Overcoming communications challenges at the Oregon Country Fair

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OCF facts

- Three-day festival held annually in mid-July
- Lane County, Oregon near Veneta
- 22,000 visitors each day
- 950 craft and food booths
- Mostly wooded area – floods in winter
- Whimsical and fun
- 17 stages, entertainment, parades, etc.
- Established in 1969
- Non-profit – limited funds


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Communications infrastructure

- Extensive staff use of two-way radio.
- Landline analog PBX covers most areas.
- Very limited availability of grid power.
- Good cellular service 362 days a year.
- Internet supplied by five bonded ADSL lines – limited need for high bandwidth for staff.

WiFi – The main challenge

- Cellular infrastructure designed for town of 4500 people, most of the time they are in homes or offices on local wi-fi.
- 22,000 visitors in a small area all trying to share pictures, video, etc. overwhelm the cellular system.
- Need for staff to access Internet wirelessly.
- Vendors depend on connectivity to process payment cards.

Initial Wi-Fi Deployment

- 900-MHz backbone from two hub locations to seven repeaters installed in trees.
- Each repeater has a 900 MHz radio with a directional antenna linking to backbone and a 2.4GHz access point with an omnidirectional antenna feeding users.
- Powered by 12-volt storage batteries at base of each tree.
- In place for past several years.


POTTERY

Multiple uses

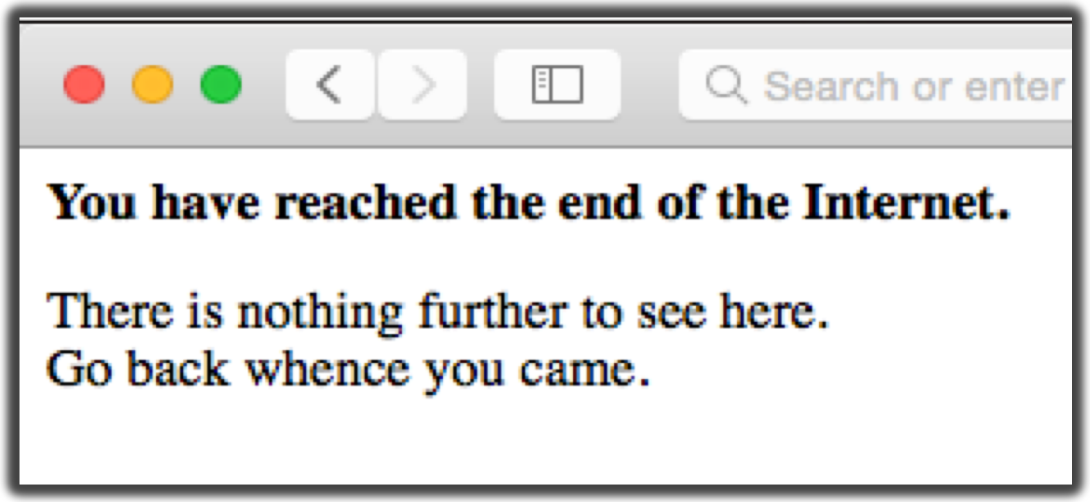
- During public hours vendor access to payment processing is critical and prioritized. Vendors are on their own SSID.
- Staff uses a separate SSID over same infrastructure for administrative needs.
- During non-public hours a third SSID is enabled for volunteers and others.
- Firewall and QoS are controlled by PFSense routers at hub.

Vendor needs are critical

- Trend over last few years away from cash and checks toward payment cards.
- Lack of grid power, cellular overload, infrastructure limits placement options for ATMs.
- Small-business merchant account access is much more prevalent than in the past – Square, Stripe, etc.
- Customers prefer to pay by card.
- Offline transactions are risky for merchants.
- Inability to process payment cards results in lost sales.

How to deliver only payment card access?

- Even if vendors don't intentionally abuse, modern smartphone apps are very chatty.
- Restrict vendor communication only to payment processors. Whitelist or blacklist? Redirect to static page.



Drawbacks

- System works well for staff use outside of public hours, but is overwhelmed by 22,000 visitors on-site.
- Hidden-node issue due to wide-coverage access points and low-power user radios near ground level.
- Foliage causes dead spots and aggravates hidden-node problem.
- 2.4 GHz band is very noisy.
- Need to change batteries periodically is labor intensive.

Multiple problems to solve

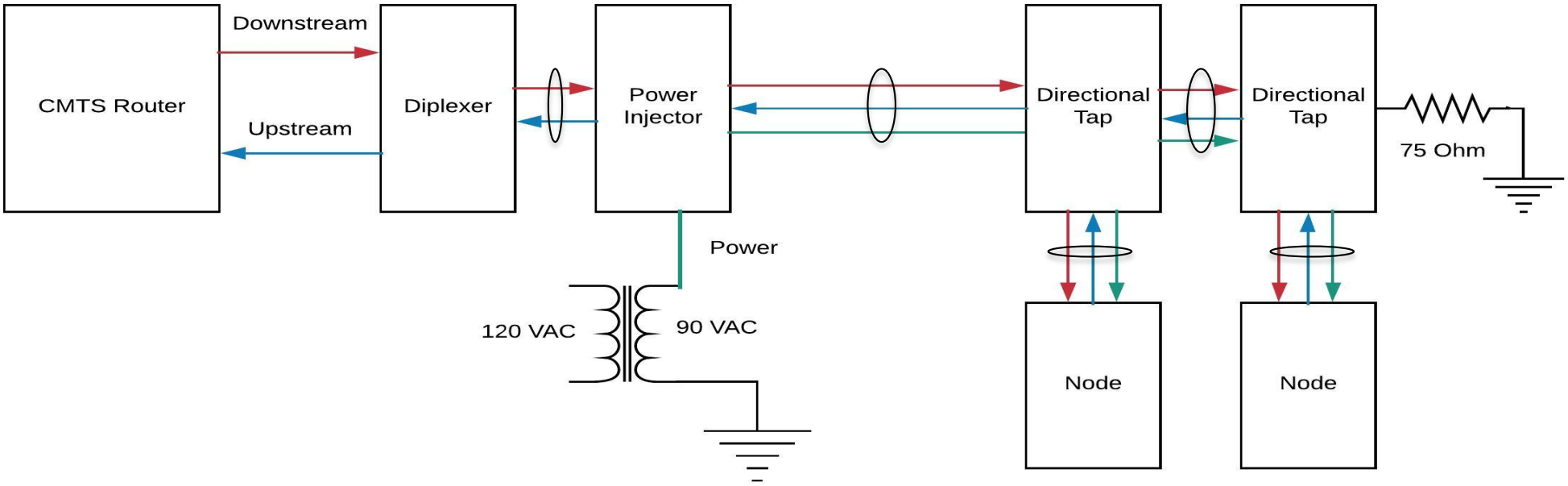
- 2.4 GHz wide-area radios unusable due to hidden node issue and interference.
- Need to reduce coverage area per access point. This requires many more APs.
- 5 GHz band less interference-prone, foliage limits range. This can be a good thing.
- Need to power equipment in the field without adding batteries requiring maintenance.
- Small low-to-ground 5 GHz pilot project in 2016 showed promise.
- Limited budget to work with.

Cable Modem Deployment

- 75-ohm coaxial cable backbone.
- Nodes powered over cable each support up to four radios.
- One trunk line can feed ten nodes and 40 radios.
- Very wide band – vacant frequencies (channels) can be used for video, etc.
- Power over cable eliminates the need for swapping batteries. Proven technology for cable providers to power infrastructure.
- Environmentally rugged.
- Expandable by tapping or extending cable trunk line.

Head-end

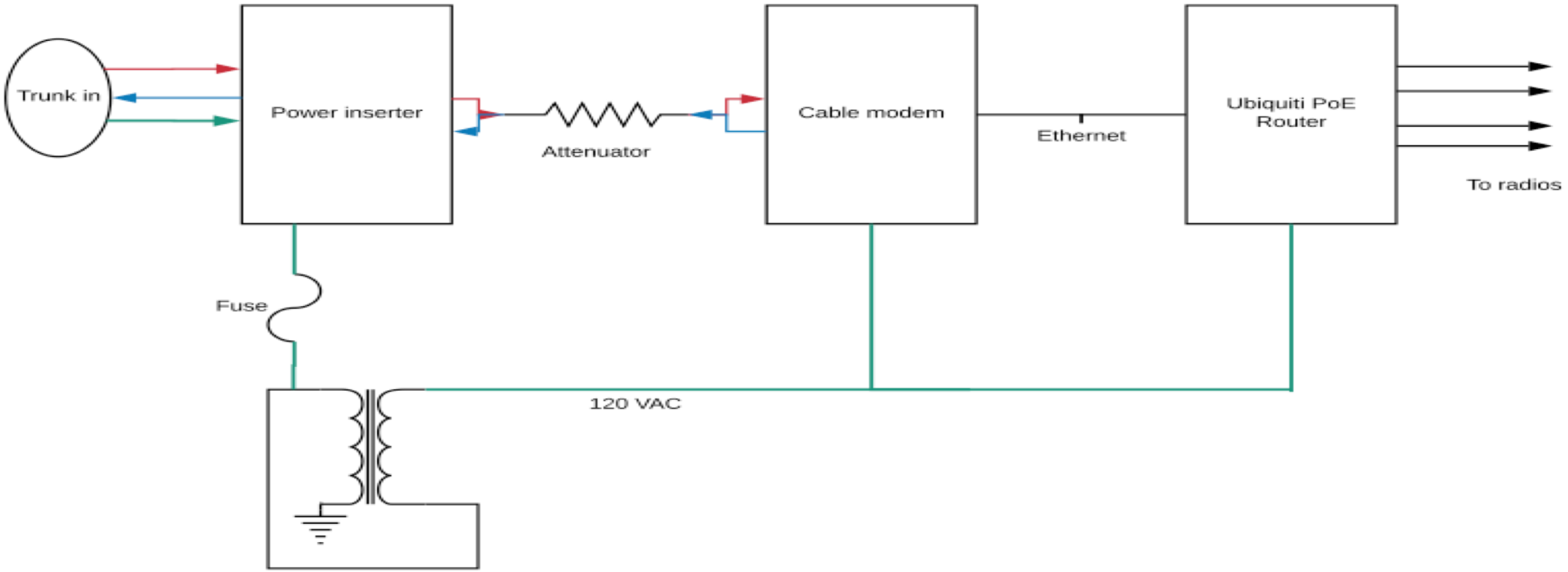
- CMTS router converts Ethernet to co-ax.
- High frequency downstream (transmit).
- Low frequency upstream (receive).
- Diplexer combines high and low frequencies onto cable.
- Power injector adds 90VAC to cable center conductor.
- Directional taps in field power individual nodes.
- 75-ohm terminator at end of line to prevent reflections.

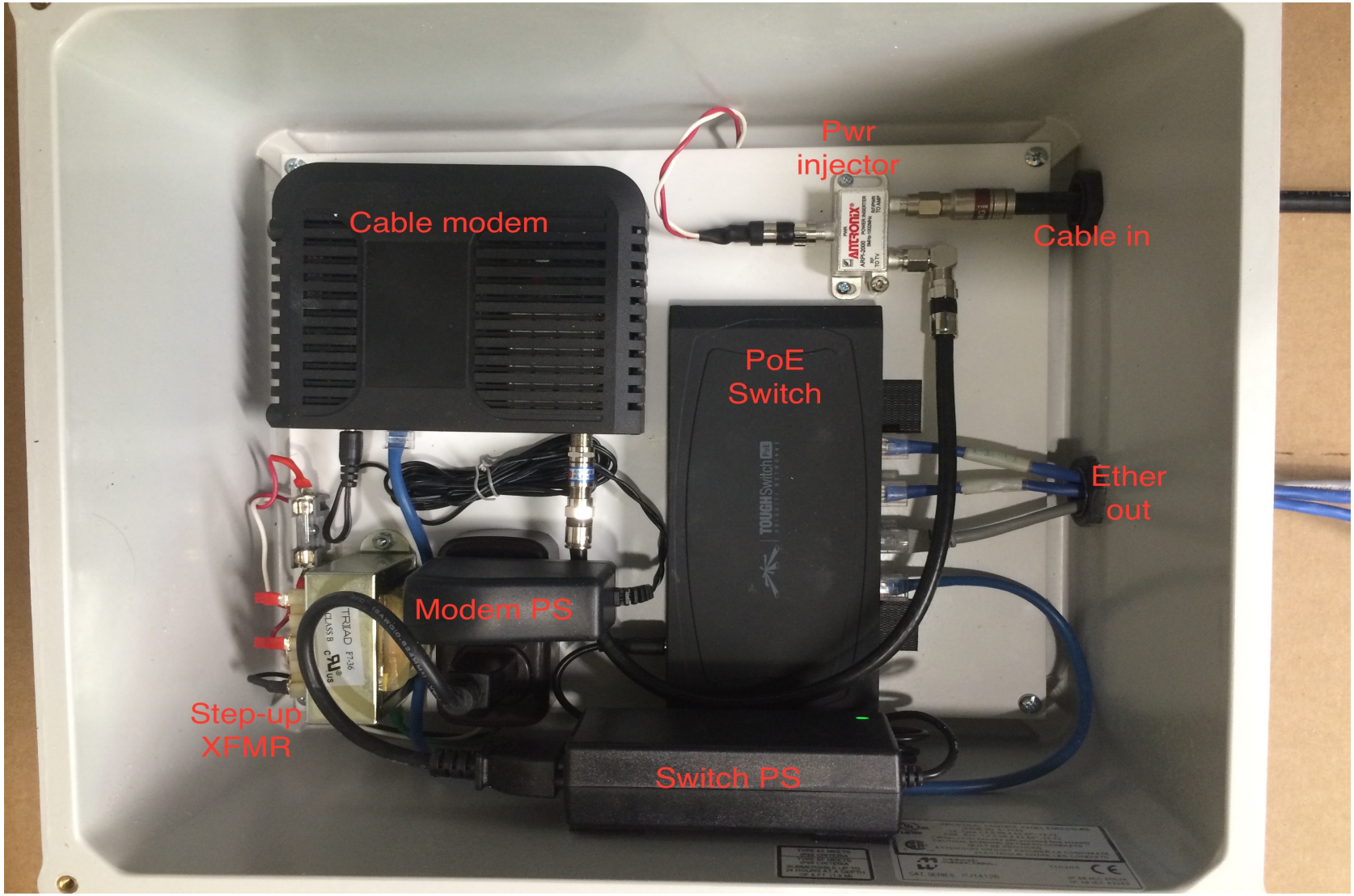

CMTS Router
Downstream
Upstream
Diplexer
Power Injector
Power
120 VAC
90 VAC
Directional Tap
Directional Tap
75 Ohm
Node
Node

Area node

- Powered from cable trunk line.
- Power inserter removes power from cable before passing RF to modem.
- Auto-transformer steps up power to 120VAC.
- Attenuator for proper RF level to modem.
- Cable modem converts back to Ethernet.
- PoE switch/router delivers power and data to radios.

Node Schematic




Pwr
injector
Cable modem
Cable in
PoE
Switch
Ether
out
Modem PS
Step-up
XFMR
Switch PS

Directional coupler and node

Directional coupler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Stealth radio

Future improvements

- Expand cable nodes throughout the area
- Faster connectivity to the Fair as a whole
- Continue to improve firewall tuning and QoS

Questions?