# ESTABLISHING & USING A REAL TIME NETWORK IN EASTERN WASHINGTON

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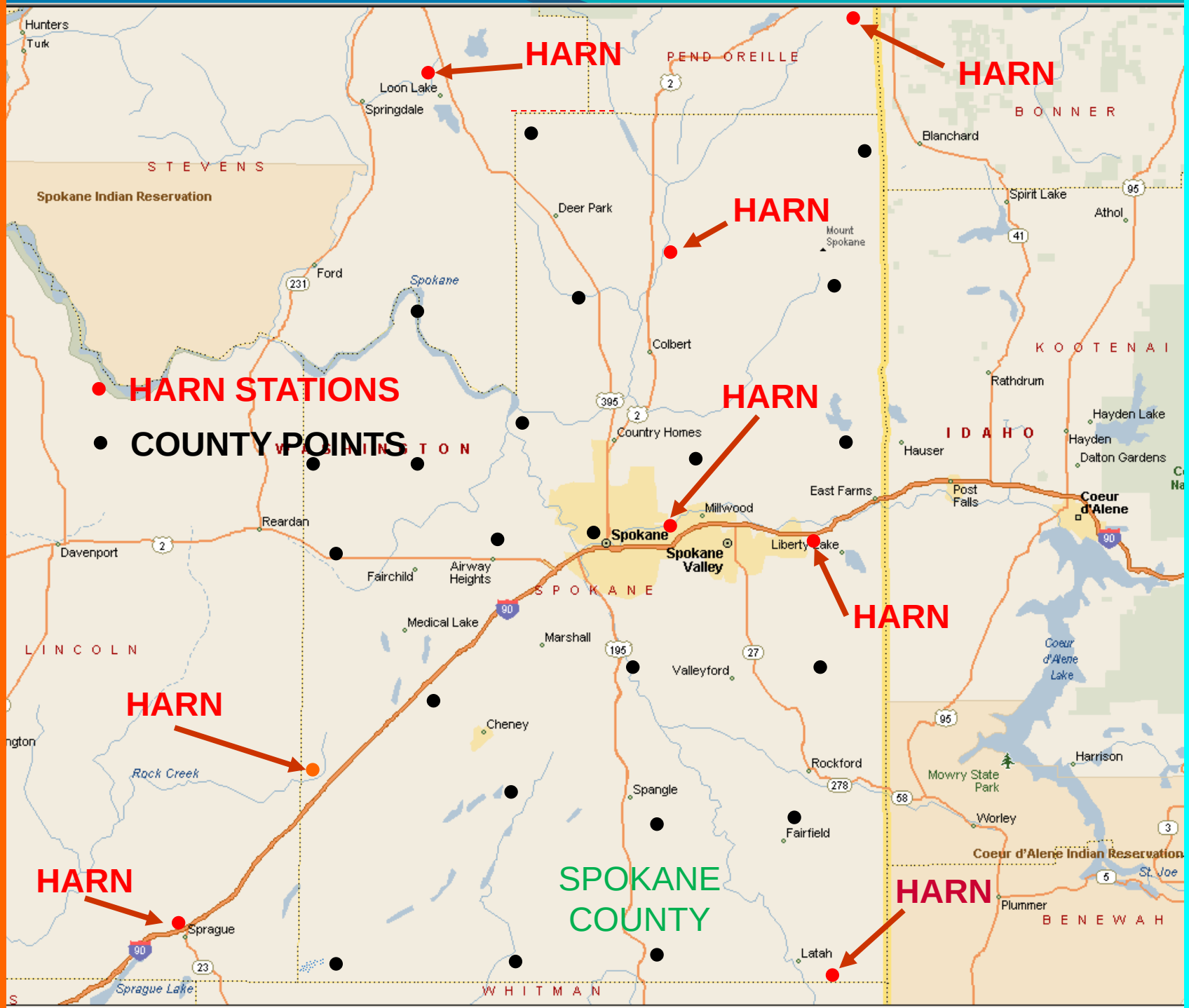
**SPOKANE COUNTY ENGINEERING**

# INTRODUCTION

- GPS and Spokane County.
- How GPS was used with in the County.
- Building a Real Time Network.
- Cell Phone problems.

# SPOKANE COUNTY ESTABLISHES THEIR FIRST GPS SURVEY CREW

We started using GPS in 1991, with two Trimble 4000 ST Single Frequency Receivers and one Path Finder Mapping Grade Receiver.


HARN
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COUNTY POINTS
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PEND OREILLE
BONNER
STEVENS
KOOTENAI
IDAHO
SPOKANE
LINCOLN
WHITMAN
BENEWAH
Spokane Indian Reservation
Coeur d'Alene Indian Reservation
Hunters
Turk
Loon Lake
Springdale
Blanchard
Spirit Lake
Athol
Deer Park
Mount Spokane
Ford
Spokane
Colbert
Rathdrum
Hayden Lake
Hayden
Dalton Gardens
Hauser
Country Homes
East Farms
Post Falls
Coeur d'Alene
Millwood
Reardan
Davenport
Spokane
Spokane Valley
Liberty Lake
Fairchild
Airway Heights
Medical Lake
Marshall
Valleyford
Cheney
Coeur d'Alene Lake
Harrison
Mowry State Park
Rock Creek
Rockford
Spangle
Worley
Fairfield
Sprague
Plummer
Latah
Sprague Lake
St. Joe

# Building the County's Grid

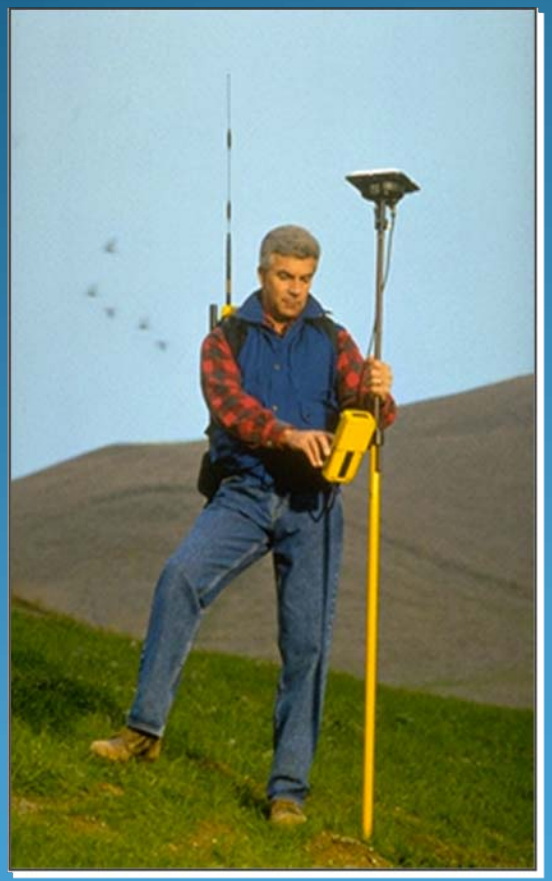
- We located and measured many First Order Benches as part of the Grid.
- We created a GEOID Model for Spokane County.

# HOW SPOKANE COUNTY FIRST USED GPS

- Established a GPS Control Network.
- Recovered Section Corners for complete Townships and supplied GIS with a Geodetic Position of each corner.
- Set Survey Control for conventional topos.
- Stock Pile Inventory. (A new system called RTK)

# SPOKANE COUNTY RENTS THEIR FIRST RTK SYSTEM

THE
BACK PACK



4000 SSI Receiver

TDC1 DATA
COLLECTOR

# USING RTK TO INVENTORY STOCK PILES

- We rented a GPS RTK unit for $8,000.
- Rent + manpower, cost was $27,000 (Crew of Two).
- Previous year the cost was $30,000 (Crew of Three).
- We were told to buy the RTK unit.
- Following year, cost was $13,169.

# GPS IS DISCOVERED

- GPS was used for the first time to stake Prairie View Road.
- First day out we slope staked 4000'.
- Next day 3000'. (Ran out of wood)
- Third day, went to another job.
  Contractor needed to catch up.

# PRAIRIE VIEW ROAD

- 90% Completed with GPS.
- 10% Completed with a Level.
- Control was a half mile from the job site.
- ≈ 3 miles of road was rebuilt.
- Total Construction Survey cost $24,178 or $8,059 per mile.

# CURTIS ROAD

- Curtis Road was a similar project completed the previous year.
- ≈ 4 miles of road
- Static GPS was used to set control.
- The rest of the project was completed with Conventional Survey Equipment.
- Total Survey Construction cost $64,874 or $16,218 per mile.

# PRESENT DAY APPLICATIONS

- Preliminary Surveys – Topo, Control, etc.
- Recovering Section Corners.
- Monument Preservation.
- Construction Staking – Center Line, Slope Stacking, Guard Rail, Drainage Structures, etc.
- Stock Pile Inventory.
- Preliminary Center Line.

# BUILDING AN EASTERN WASHINGTON VRS NETWORK

- Local surveyors meet and begin looking at starting a VRS type network.
- Will it be Public or Private.
- Who will sponsor it.
- Public funded organizations cannot provide data to a “For Profit Network.”

# BUILDING AN EASTERN WASHINGTON VRS NETWORK

- After about six months of meetings, WSDOT, the City & County of Spokane and the Spatial Reference Center of Washington (SRCW) were the only agencies that remained active in the planning process.

# BUILDING AN EASTERN WASHINGTON VRS NETWORK

- Where could we build our stations?
- How do you build a CORS station?
- Who would manage the VRS network?

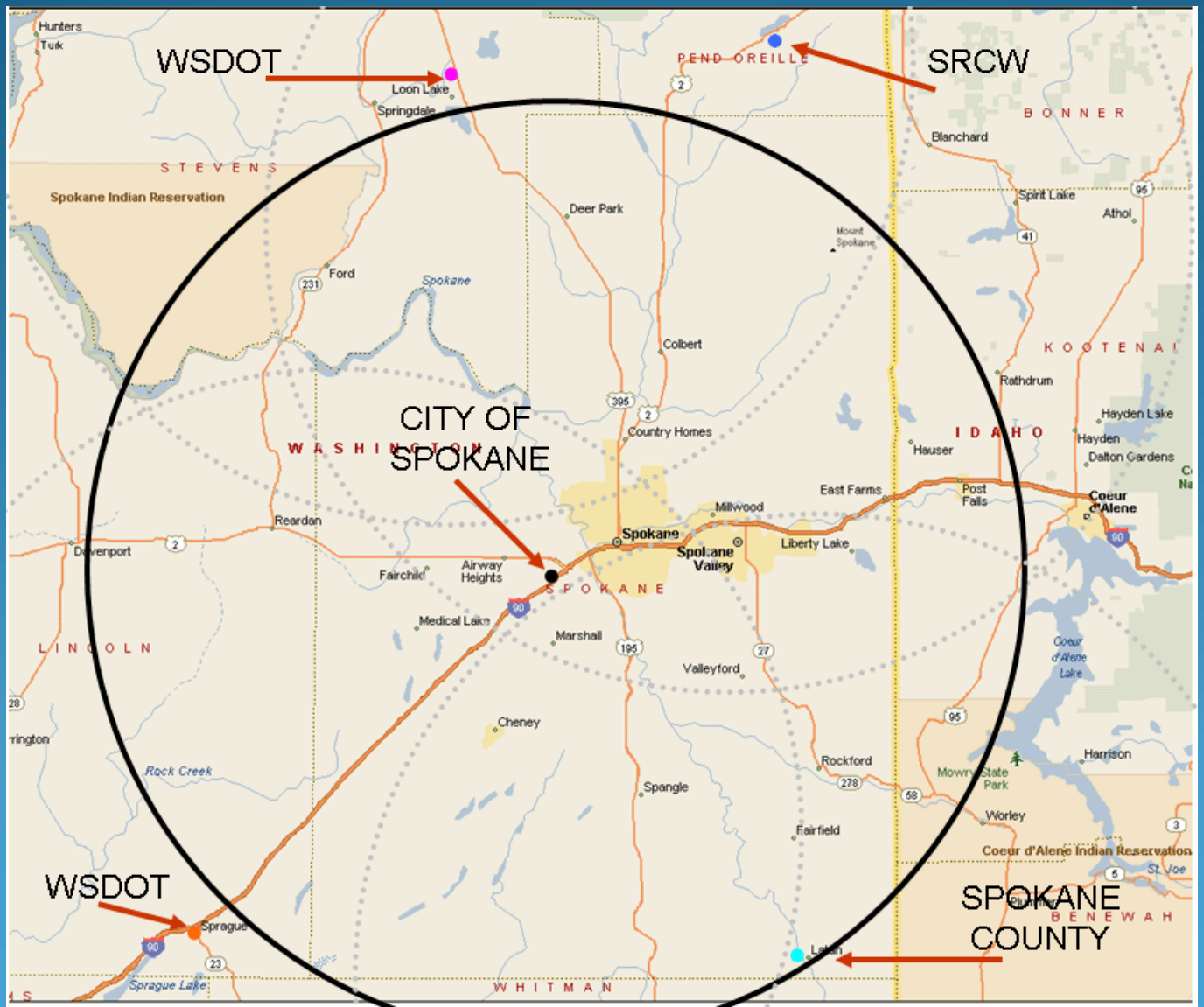
# SPOKANE'S VRS NETWORK

- It was each agency's job to sell the network to their management.

# SELLING VRS TO COUNTY MANAGEMENT

- $150 - $200 per hour GPS crew time
- 2 to 2 ½ hours lost per day due to setup.
- 0 hours lost for setup.
- No concerns about base station theft.
  ($30,000 in equipment)
- Some sites will still need radio setup.
- Estimated cost to build our station $35,000.

# SPOKANE'S VRS NETWORK



# DRILLING TO SET THE RODS



# SPOKANE COUNTY'S CORS SITE


Each leg was epoxied into a three feet deep hole, bored into a basalt ledge.

# SPOKANE COUNTY'S CORS SITE


Our site is up and running.

# SPOKANE VRS NETWORK

- The Spokane VRS Network went live April 17, 2006.
- The Spokane VRS Network was built on “Five Stations.”
- The Eastern Washington VRS Network begins to grow.

# HOW WE WORKED AROUND POOR CELL COVERAGE

- In some locations Cell reception is very poor.
- RTK can us the same problem, requiring several base setups.
- How did we overcome these problems?
- We setup a Local Wi-Fi Hot Spot.

# WE PARKED A TRUCK WHERE THERE WAS CELL COVERAGE


ROUTER HAS ABOUT A 300' RANGE.

AC OR DC POWERED.

WE USED A CRADELPOINT MBR900 ROUTER FOR THE WIRELESS NETWORK.

OPERATES WITH A USB CONNECTION.

USES A USB MODEM OR A CELL PHONE.

CORD SHOWN IS NOT SOLD BY VERIZON.

# PROBLEM USING A WIRELESS ROUTER.

- THE ROUTER DOES NOT ALWAYS COVER THE AREA .

## SOLUTION

- YOU USE A WIRELESS REPEATER .


AN ENCORE REPEATER DOUBLES OUR RANGE .

CUSTOM MADE CABLE

WAL-MART

SET UP CAN ALSO BE USED TO CHARGE A CELL BATTERY.

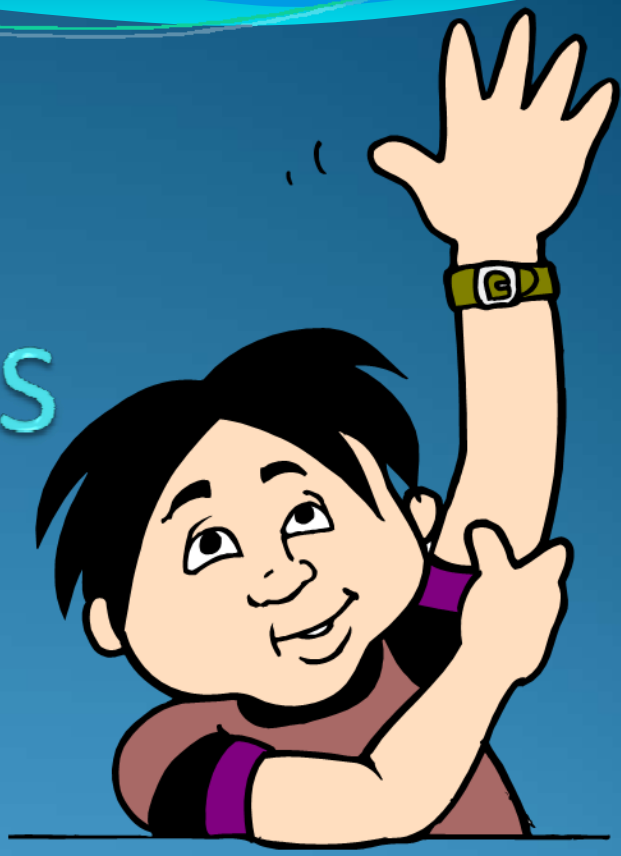
## How GPS Bends Time.

Einstein knew what he was talking about with his relativity discussions. For proof, just look at your hand held GPS. The global positioning system relies on 24 satellites that transmit time-stamped information on where they are in space. Your GPS receiver registers the exact time at which it receives that information from each satellite and then calculates how long it took for the individual signals to arrive. By multiplying the elapsed time by the speed of light, the unit can figure out how far it is from each satellite, compare those distances, and calculate its own position.

To achieve accuracy to within a few meters, the satellites' atomic clocks must be extremely precise, within plus or minus 10 nanoseconds. Here's where things get weird: Those amazingly accurate clocks never seem to run quite right once they are in space. One second as measured on the satellite never matches the same second measured on Earth, Just as Einstein predicted.

According to Einstein's "Theory of Relativity"; A clock that's traveling fast will appear to run slowly from the perspective of someone standing still. The GPS satellites move at about 9,000 mph, enough to make their onboard clocks slow down by 8 microseconds per day from the perspective of a GPS receiver and totally miscalculate the location data. To counter this effect, the GPS system must adjust each time single it receives from the satellites.

# Questions



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