

COMMUNITY WIRELESS MESH NETWORKS

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Talk Overview



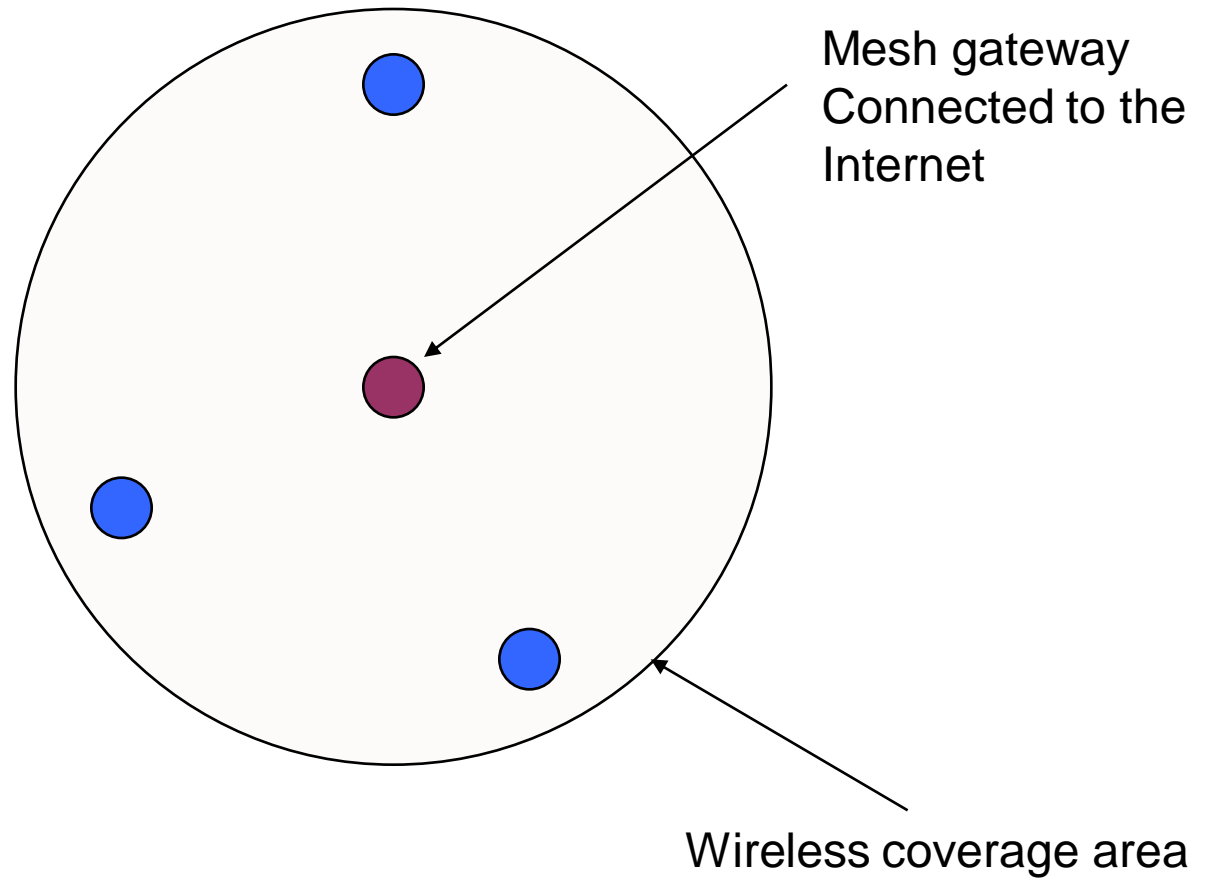
- Johnathan Ishmael, Sara Bury, Dimitrios Pezaros, Nicholas Race, "Deploying Rural Community Wireless Mesh Networks," *IEEE Internet Computing*, vol. 12, no. 4, pp. 22-29, Jul/Aug, 2008


- Wray Community Wireless Mesh Network
- Technical Challenges
- Research Directions





Traditional Access Point

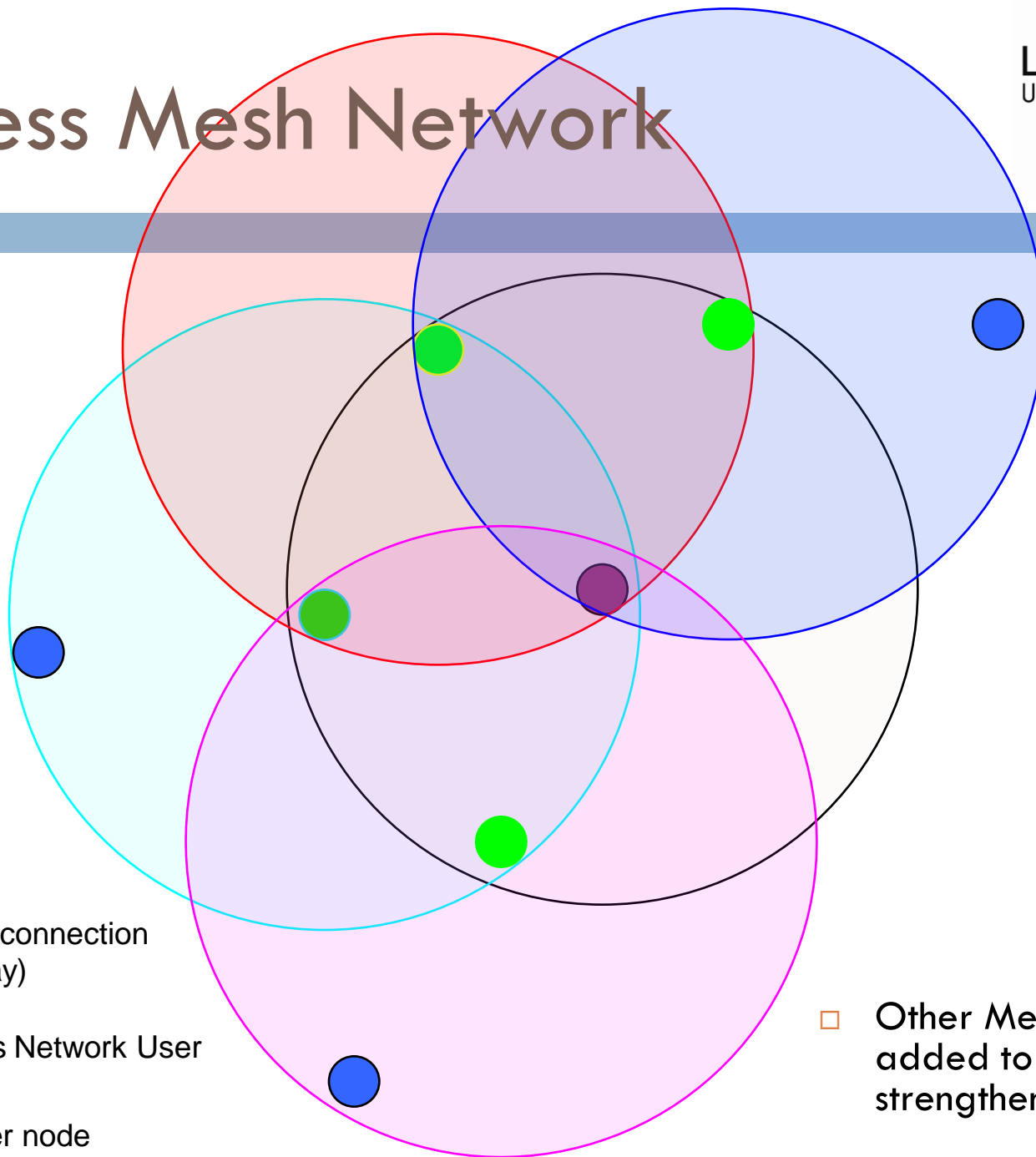


 Internet connection
(Gateway)

 Wireless Network User



Wireless Mesh Network



● Internet connection
(Gateway)

● Wireless Network User

● Repeater node

□ Other Mesh nodes
added to extend and
strengthen the coverage



Benefits of WMNs

- Ease & Simplicity:
 - ▣ Rapid, scalable deployment without the need for existing infrastructure
- Robustness:
 - ▣ Self-healing: Continuous re-configuration as routes are broken
- Price:
 - ▣ User connects to the Mesh network, like a normal Access Point (no special equipment required)





Agreement with Wray Community

- University offered to:
 - ▣ Provide free backhaul to community
 - ▣ Install LocustWorld WMN equipment & antennas at the village school
 - ▣ Supply additional Mesh equipment for use throughout the village
 - ▣ Ensure connectivity to the village on a “best effort” basis
- University is not focused on:
 - ▣ Solving end user connection issues
 - *“My PC doesn’t work”, etc!*
 - ▣ Management/Access control of MESH network
 - *Although have been doing this for the time-being...*



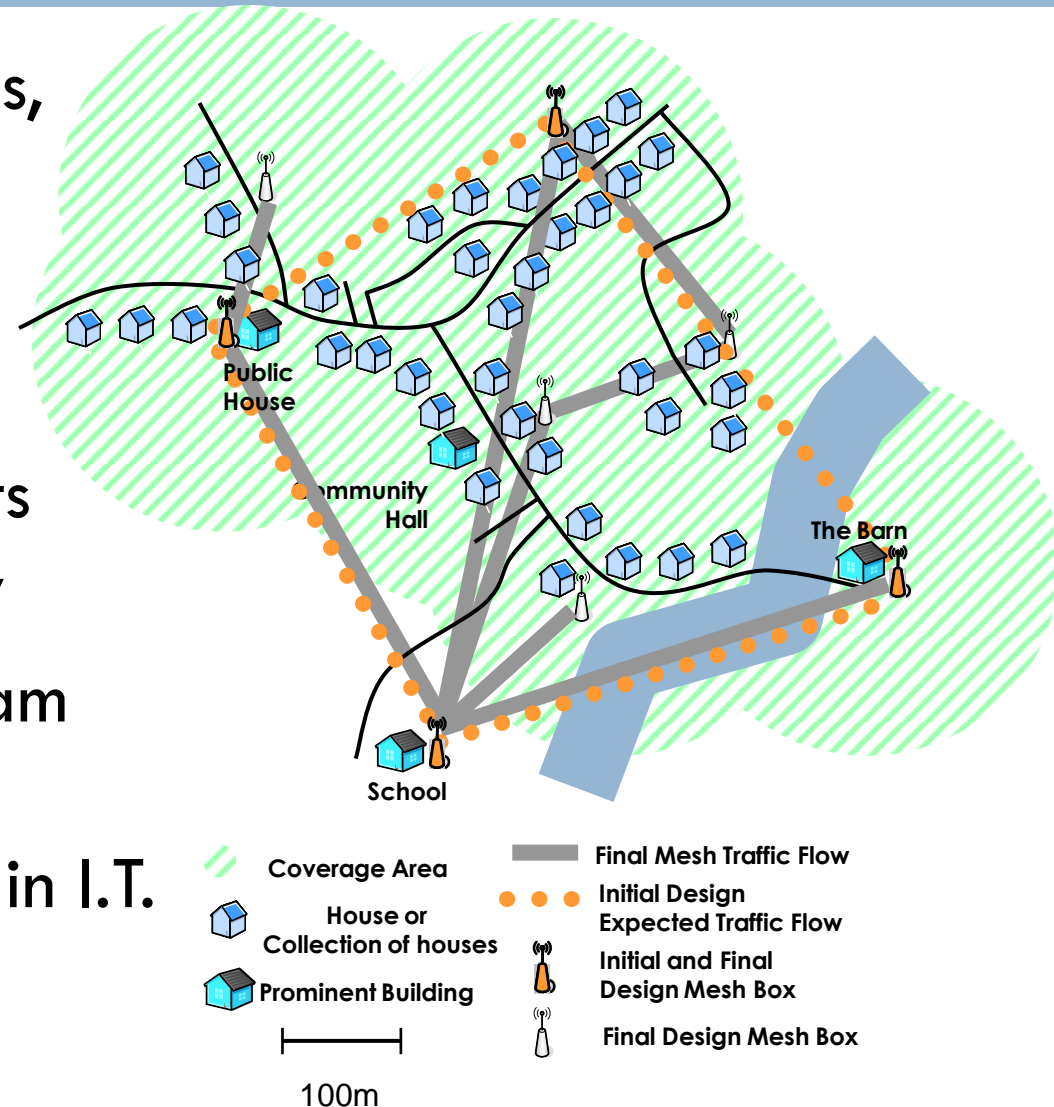
Wray WMN – Phase 1:

- ❑ Participated in Deployment of the Wray Wireless Mesh Network:
 - ❑ Initial configuring of hardware
 - ❑ Establishing a community-based team for day-to-day mesh management
- ❑ Technical Challenges
 - ❑ Aerials incorrectly deployed
 - ❑ Software not operating to the ‘ethos’ of Wireless Mesh Networks (not self-managing)
- ❑ Social Challenges
 - ❑ Large learning curve for local community, both in using and maintaining the network
 - ❑ Users’ expectations were considerably high
 - ❑ Expected wireless adaptors to function from anywhere
 - ❑ Lack of understanding of underlying technology



Wray WMN – Phase 2:

- Raised existing aerials, shortened cables
- Expanded number of Mesh boxes
- Fitted aerials to clients with poor connectivity
- Community-based team and users gaining increased confidence in I.T.





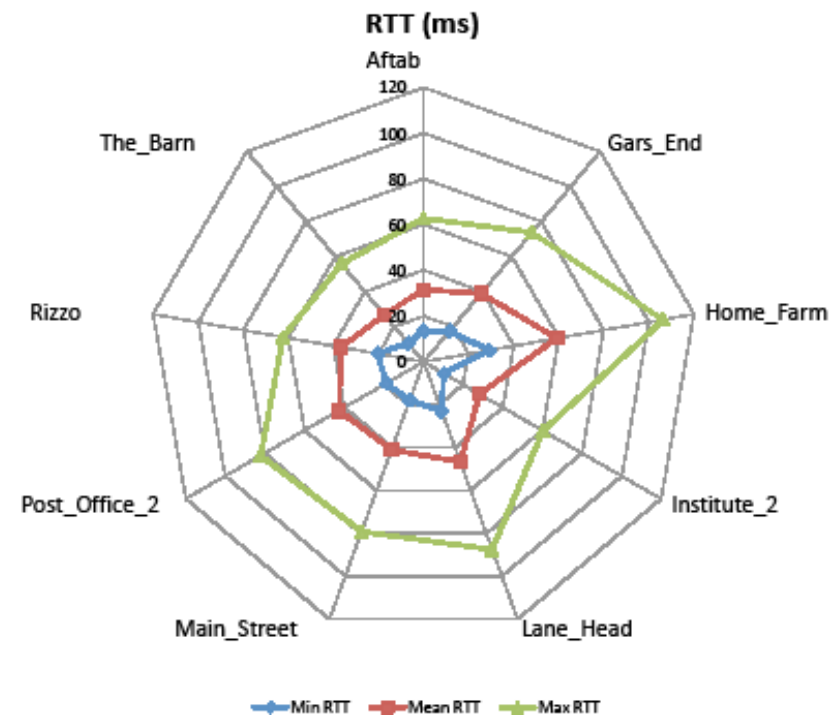
WMN Problems

- “The BBC is broken, can you fix it?”
- After several months of continued operation the mesh began to behave unexpectedly:
 - Routes would fail and change periodically
 - Clients with poor access suddenly had no access
 - Unpredictable service to well connected clients
- No significant capabilities of visualising and understanding Wireless Mesh Network behaviour



Monitoring Platform

- Developed a bespoke monitoring platform to analyse the behaviour of the Wray WMN
- Captured data at 60 second intervals including:
 - Packet Flows
 - Routing tables
 - Signal Strength
 - Connected Clients





WMN Issues

- Investigation of the data showed a growing change in user behaviour :
 - short lived, low bandwidth → long lived, high bandwidth
- **Route Flapping:** Network easily disrupted by long lived flows and high number of connections from applications such as Peer to Peer
- **Flash Crowds:** Community Element effecting the network -- The YouTube Effect
- **Poor Design:** This problem was compounded by the inability of the Mesh to restore its state after disruption



Fixing the Problems

- To alleviate the problems on the Wray WMN the following actions were taken:
 - The gateway choice for each Mesh Node was hard coded
 - Available routing paths were heavily restricted, resulting in only 'good' paths being used
 - Automatic pathway blocking disabled
 - Traffic shaping enabled
 - Boot order of Mesh Boxes closely observed
- In summary, Mesh elements of the network removed or heavily restricted



Usage Trends

- 2004: 10 Users – 6 Mesh Boxes
- 2005: 30 Users – 6 Mesh Boxes
- 2006+: 130+ Users – 10 Mesh Boxes

Table 1. Daily mean meshbox load (Kbytes per second).

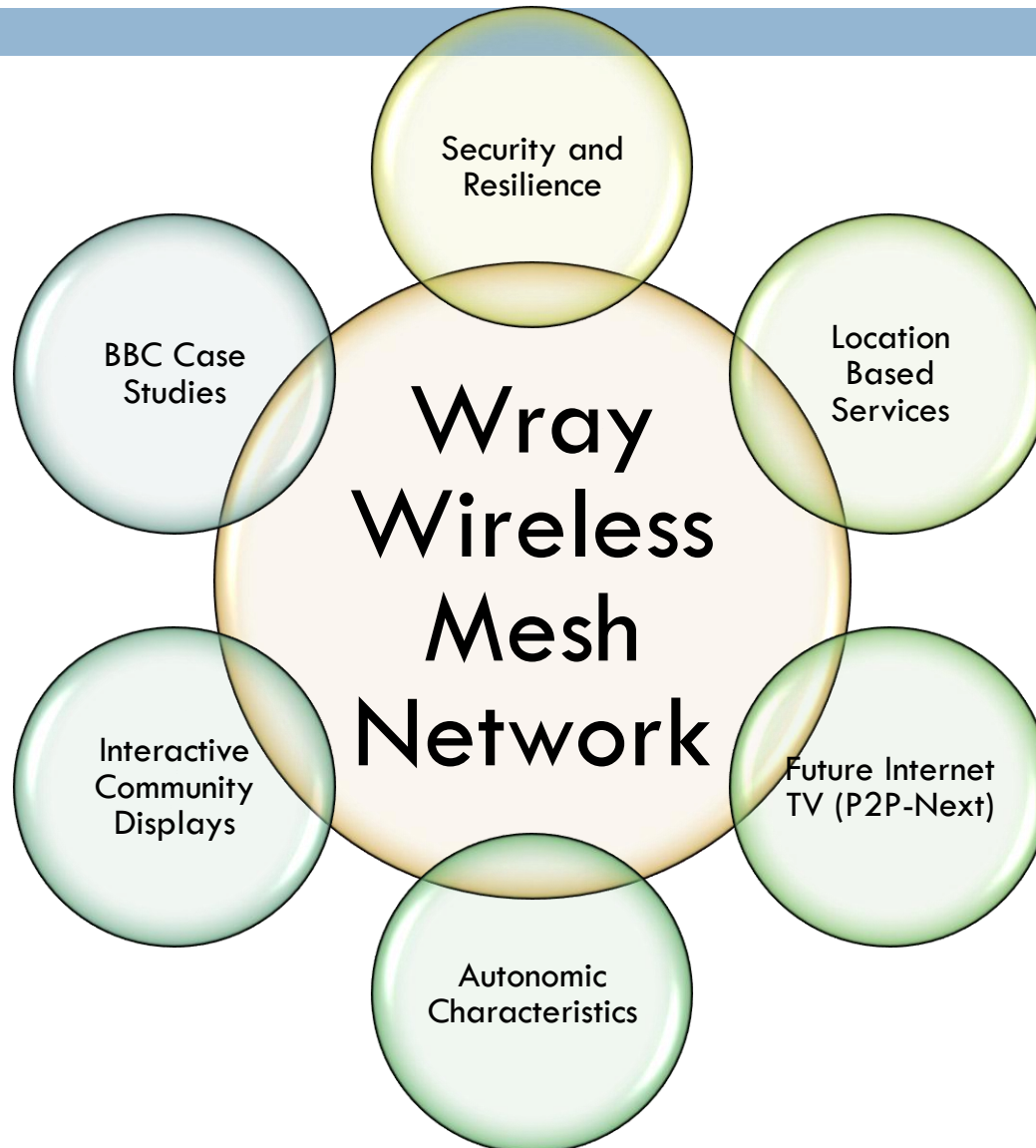
Month	Minimum	Median	Mean	Maximum
November 2005	2.27	6.2	9.14	25.86
October 2006	2.78	8.28	8.68	17.77

Table 2. Daily aggregate mesh utilization (Gbytes).

Month	Minimum	Median	Mean	Maximum
November 2005	1.18	3.16	4.75	13.66
October 2006	2.86	7.34	9.0	18.14



Research Directions



- WMNs need significant research to make them Dynamically self-organising and self-configuring
- Provided a significant resource both for research and the local community
- Wray WMN provided significant benefits to rural businesses, improving community awareness and communication

