth link.

Reasons To Handoff

- Two reasons for handoff
  - Handoff Controller only hands off due to mobility.
  - External Controller on proxy issues advice based on network conditions.
- Where is the network state?
  - Beacon packets include state necessary for mobility decisions.
  - Network monitor collects network state necessary for load balancing.

Beacon Packets

- Only include BS identifier.
- Device drivers on mobile measure signal strength, quality, SNR
- Handoff Controller uses this for handoff.
- Beacons may include in future:
  - Other networks that are “nearby”.
    - e.g. Wavelan BS near building entrance will have Metricom as a “near” network.
    - Allows us to hide network registration latency.
  - Snapshot of NM’s collected statistics.

Network Monitor State

- Data Repository for:
  - Latency, Bandwidth, Jitter.
  - Packet error rate.
  - Cost(in watts or cents) to send/recv a “chunk”.
  - Maximum and optimal packet size, used for chunking decisions.
- Measurements kept for each mobile’s network interface.
- All measurements have confidence intervals.

Sample Ext. Controller Msgs.

- To handoff controller:
  - » Use this network/basestation
    - – Switch to this network if it is available.
  - » Don’t use this network/basestation
    - – Unless it is the only one available.
  - » Use any network/basestation
    - – Removes all constraints.

Handoff Controller Msgs.

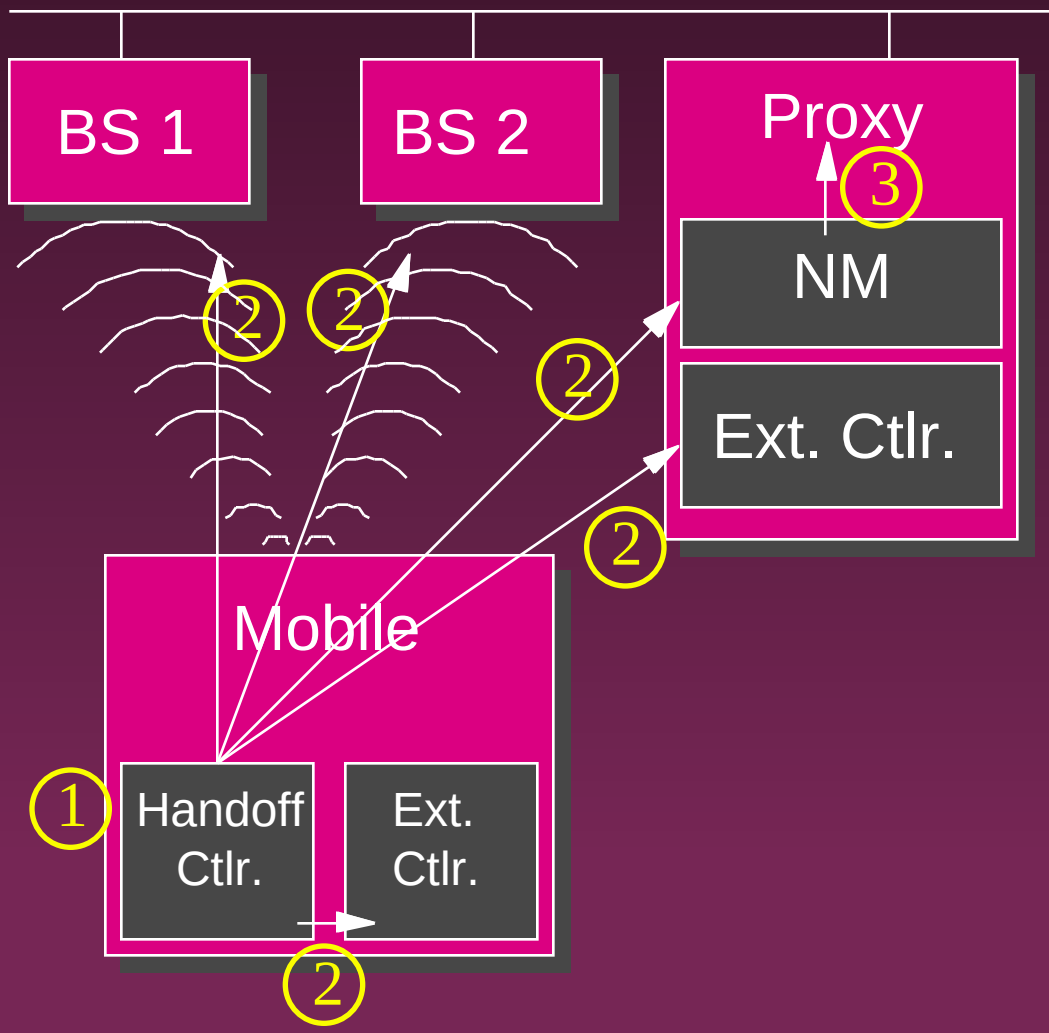
- To external controller/NM(for state)
  - List (all, active) networks/basestations
  - List used network/basestation
    - If a certain net/bs is “locked in”.
  - List unused network/basestation
    - If a certain net/bs is “locked out”.
- To basestations(for routing)
  - list-active-network/bs-reply
- To client-side GloMop library:
  - disconnected-network

Network Monitor Messages

- Serves collected data:
  - whatis-current-bandwidth-reply
  - whatis-current-latency-reply
- Registers callbacks for when measurements change:
  - register-bandwidth-lessthan
  - register-bandwidth-greaterthan
  - etc.

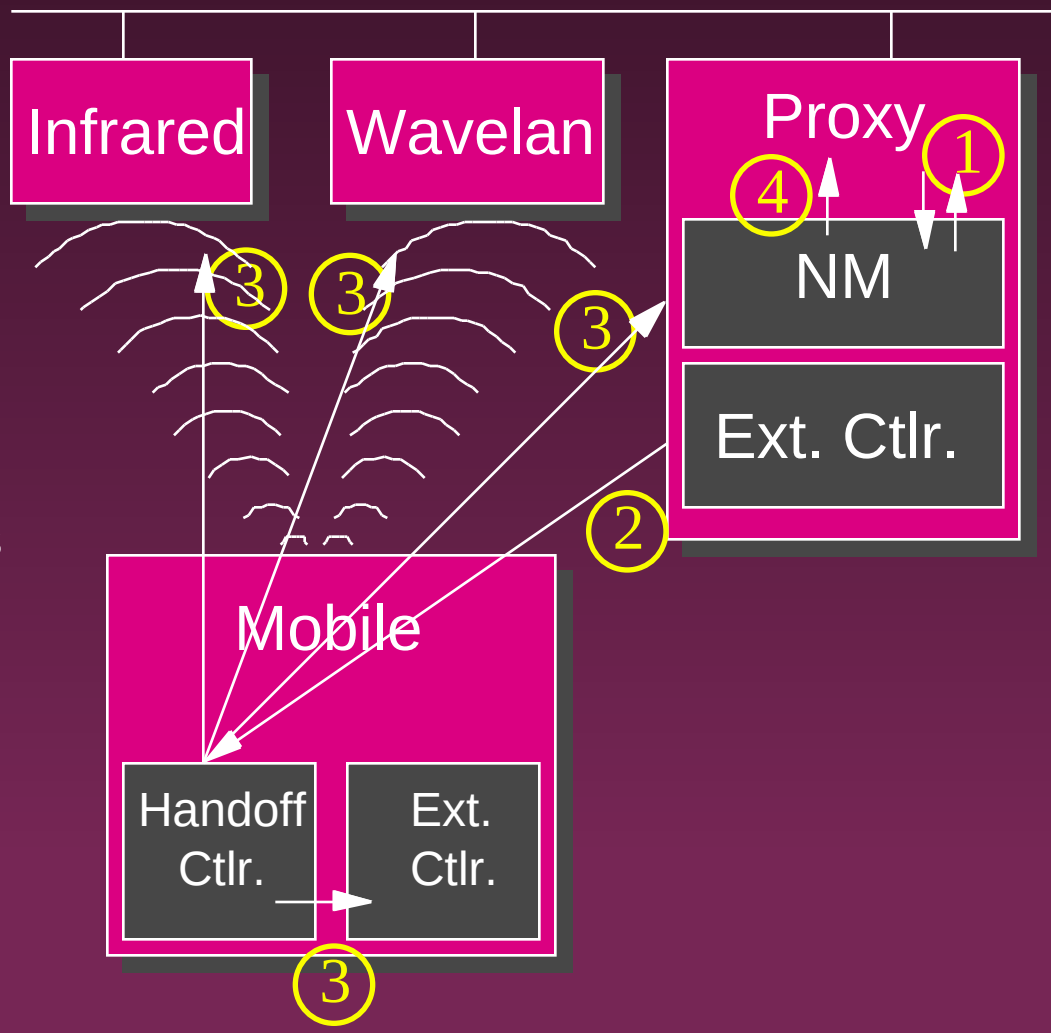
Scenario 1 (Mobility)

- Handoff controller receives beacon packets and notices that new BS has higher SNR.
- Sends routing msgs to BS, new BS state to ext. controller & NM.
- New BS's lower bandwidth triggers a previously registered register-bw-lessthan event, so NM tells Proxy, which changes amount of distillation.



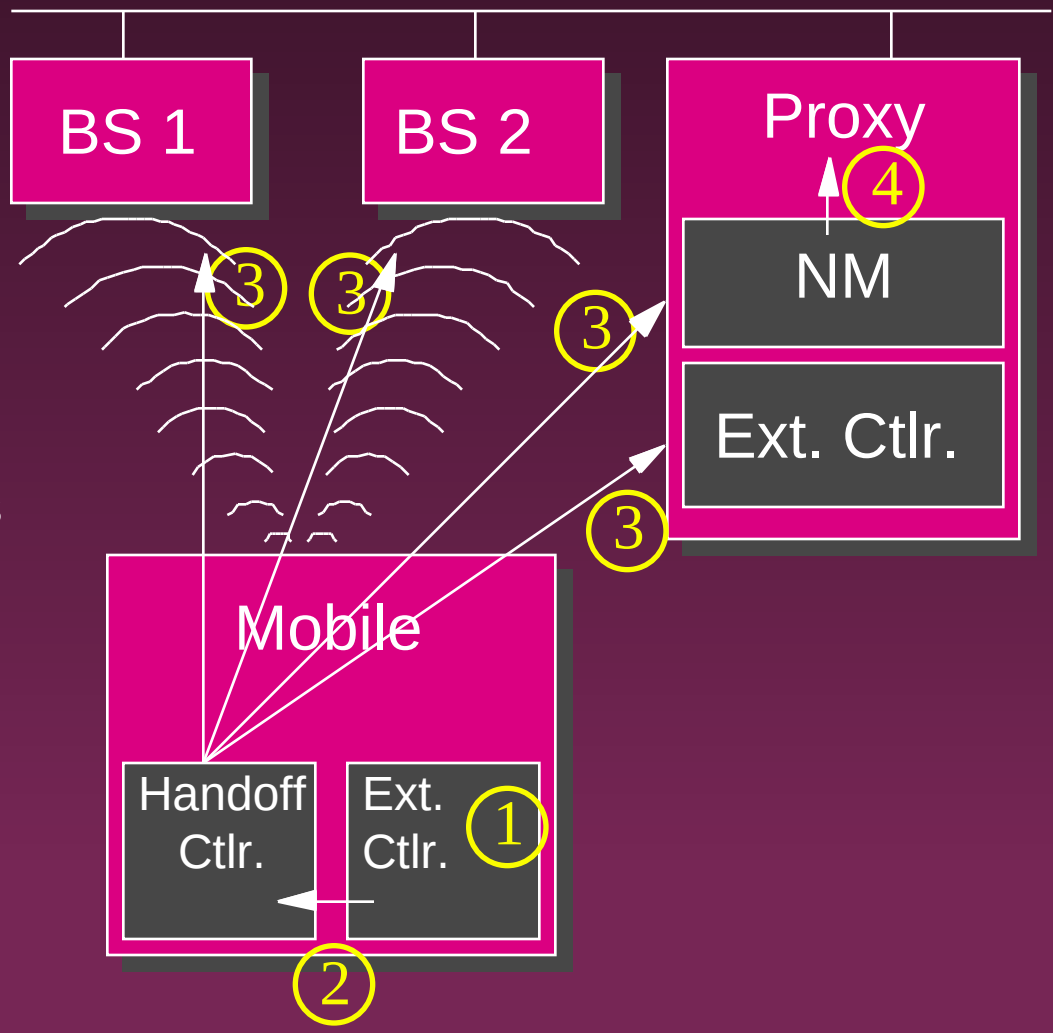
Scenario 2 (Load Balancing)

- Proxy queries NM and notices that Infrared is overused while Wavelan is underused.
- External Controller on proxy sends advice to handoff controller on mobile.
- Handoff Controller sends routing msgs to BS, new network state to other Ext. Controller and NM.
- New latency, bandwidth callbacks are triggered and msgs sent to proxy.



Scenario 3 (User Control)

- User (via External Controller) decides to switch to Metricom from Wavelan.
- Ext. Controller sends advice msg to Handoff Controller.
- Handoff Controller sends routing msgs to BS, new network state to other Ext. Controller and NM.
- New latency, b/w callbacks are triggered and msgs sent to proxy.



Current Status / Goals

- Have preliminary handoff controller.
- Have 2 preliminary external controllers.
  - » Text-based shell
  - » Tcl/Tk GUI
- In next 6 months:
  - » NM completed & integrated w/ Proxy.
  - » Improve handoff controller to add automatic vertical handoff.

What's Wrong With This Picture?

- Violating KISS?
- Is "advice" really necessary?
  - » Maybe the choice for any given situation is actually obvious.
- What happens when there are multiple Proxies?
  - » Maybe need a "bandwidth manager" that does the load balancing instead.
- Uploads? Need a "NM-lite"?