# Grande-Prairie to Alaska Microwave System 1961 

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Ottawa On 2017


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# CN Telecommunications Engineering Dept. 1960 

Chief Eng̣ineer

Asst. Chief Eng̣ineer

| Radio --------------Equipment ----- Outside Plant----------Power |  |  |
| :--- | :--- | :--- |
| VHF/UHF | Audio | Cable installation |
| CNR mobiles | Channelizing | Voice/TV-studio |
| Generators/ |  |  |
| Microwave |  | Site surveys-roads |
| Standby |  |  |
| LP Broadcast |  | Pole line Mtce |



## Grande Prairie-Alaska Microwave System

Construction commenced in 1960
Completed in 1961
Turnkey fixed price of $\$ 25$ million
Canadian portion connected Colorado Springs to Clear Alaska
CN Telecommunications was prime contractor RCA Victor Montreal supplied MM-600 6Ghz microwave Dominion Bridge fabricated towers Butler Buildings used System comprised 42 microwave sites Grande Prairie AB- Yukon/Alaska border is $1310 \mathrm{mi} / 2096 \mathrm{Kms}$

Highest site in Highway- 8 Mile Creek elevation 5552 ft . Total length of tower sections- 9160 ft .

## Purpose of the system

-Provide a back up communication system from Colorado Springs to Clear Alaska in event of Pacific cable being lost. System was contracted to CNTelecommunications by the U.S. SignalCorps for $\$ 25$ million.

It was a turn-key system and part of the BMEWS (Ballistic Missle Early Warning System)

## Grande-Prairie-Alaska Microwave Route Map



## Distances on the Alaska Highway

Grand Prairie Ab-Dawson Creek B.C. 131kms
Dawson Creek B.C.-Ft. Nelson B.C. ..... 455kms
Ft.Nelson B.C. -Watson Lake Y.T. 513 kms
Watson Lake Y.T.-Whitehorse Y.T. 438kms
Whitehorse Y.T.-Haines Jct Y.T. 154 kms
Haines Jct Y.T.- Beaver Creek Y.T. ..... 291kms
Beaver Creek Y.T.- Tok Jct Ak 176kms
Total 2156 kms


| STATION | $\begin{aligned} & \text { LATITUDE } \\ & \text { LONGITUDE } \\ & \circ \text {. " } \end{aligned}$ | ADJACENT STATION | $\left\lvert\, \begin{aligned} & \text { PATH } \\ & \text { LMNGIH } \\ & (\text { miles }) \end{aligned}\right.$ | $\begin{array}{r} \text { THUE } \\ \text { BEARING } \\ \mathrm{N} \circ \quad \mathrm{O} \\ \hline \end{array}$ | Tormir <br> BASE <br> ELEV. <br> (2, 1 ) |  | MamTJTITE RADIO SYSTEM |  |  | AUKILIARY RADIO SYSTE? |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  | WhATETTIER <br> FRis. $8:$ POL. | $\begin{array}{c\|} \hline \text { ANT, } \\ \text { IEVEI } \end{array}$ | $\begin{gathered} \text { ANTP. } \\ \text { TYPE } \\ \hline \end{gathered}$ | TRAIS:ITTER FREA. 2: POL | $\begin{gathered} \text { ANT. } \\ \text { LEVEL } \end{gathered}$ | $\begin{aligned} & \text { AJTT. } \\ & \text { TYYPE } \end{aligned}$ |
| Steamboat | $\begin{array}{r} 584115 \\ 1234555 \end{array}$ | Fort Nelson Summit Pass | $\begin{aligned} & 38.2 \\ & 34.6 \end{aligned}$ | $\begin{array}{r} 77.5 \\ 264.0 \end{array}$ | 3615 | 230 | $\begin{aligned} & \text { MM }(5 s, 13 s) \text { H } \\ & M M(4 s, 12 s) V \end{aligned}$ | $\begin{aligned} & 120 \\ & 120 \end{aligned}$ | $\begin{aligned} & 40 \\ & 40 \end{aligned}$ |  |  |  |
| Summit Pass | $\begin{array}{r} 583753 \\ 1244311 \end{array}$ | Steamboat <br> Eight Mile Creek | $\begin{aligned} & 34.6 \\ & 37.9 \end{aligned}$ | $\begin{array}{r} 84.0 \\ 313.0 \end{array}$ | 5473 | 340 | $\begin{array}{ll} \text { MM }(5,13) & V \\ \text { MM }(4,12) & V \end{array}$ | $\begin{aligned} & 240 \\ & 110 \end{aligned}$ | $40$ $40$ |  |  |  |


| Tagish | $\begin{array}{r} 601628 \\ 1341102 \end{array}$ | Seaforth Creek Canyon Mountain | $\begin{aligned} & 20.9 \\ & 36.0 \end{aligned}$ | $\begin{array}{r} 59.5 \\ 318.0 \end{array}$ | 3973 | 145 | $\begin{array}{ll} \text { MM }(4,12) & \text { H } \\ \text { MM }(5,13) & \text { H } \end{array}$ | $\begin{array}{r} 60 \\ 130 \end{array}$ | $\begin{aligned} & 40 \\ & 40 \end{aligned}$ |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Teslin | 601236 1324841 | Hazel <br> Squanga Creek | $\begin{aligned} & 37.5 \\ & 29.4 \end{aligned}$ | $\begin{aligned} & 122.0 \\ & 313.5 \end{aligned}$ | 3549 | 100 | MM ( $4 \mathrm{~s}, 12 \mathrm{~s}$ ) H $M M(5 s, 1.3 \mathrm{~s}) \mathrm{V}$ | $90$ $90$ | $\begin{aligned} & 40 \\ & 40 \end{aligned}$ |  |  |
| Townsend Creek | $\begin{array}{r} 565918 \\ 1221003 \end{array}$ | Blueberry Atick Creek | $\begin{aligned} & 24.0 \\ & 22.6 \end{aligned}$ | $\begin{aligned} & 140.5 \\ & 302.5 \end{aligned}$ | 3410 | 295 | $\begin{aligned} & M M(3 s, 11 s) \text { H } \\ & M M(4 s, 12 s) \text { H } \end{aligned}$ | $\begin{aligned} & 290 \\ & 290 \end{aligned}$ | $\begin{aligned} & 40 \\ & 40 \end{aligned}$ |  |  |
| Valhalla | 552758 1191821 | Grande Prairie <br> Keeping | $\begin{aligned} & 29.0 \\ & 27.5 \end{aligned}$ | $\begin{aligned} & 133.5 \\ & 268.5 \end{aligned}$ | 2745 | 235 | $\begin{aligned} & M M(5 s, 13 s) V \\ & M M(4 s, 12 s) V \end{aligned}$ | $\begin{aligned} & 230 \\ & 230 \end{aligned}$ | $\begin{aligned} & 40 \\ & 40 \end{aligned}$ |  |  |
| Watson Lake | $\begin{array}{rrrr}60 & 03 & 24 \\ 128 & 34 & 31\end{array}$ | Hyland River McKinnon | $\begin{aligned} & 18.0 \\ & 27.3 \end{aligned}$ | $\begin{aligned} & 106.0 \\ & 274.0 \end{aligned}$ | 3021 | 210 | $\begin{array}{ll} \text { MM }(4,12) & V \\ \text { MM }(5,13) & V \end{array}$ | $\begin{aligned} & 100 \\ & 100 \end{aligned}$ | 40 40 |  |  |

## Grande Prairie-Alaska Microwave Svstem-1961

| Site Name | Elevation(Ft) | Tower Height(Ft) | Path Length(Ft) |
| :--- | :--- | :---: | :---: |
| 101 Grande Prairie | 2200 | 225 | 29.0 |
| 102 Valhalla | 2745 | 235 | 27.5 |
| 103 Keeping | 2990 | 245 | 25.2 |
| 104 Dawson Creek | 2540 | 360 | 22.2 |
| 105 Pine Valley | 2647 | 325 | 33.8 |
| 106 Coffee Creek | 2901 | 275 | 31.1 |
|  |  |  |  |
| 101 Blueberry | 3140 | 285 | 24.0 |
| 102 Townsend Creek | 3410 | 295 | 22.6 |
| 103 Atick Creek | 4129 | 165 | 28.0 |
| 104 Minaker River | 4057 | 215 | 35.7 |
| 105 Bougie Creek | 2147 | 225 | 26.7 |
| 106 Big Beaver Creek | 1582 | 345 | 26.0 |


| 113 Fort Nelson | 1488 | 315 |  | 38.2 |
| :--- | :---: | :---: | :---: | :---: |
| 114 Steamboat Mtn | 3615 | 230 | 34.6 |  |
| 115 Summit Pass | 5473 | 340 | 37.9 |  |
| 116 Eight Mile Creek | 5552 | 355 |  | 39.5 |
| 117 Mould Creek | 3407 | 250 | 23.5 |  |
| 118 Geddes Creek | 2950 | 100 | 24.8 |  |
|  |  |  |  |  |
|  |  | 370 | 28.9 |  |
| 119 Oregon Lake | 2710 | 225 |  |  |
| 120 Hyland River | 2870 | 300 | 27.3 |  |
| 121 Watson Lake | 3012 | 350 | 23.5 |  |
| 122 MCKinnon | 2830 | 350 | 19.7 |  |
| 123 Rancheria River | 2870 | 345 | 7.7 |  |
| 124 Freer Creek | 3320 | 300 |  |  |


| 125 Shilsky Lake | 4520 | 225 | 24.3 |  |
| :--- | :--- | :---: | ---: | :--- |
| 126 McNaughton | 4108 | 200 | 21.5 |  |
| 127 Hazel | 3320 | 275 | 37.5 |  |
| 128 Teslin | 3549 | 100 |  | 29.4 |
| 129 Squanga Creek 2557 | 265 |  | 9.2 |  |
| 130 Seaforth Creek | 3213 | 155 | 20.9 |  |
| 131 Tagish | 3973 | 145 | 36.0 |  |

## Grande-Prairie - Alaska Microwave System-1961

| Site | Name | Elevation (Ft) | Tower Height (Ft) | Path Length (Mi) |
| :---: | :---: | :---: | :---: | :---: |
| 132 | Canyon Mtn | 4243 | 145 | 8.3 |
| 133 | Whitehorse | 2370 | 50 | 13.8 |
| 134 | Laberge | 3495 | 265 | 31.0 |
| 135 | Mendenahall | 2734 | 275 | 12.9 |
| 136 | Champagne | 2435 | 240 | 35.0 |
| 137 | Paint Mtn | 4525 | 30 | 28.0 |
| 138 | Boutellier | 3370 | 100 | 32.0 |
| 139 | Burwash | 2834 | 270 | 35.0 |
| 140 | Don Jek River | 2813 | 345 | 41.8 |
| 141 | Horse Camp Hill | 4575 | 205 | 38.9 |
| 142 | Mt.Dave** | 3005 | 100 | 40.2 |

## Site Selection Criteria

Topographic Maps- 1:50,000, contours south of Ft.Nelson-50ft, remainder of system-100ft.

Practicability Survey- If good radio path, proximity to power, practical tower heights. Performed by CNT Engineers, RCA Victor and Racey MaCallum \& Assoc.

Photogrammetry- Obstruction investigation done by Shaw Photogrammetric Services of Hull,P.Q. Refined original work done by the Army SurveyEst. Tree heights as well defined heights of peaks /obstructions to $+/=5$ or 10 ft.

## Site Selection Criteria-cont'd

Survey- Data obtained for civil work as well as site elevations and coordinates, accurate to $\mathbf{5 f t}$.

Final Profile- Once determined from above data- tower heights may be calculated, based on $4 / 3$ earth's radius.(example)

Antenna Heights- generally chosen based on clearance over all obstructions will be at least 0.6 First Fresnel zone clearance at $K=0.8$. This may be modified if reflections are expected. Reflections are either minimized by causing the reflecting point to appear at one end or by utilizing obstructions to block the reflected ray.

Suspected reflections are investigated using K=infinity.


## Fresnel Zone Clearance


$r_{(\text {in mts })}=17.32 \times \sqrt{\frac{d}{4 f}}{ }_{(\text {(in } \mathrm{KHz})}$
$r_{(\text {in ft })}=72.05 \times \sqrt{\frac{d}{4 f}}$ (in miles)

TYPE MM-600-6 PARABOLOID WITH CENTRE FEED.
BASED ON EXPERIMENTAL \& THEORETICAL CONSIDERATIONS APPLIER TO THE MM-600-2 PARABDLOID WITH CENTRE FEED.

NOTE 1: THIS GRAPH SHOWS THE ENVELOPES OF THE PEAKS


Also used
Quadruplexors (4 cavity tunable Filters) to provide Selectivity. One
Filter per transmit Path and one per Receive path.





Peace River Bridge -55.4Km-2100ft long



Muncho Lake B.C.

## F

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## Observations

Followed highway-leap frogged Failures < 0.0001\%/year 6Ghz - first in Canada Interconnecting dissimilar systems No snow tires
No break generators, 1 Hz at 60 Hz
Airfare Toronto-Whitehorse-\$260
3/4 ton Fargo+ camper
Grande Prairie building
Antenna aiming
B.C.band monitoring

Otter Falls- 20 miles off Hwy
Tagish Mtn wolf
Mile 351.2-opical illusion?
Flat tires-cause-Rancheria-Bailey
bridge
RCA vehicle vs VIP vehicle-Summit
Pass
Accident
Another flat tire-mile 1188.5-Snag
Armchair Supt.CNR-
Site 135 or 138 Diesel fuel

6Ghz feeders -waveguide presurized Dry nitrogen to eliminate moisture

Ice covers protect W/G from falling ice No break generators where no local power

Order wire for inter site communications
Supervisory control system- doors,temp.
Two aerial tramways by Norwegian company Buildings on permafrost had temp sensors.
RCA Victor Montreal: Greg Bayliss, Engineering Mgr
Dan Mercek -Engr
John Elvidge-Engr
Ron Saunders- Antenna erection, technician
Marc Lopionowski-Engr
Dean Colis-Engr
Bill Davidson-Engr
Bob Williamson-Engr
Ken Gordon-Engr
Bill Fosty-Engr
Bob Smith-Engr
Mo Allan- Tech
Bob Vincent-Tech
Ken Jensen-Engr.
Pat Cicciu-Tech
Marcel Labelle-Tech
Roland Grenier-Engr
Andre Roscynski-Engr
Leo Arsenault-Engr
Jack Garrison-Tech
CNTelecommunications C.J.Bridgland, General Radio Engineer
J.S. Ford, Asst Chief Engineer
Anthony Pichota, Asst. Radio Engr.
John Rice, Engr, Radio
Alan Hodgins, Technologist, Radio
Ed Marek, technologist, Radio
Alan Bentley, Engr., Radio
Frank Takasaki,Engr Outside Plant


