Making the Home Network Accountable:

tackling TCO through studies of practice

Cosener Talk
July 2010

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From broadband to wireless networks

- Massive adoption of broadband in households around the world
- Accompanied by a massive uptake of home networks
- More and more computing devices in the home
- Increasing distribution of these devices *around* the home
- The turn to wireless networks for support
- Also encouraged by wireless being offered as a standard feature with many ADSL modems

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A disastrous visit

- Arrival of a guest: first night all is well

- The problem becomes manifest: the host browses the web but the guest can't get a connection

- Rebooting of the guest machine: gets a connection but now the host can't get online

- Persistence of connection from some machines and not from others

- Trying to debug the network:

  - Changing channel – but has the AP got a new lease from the ISP?

  - Inadvertent changing of settings

  - Changing configuration of client bridge

  - Dependence on client machine views, what's the state of the connection to the main AP?

  - Resort to forums – having to use 3G

  - When is a connection a connection?

  - Finally arrive at number of DHCP lease issue

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Providing support and its impact on TCO

- Customer service and the provision of support:
    - Service engineers > Helplines > Online resources
    - Autonomic systems
- The cost of support and the aim of reducing TCO by reducing the cost of support:
    - The lowest overhead for everyone is if the users can fix it for themselves (quickly/easily)
- Relation to home networks:
    - BT example: £10 per call – over 90% of calls not relating to BT equipment
    - Hard for users to resolve troubles when things go wrong (or even know where the trouble lies)

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Issues

- Visibility:
    - Variety of interfaces
    - Often apparently in the wrong place
    - Complexity of interfaces
    - No grounding in commonsense reasoning about how such things might work
    - Difficulty of getting view from the network perspective
- Distribution of devices
- Interrogatibility
    - Looking for self-evident guidance that isn't there
- What counts as an anomaly?
- Situated reasoning and relative priorities
    - Guest access v the kids playing a game
- Reducing TCO in this space means making home networks more available to ordinary, non-specialist understanding
- The need to look at and understand local practice

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Homework

- EPSRC-funded project under the WINES III initiative (ending 2012)
- Collaboration between University of Nottingham, University of Glasgow, Imperial College London, Georgia Institute of Technology, Microsoft Research (Cambridge), and BT
- Goal = investigating how to create completely new network architectures that are adapted to not just technical but human considerations
- Work grounded in studies of use of computer networks in the home
- Combining empirical understanding of use with fundamental reinvention of protocols, models and architectures
- Ambitions:
    - Developing techniques and tools that users will readily understand
    - Developing an infrastructure that can configure and repair itself

- See http://www.homenetworks.ac.uk/

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Ethnography and studying networks in the wild

- Ethnography:
  - "Getting down off the verandah" and "Grasping the native's point of view"
  - Hanging around… but that's not the point
  - Arriving at a "thick description"
  - Understanding local reasoning and methods

- Homework studies:
  - Studying network use in the wild
  - Ongoing observations in multiple households constituted in numerous different ways
  - Variety of methods:
    - Principally observation
    - But also interviews and logging
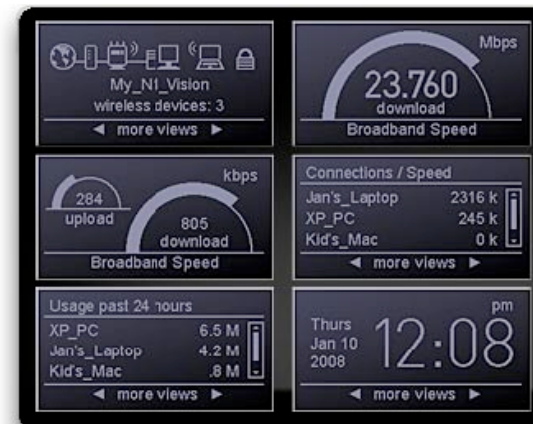
Trying to fix the network

- People turn to a range of simple practices to resolve troubles when they arise, e.g.:
    - (i) Discovering trouble
        - Is it really a problem?
    - (ii) Standard procedures
        - Restarts and reconnections
    - (iii) Reasoning about causes and assigning blame
        - Comparing past and present behaviours
    - (iv) Inspections
        - Trying to make the grounds of trouble visible
        - Investigating settings and connections
    - (v) Interventions
        - Changing settings
        - Doing resets
        - Observing outcomes
- However, faced with current issues regarding transparency and accountability, they often move rapidly to escalation

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Escalation

- There are various escalation techniques:
    - (i)   Locating external information, e.g. using forums…
    - (ii) … then testing the proposed solutions (or not)
    - (iii) Seeking external assistance, e.g. helplines
    - (iv) Enabling external intervention
    - (v) Service interventions
        - Someone who knows
        - Local contracts
        - Service engineers

- Many of these strategies carry TCO implications

Making the home network more visible and intelligible

- Have been some moves towards tackling some of these issues on the part of manufacturers etc., e.g. Belkin N1 Vision Access Point:
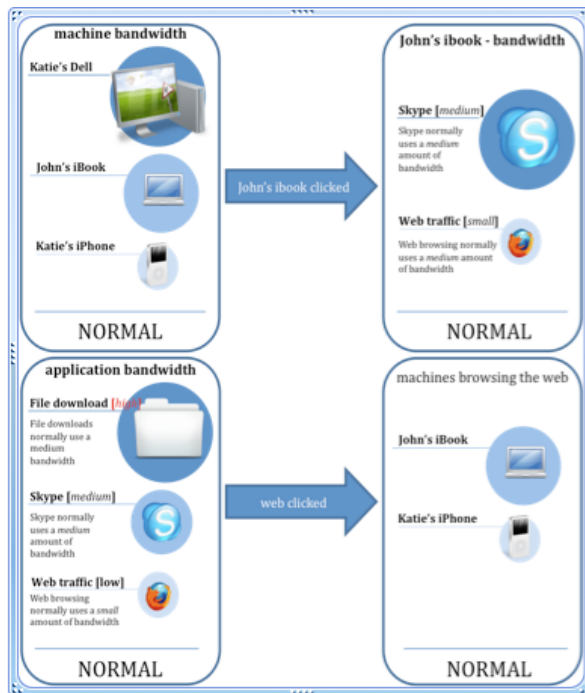

- Real time
- But technical and limited to just one level and understanding of connection

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Ways forward

- Homework has been concentrating on how to provide information about networks and their performance that is both transparent and accountable
- This demands provision of both technical infrastructural resources and policies that can then translate readily into a variety of situated representations
- The implications of the representations must be evident to the members of the setting…
- … and open to their ordinary reasoning, e.g. accountable
- Also looking at how to use these as tools through which users can easily manage their own, local network configurations, according to need
- Currently building variety of early prototypes that can be inserted into real home environments to then gather further understanding and refine across further iterations …
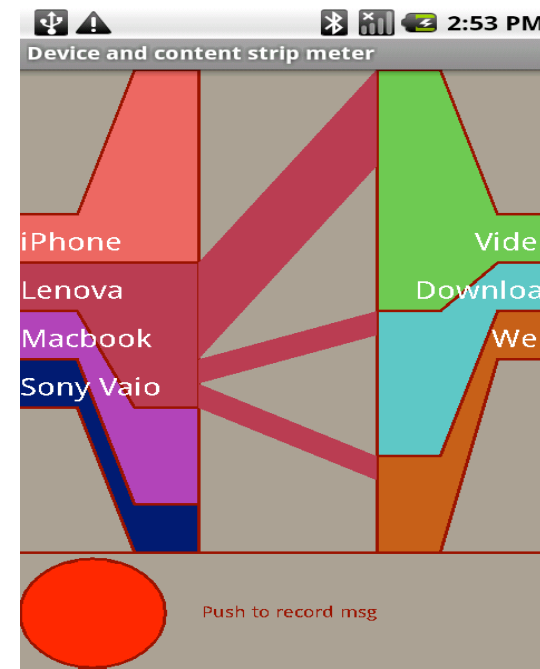
Smartphone displays …

- Showing various views of the network

- **Bandwidth Contention**   **Network Activity Monitor**
- *Bandwidth consumption: by device / by application*   *Inspecting Download Activity: by device / by content*

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Ambient displays …

- Showing network activity

- ***The Signal Probe***
- *Signal Strength / Bandwidth Usage / Connection Warning / Forbidden Activity*
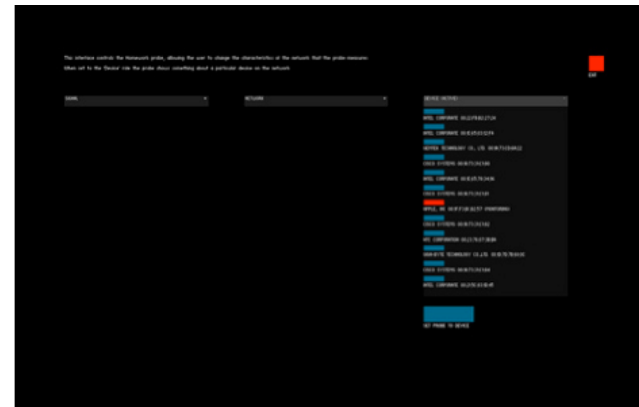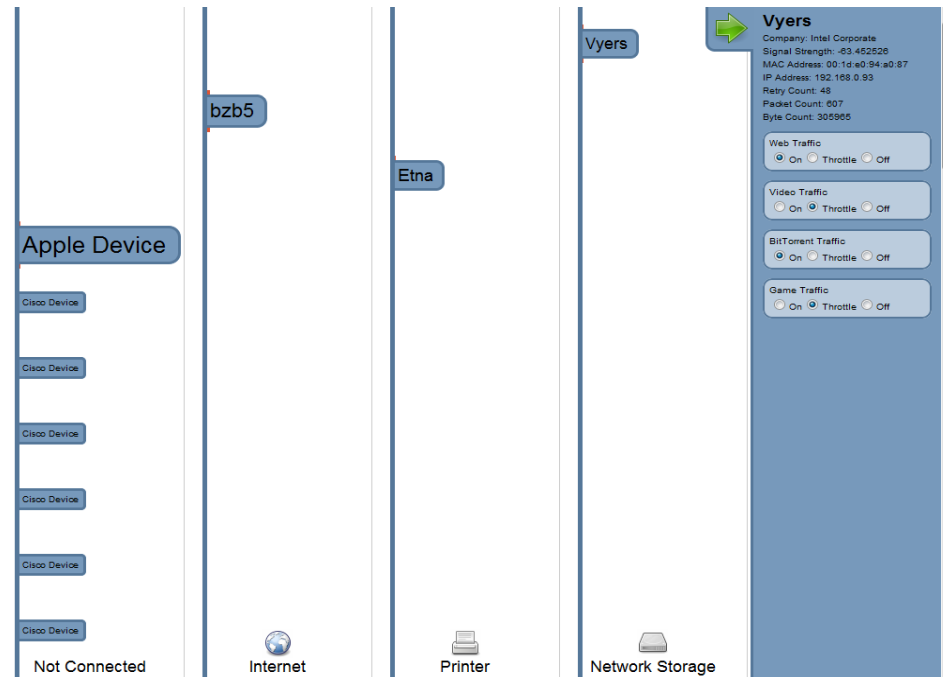

Fig 1a. Prototype of the LED Probe

Fig 1b. GUI for selecting what the probe 'signals'

Display and control interfaces …

- Offering scope for network management

- ***Device Control Panel***
- *All devices available to router / Signal strength / Permissions / Quality of connection / Control internet-based applications*

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Mixed interfaces …

- **_Personal Network Presence_**

- _Configurable Personal Representations_

- Permissions - Mobile Display showing:
    - Devices on the network
    - Access rights
    - Bandwidth usage
    - Connection retry count
    - Signal strength

- Network Activity Report – Physical Artefact showing:
    - Devices on network
    - Bandwidth
    - Port usage

- Utility Bill – Paper Display showing:
    - Numerical itemization of device-related bandwidth consumption and port data
    - Trends

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