Passive Repeater Applications for Rural ITS Communications Systems

"The Prequel"

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Caltrans, District 2

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- **It is positioned so that it reflects a microwave beam and makes it possible to build a transmission path where there is no direct line-of-site.**
- **This concept and equipment has existed since the 1950’s and is also called a “Microwave Reflector”.**

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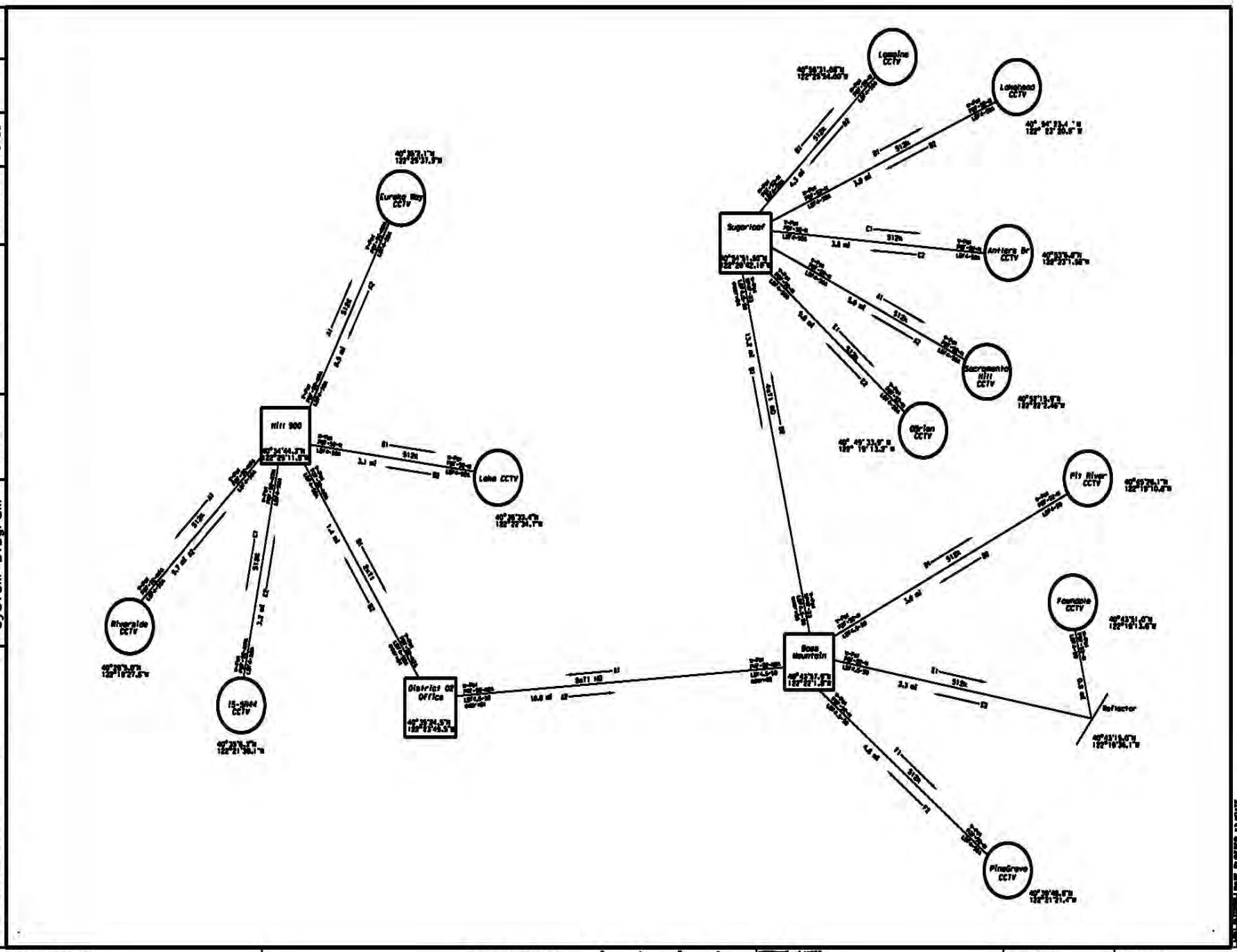
- **How would a typical Rural ITS “wireless” communications system benefit from using this technology?**
- **Let’s look at the current TMS Microwave system layout here in District 2.**


Redding Wireless System Diagram
ITS ENGR and SUPPORT
CALCULATED-DESIGNED BY
CHECKED BY
R. Beals
-
REVISED BY
DATE REVISED
R. Beals
10/08
Hill 900
Lake CCTV
Eureka Hill CCTV
Riverside CCTV
District 02 Office
Boss Mountain
Sugarloaf
Lassing CCTV
Longwood CCTV
Antlers Br CCTV
Sacramento Hill CCTV
Orion CCTV
Pit River CCTV
Fountain CCTV
Reflector
Pine Grove CCTV
BORDER LAST REVISED 3/1/2007
RELATIVE BORDER SCALE IS IN INCHES
0 1 2 3
CU 02 369
EA XXXXXX

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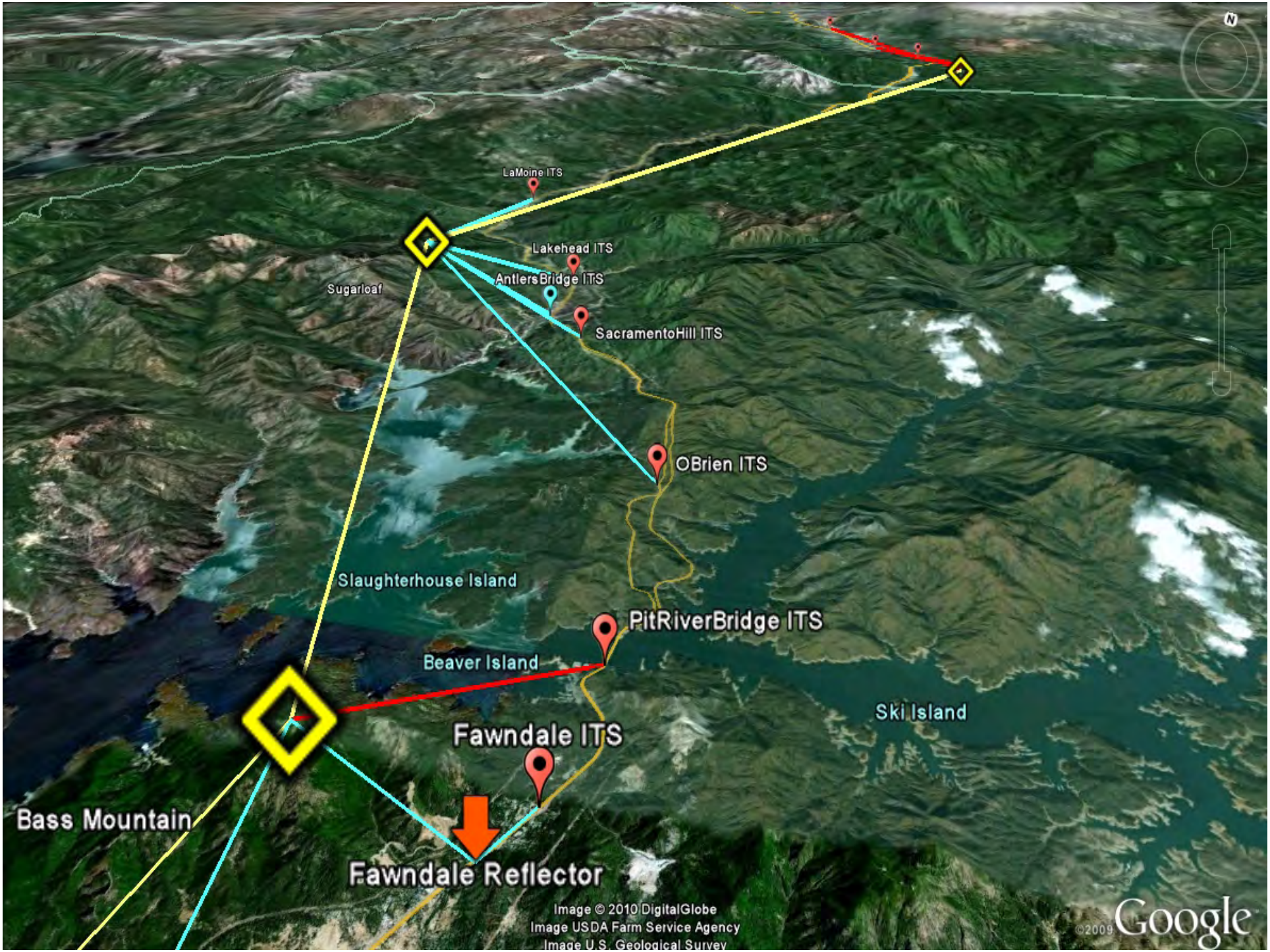
- **Note that a “backbone” interconnects several mountaintop radios sites with the District 2 Office.**


LaMoine ITS
Lakehead ITS
AntlersBridge ITS
Sugarloaf
SacramentoHill ITS
OBrien ITS
Slaughterhouse Island
PitRiverBridge ITS
Beaver Island
Ski Island
Fawndale ITS
Bass Mountain
Fawndale Reflector
Image © 2010 DigitalGlobe
Image USDA Farm Service Agency
Image U.S. Geological Survey
©2009 Google

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- **Note that a “backbone” interconnects several mountaintop radios sites with the District 2 Office.**
- **Then roadside links connect the TMS field elements with the mountaintop.**

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- **In general, as rural highways cross mountainous areas they tend to follow rivers and canyons.**
- **Wireless backbones tend to be built from mountaintop to mountaintop.**
- **Often there are long segments of highway that are obstructed from a line-of-sight path to the mountaintop.**

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- **Just as often there are many cut-banks next to the roadway that can offer tens or even hundreds of feet of added elevation that is within the right-of-way.**
- **This is a perfect application for a passive repeater.**
- **The microwave beam can be “bent” around obstructions and allow a good path to be developed.**

What is a " Passive Repeater" and how does it fit into a Rural ITS communications strategy?

- **As an example, let’s look at the highway that is visible from Bass Mountain, 10 miles north of Redding in District 2.**


ITS Node (behind the hill)
Interstate 5
Interstate 5


ITS Node (behind the hill)
Interstate 5
Interstate 5
No Direct Path to
the Roadside – the
ITS Node is Hidden
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Second Step of the Cut-Bank has a Direct Path to both the ITS Node and the Mountain Radio Site
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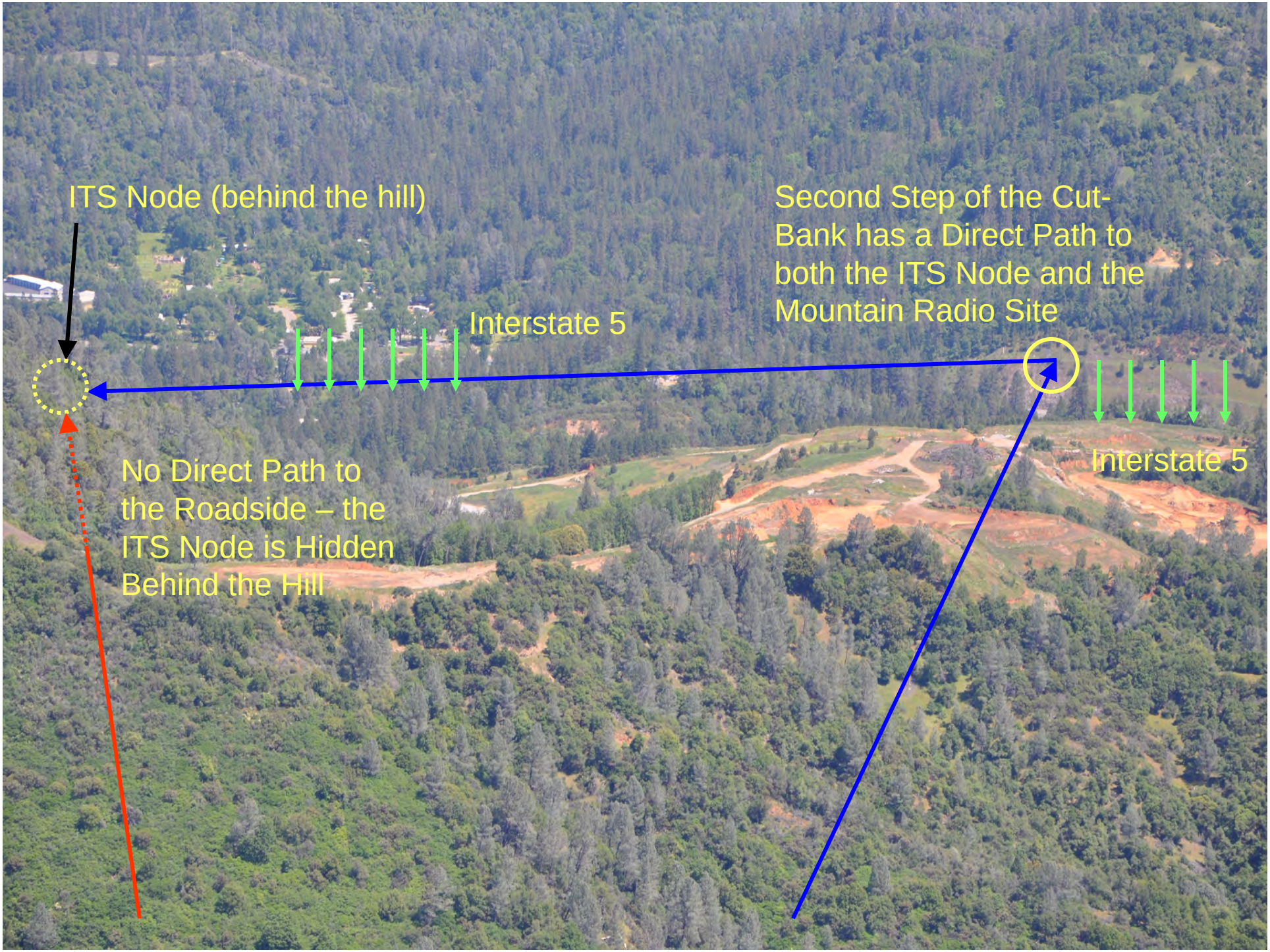
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Second Step of the Cut-Bank has a Direct Path to both the ITS Node and the Mountain Radio Site
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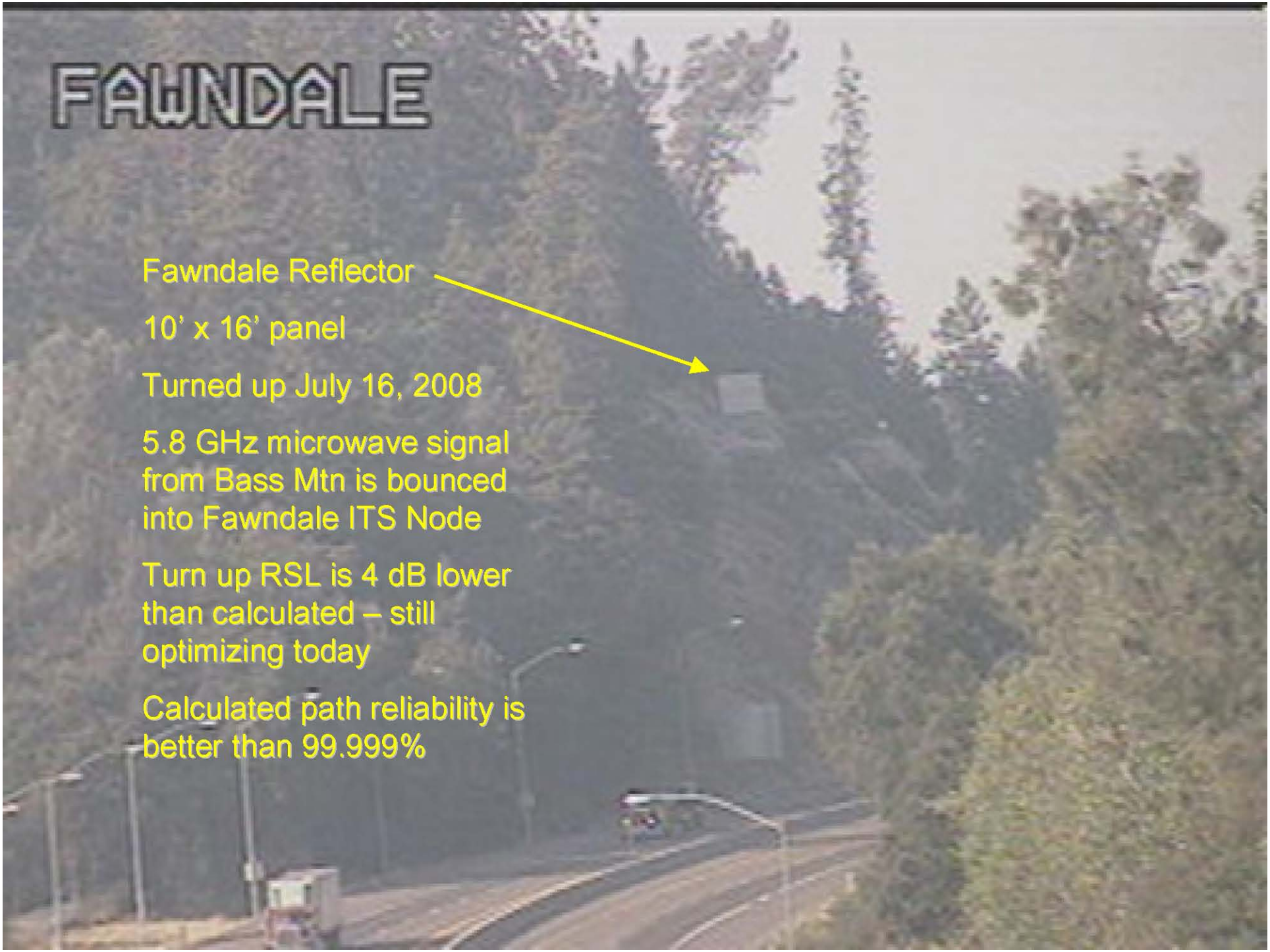
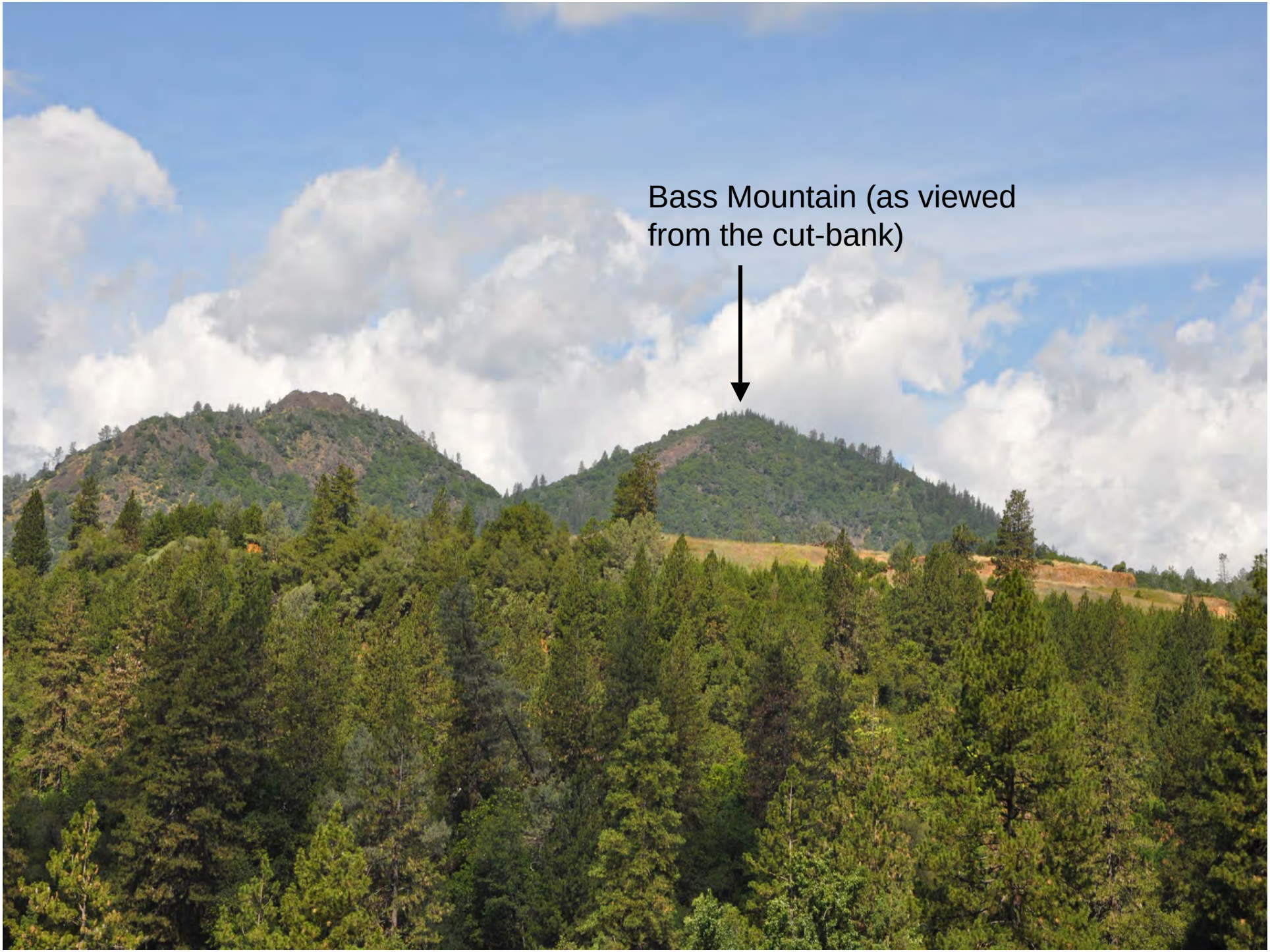
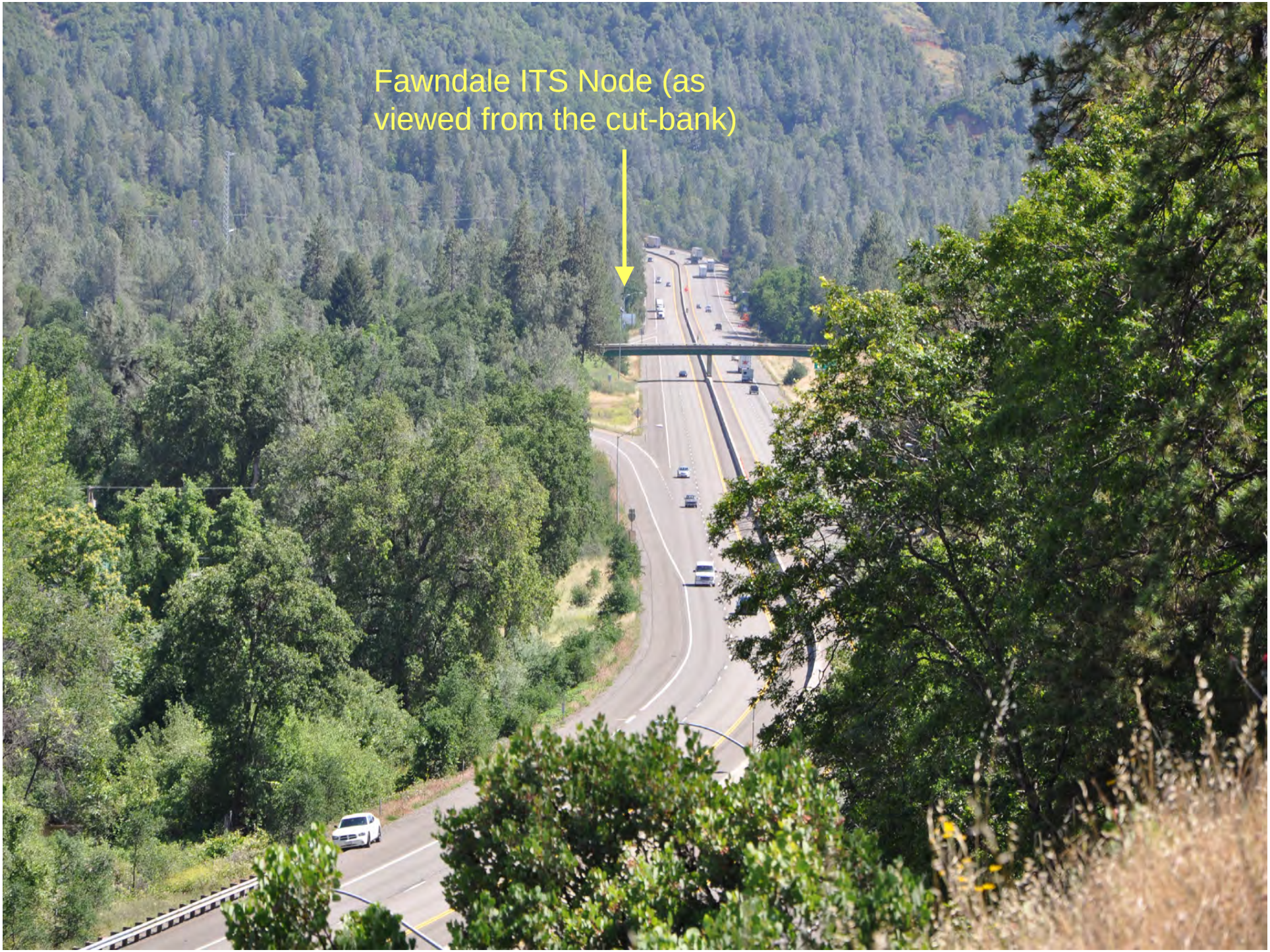
Look Closely and You
Can See the Reflector
Interstate 5


FAWNDALE
Fawndale Reflector
10’ x 16’ panel
Turned up July 16, 2008
5.8 GHz microwave signal from Bass Mtn is bounced into Fawndale ITS Node
Turn up RSL is 4 dB lower than calculated – still optimizing today
Calculated path reliability is better than 99.999%


Bass Mountain (as viewed
from the cut-bank)


Fawndale ITS Node (as
viewed from the cut-bank)

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- **Let’s also look at the highway from a different site, Sugarloaf, near Lakehead in District 2.**


HHH

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- **As you can see from the photos, there are many locations where the highway is obstructed by hills.**
- **A Passive Repeater(s) could be successfully deployed at several different locations to provide connectivity to the hidden roadside segments.**

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- **RIGHT of WAY – The cut-banks are within Caltrans' R of W.**

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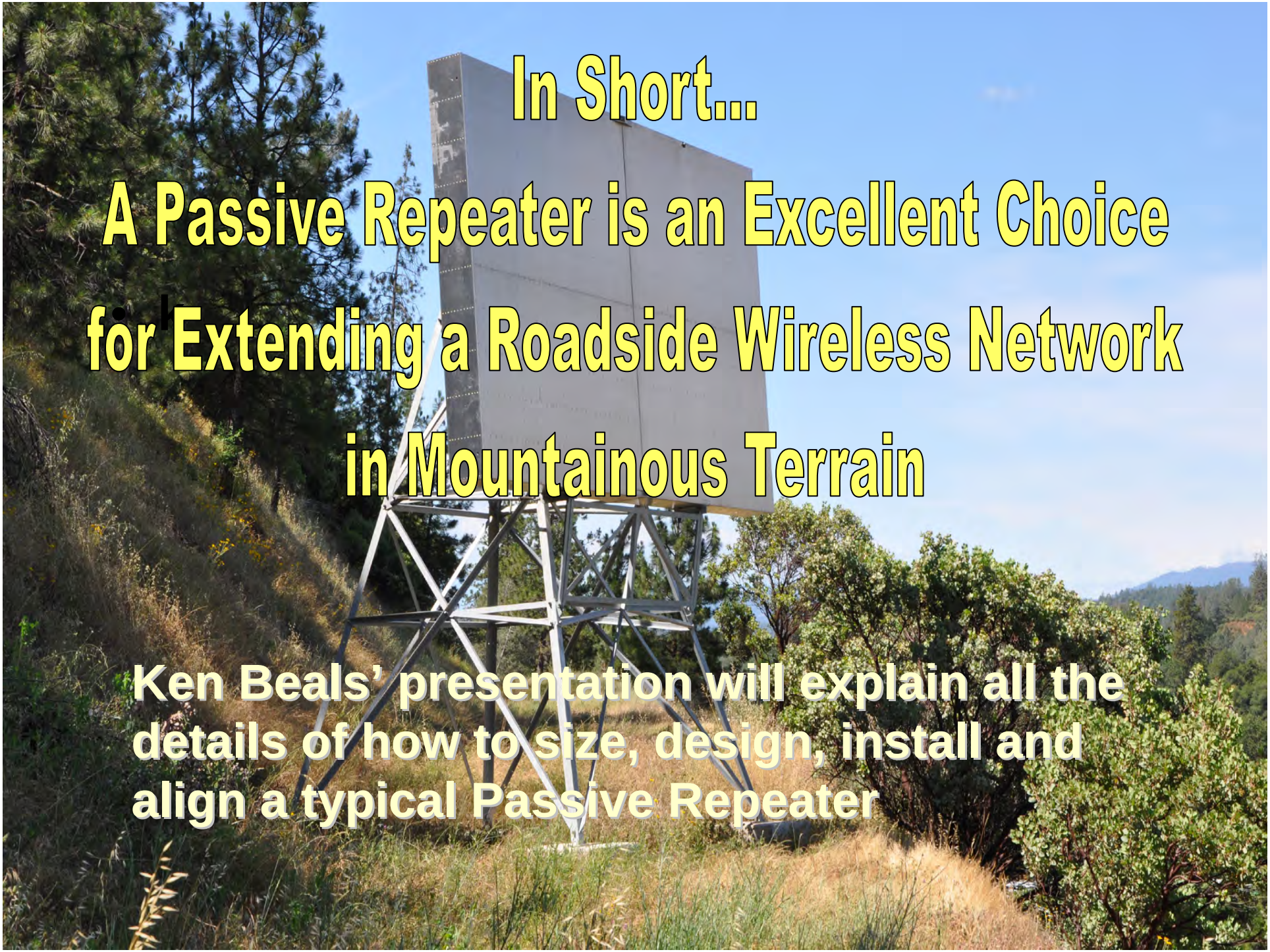
- **UTILITIES – There is no active electronic equipment so no need for commercial power or telephone.**


In Short...
A Passive Repeater is an Excellent Choice
for Extending a Roadside Wireless Network
in Mountainous Terrain



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Ken Beals' presentation will explain all the details of how to size, design, install and align a typical Passive Repeater


Any Questions?