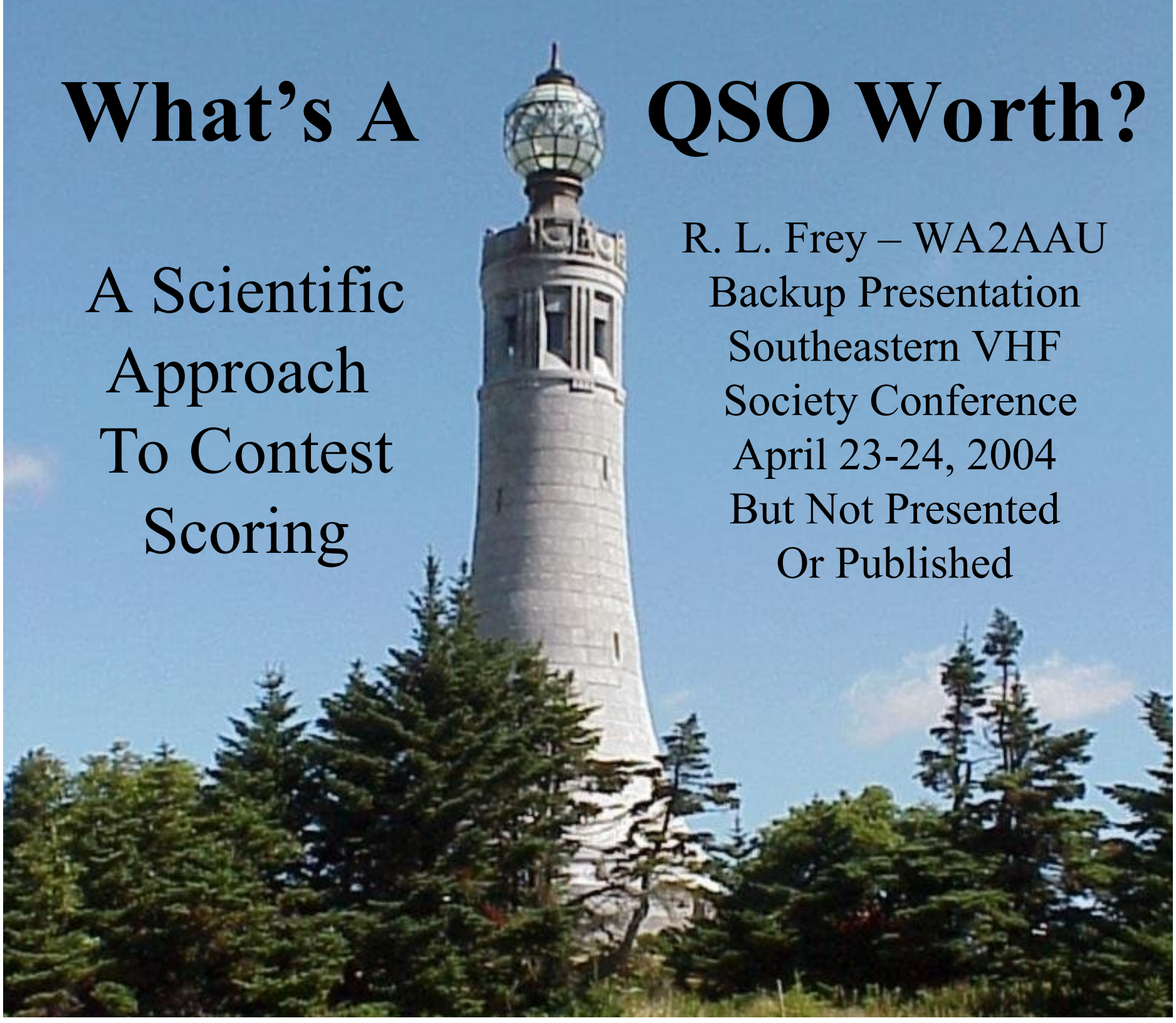
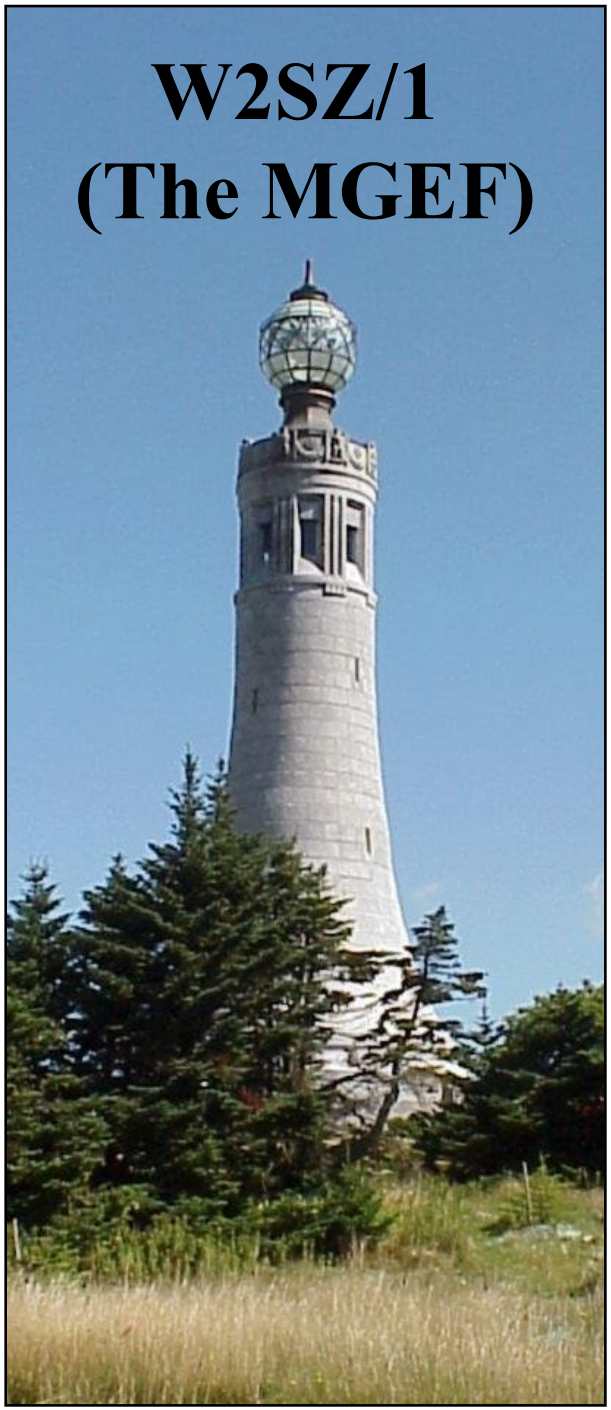


What's A QSO Worth?

A Scientific Approach To Contest Scoring

R. L. Frey – WA2AAU

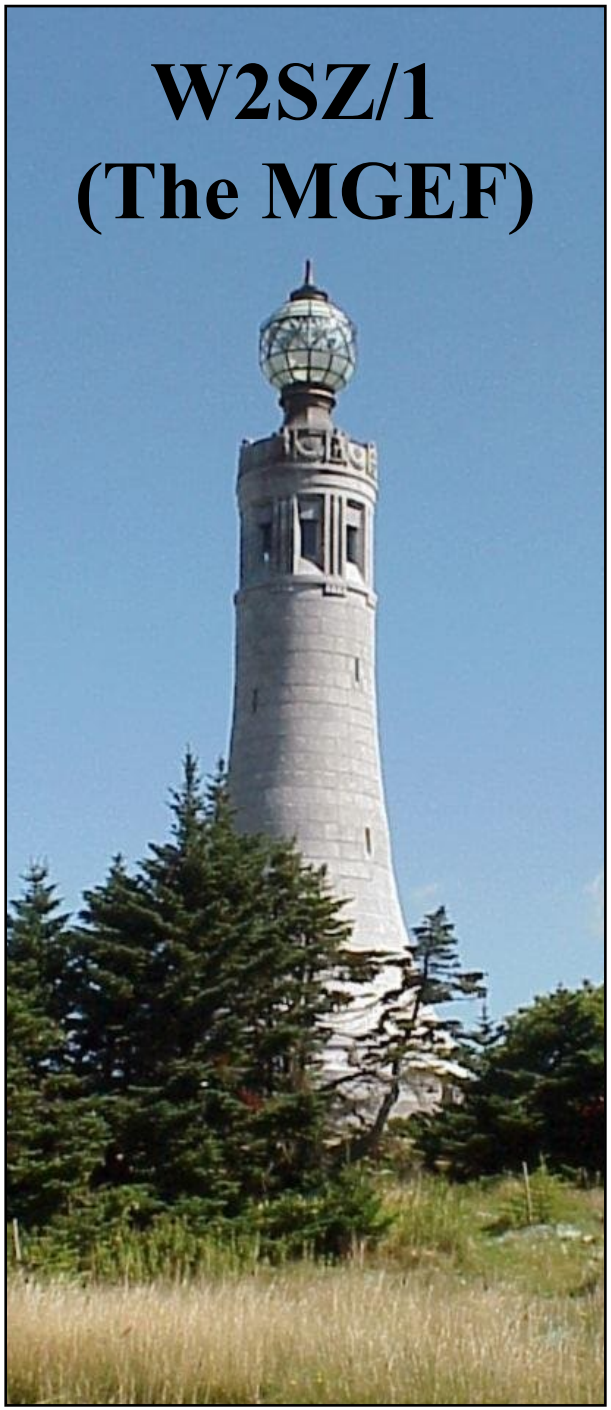
Backup Presentation
Southeastern VHF Society Conference
April 23-24, 2004
But Not Presented
Or Published



Introduction

What Drives Contest Scoring?

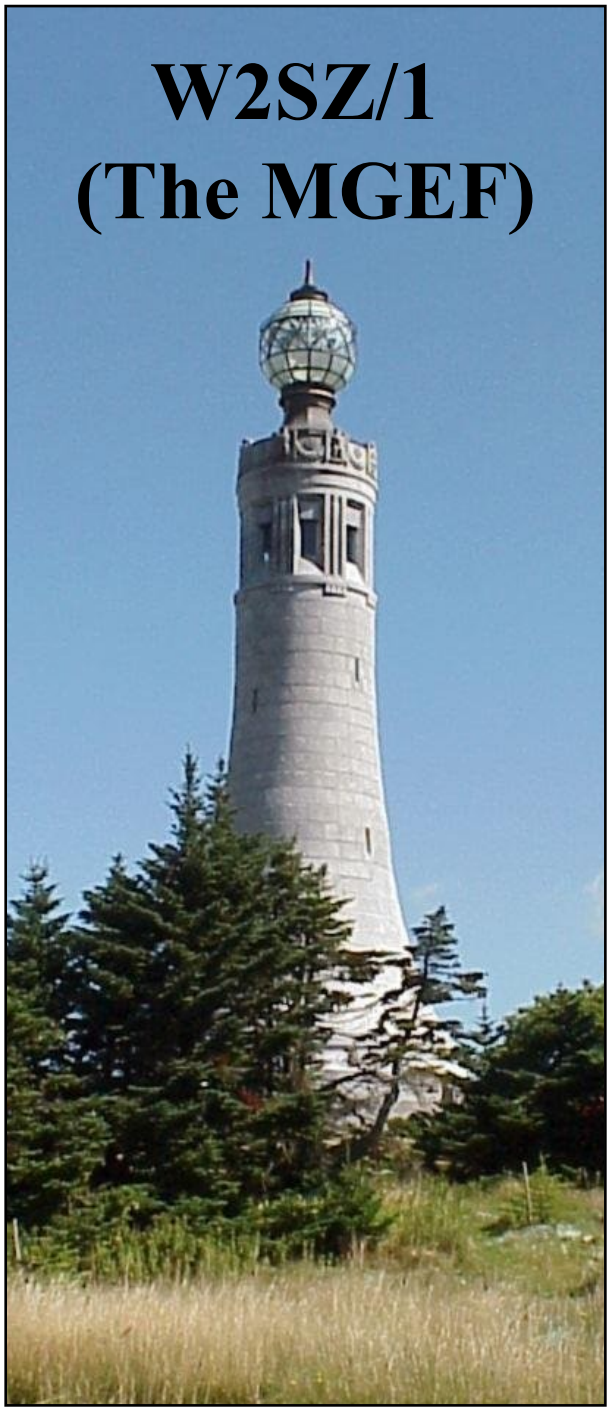
- Reward For Effort Expended
- Incentive For Desired Behavior
- Attempt To "Be Fair"
- Provide A "Level Playing Field"
- But Sometimes Emotions Overcome Common Sense
- Can We Do Better Than To Just Guess At Point Values? -- YES!



Introduction

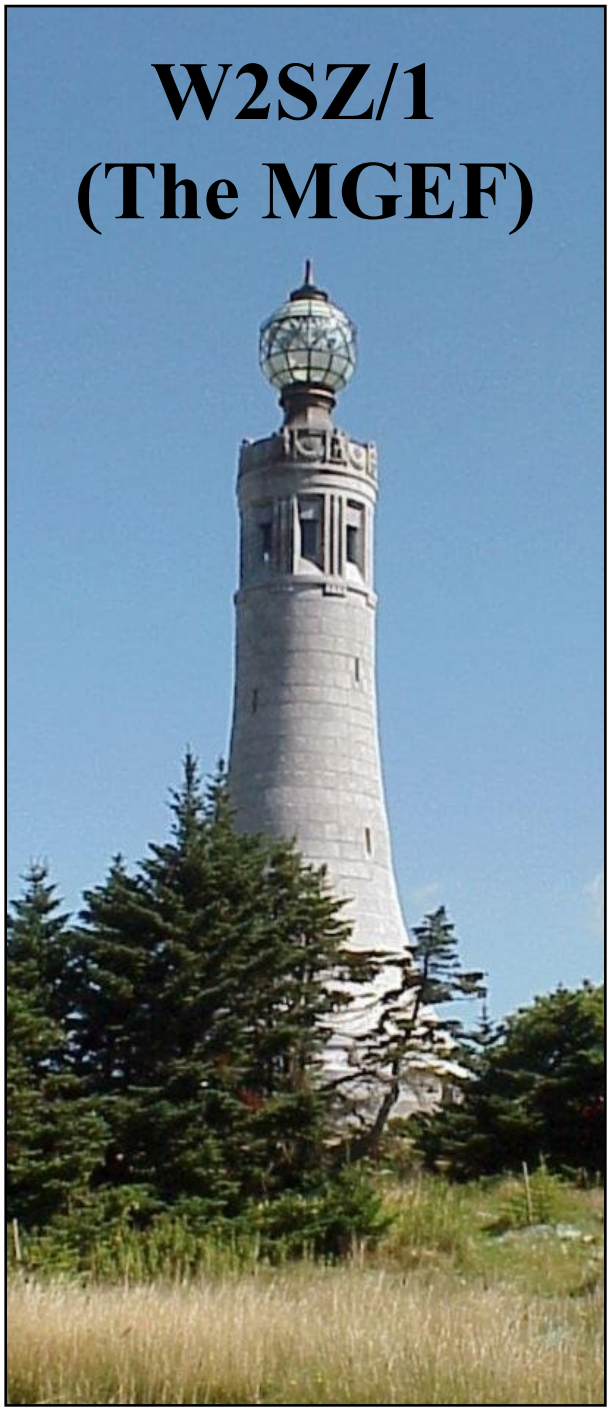
Focus Of This Talk

- Look At One Small Aspect...
- Present An Objective Look At How QSO Points Should Be Awarded in VHF Contests.
- Use Neutral Scientific Measures To Determine "Value" of QSOs
- Attempt to Quantify "How Hard" It Is To Make A QSO



Background

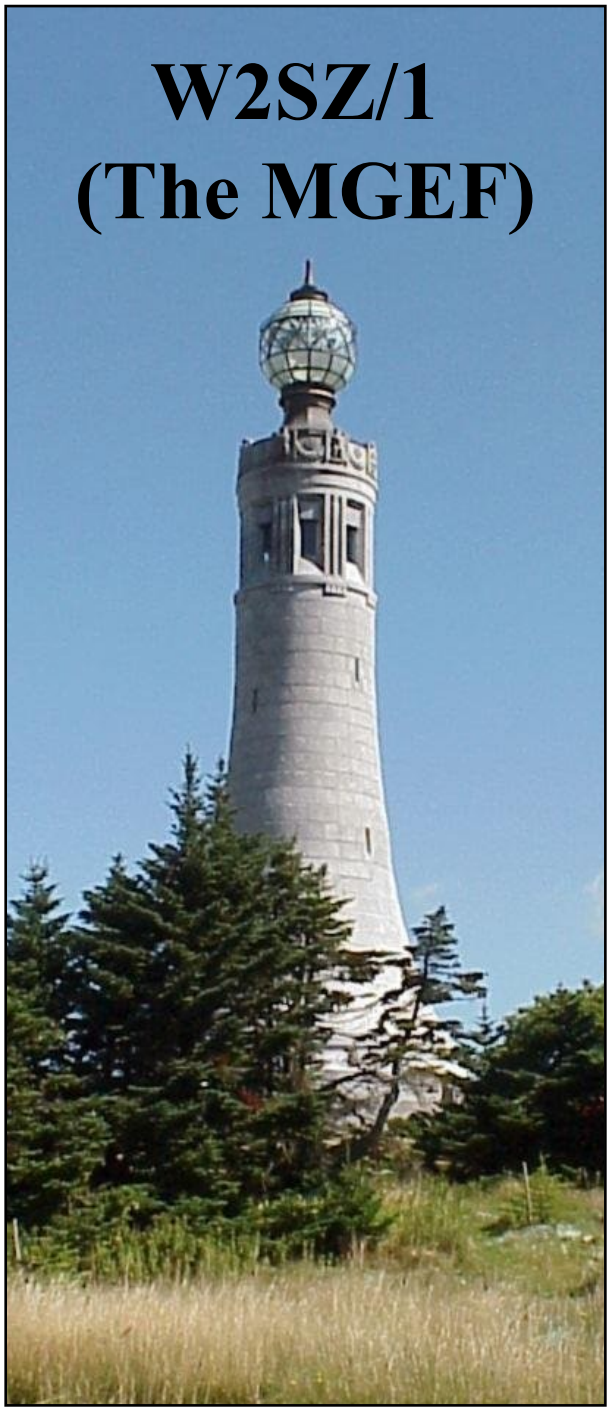
- Traditional VHF Contest Scoring Has Been Sections **X** QSO Points
  - Very Large Reward For Inc. Range
  - Getting On New Bands Rewarded In 2 Ways - More Grids, More Qs And They Multiply **X** all bands
- Another Approach In Europe Is Range Scoring, Something Like Our 10G and Up Contest.
  - Lukewarm Interest in US for VHF



Background

What Is Rewarded?

- Making Station Work Better
  - Doubling Range Increases QSOs by R^2; Grids by R^2 and Score by R^4 !!!
  - Even Small Improvement Rewarded
- Above Goes For Operator Skill
- Getting On New Bands
  - New Grids and Qs Mult ALL Others
- Staying On The Air
  - Q x G Makes Last QSOs worth more.



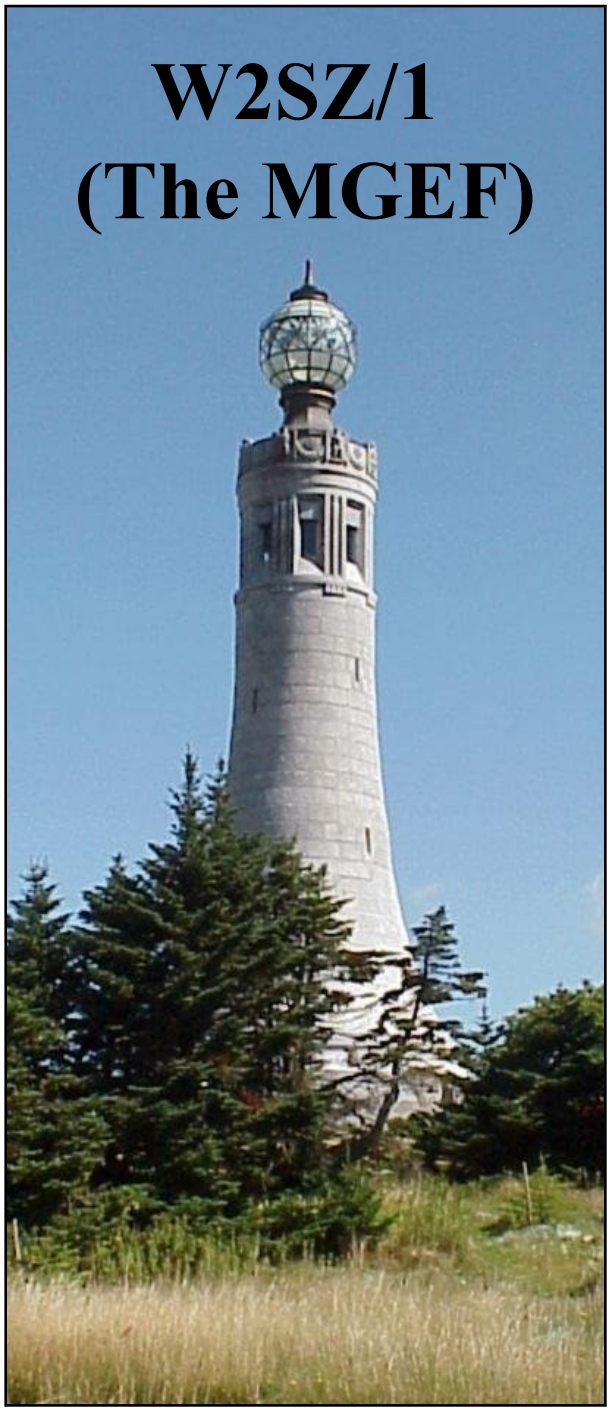
Background

QSO Point Values

- Increase With Increasing Freq.

Band	50	144	222	432	903	1296	All uW
Points	1	1	2	2	3	3	4

- It's "Harder" to Make QSOs on Higher Frequencies.
- Equipment At High Frequencies Not Available & Difficult to make
- Incentive to Populate Lightly Used Higher Bands



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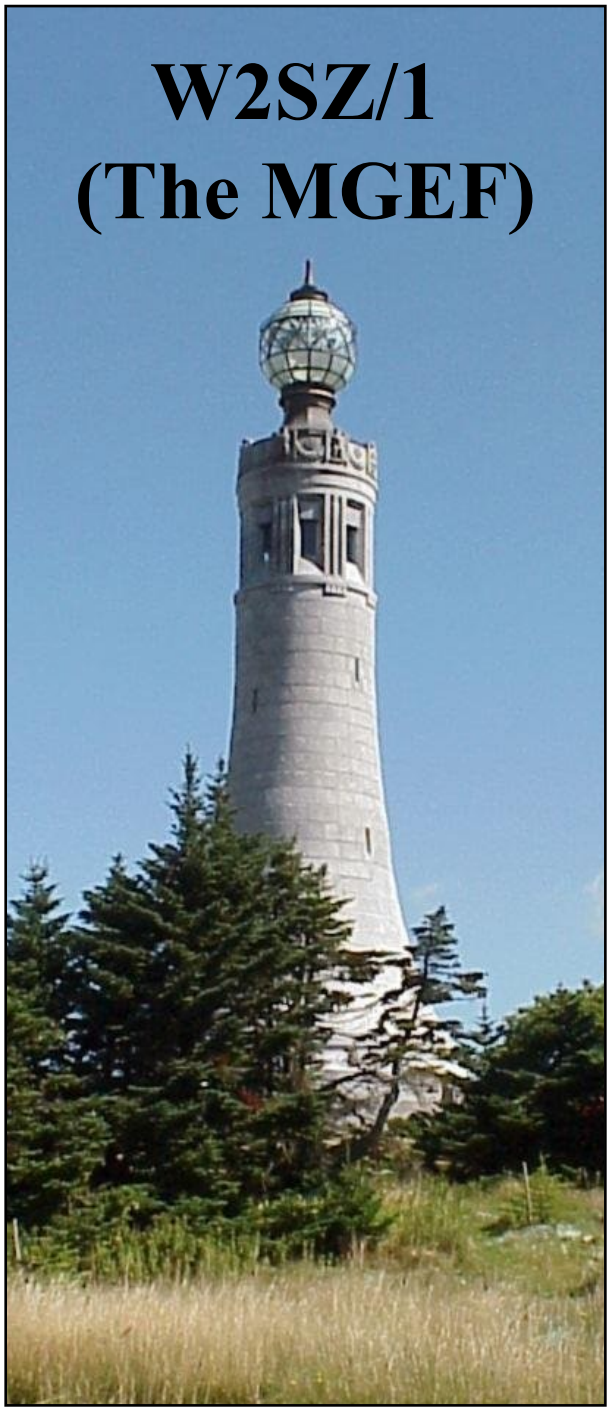
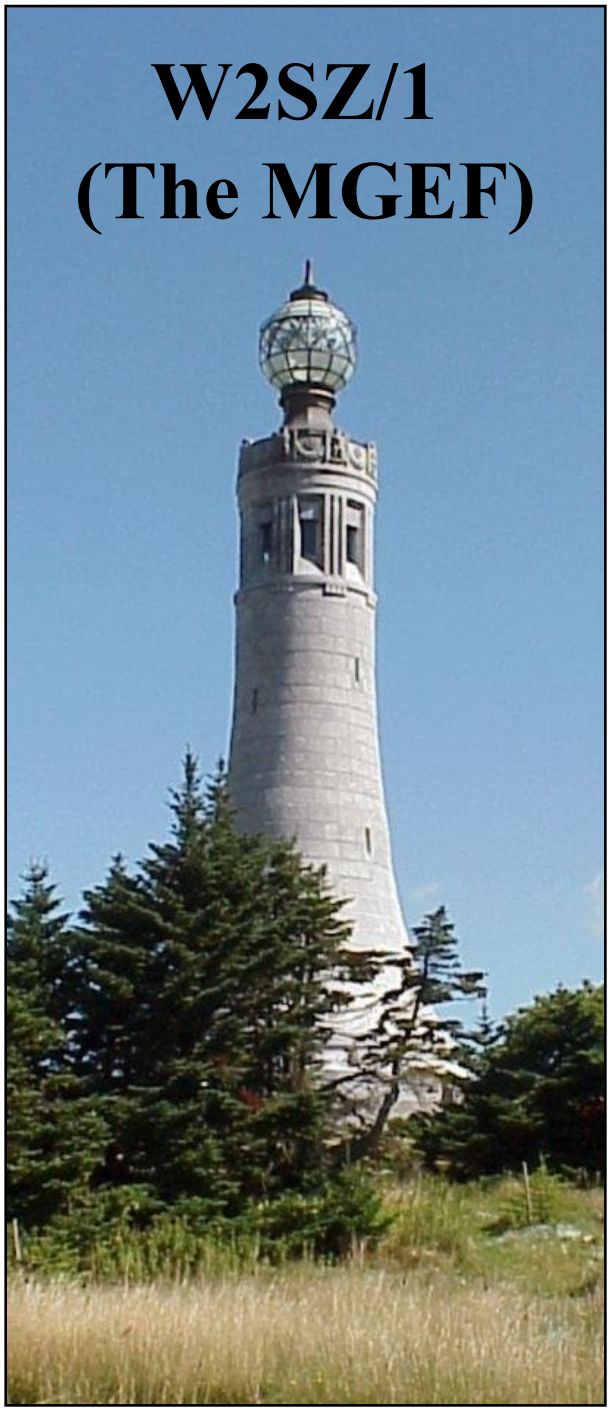


Objective Measures

- Value Of QSO
  - Use The Communication Range Possible on a Given Band As A Metric To Determine The Difficulty/Value
  - Short Range Bands → Higher Value
  - Use Current QSOs x Grids Method As a Guide to QSO Value
- Difficulty Of Making QSO
  - Antenna Pointing
  - Frequency Stability



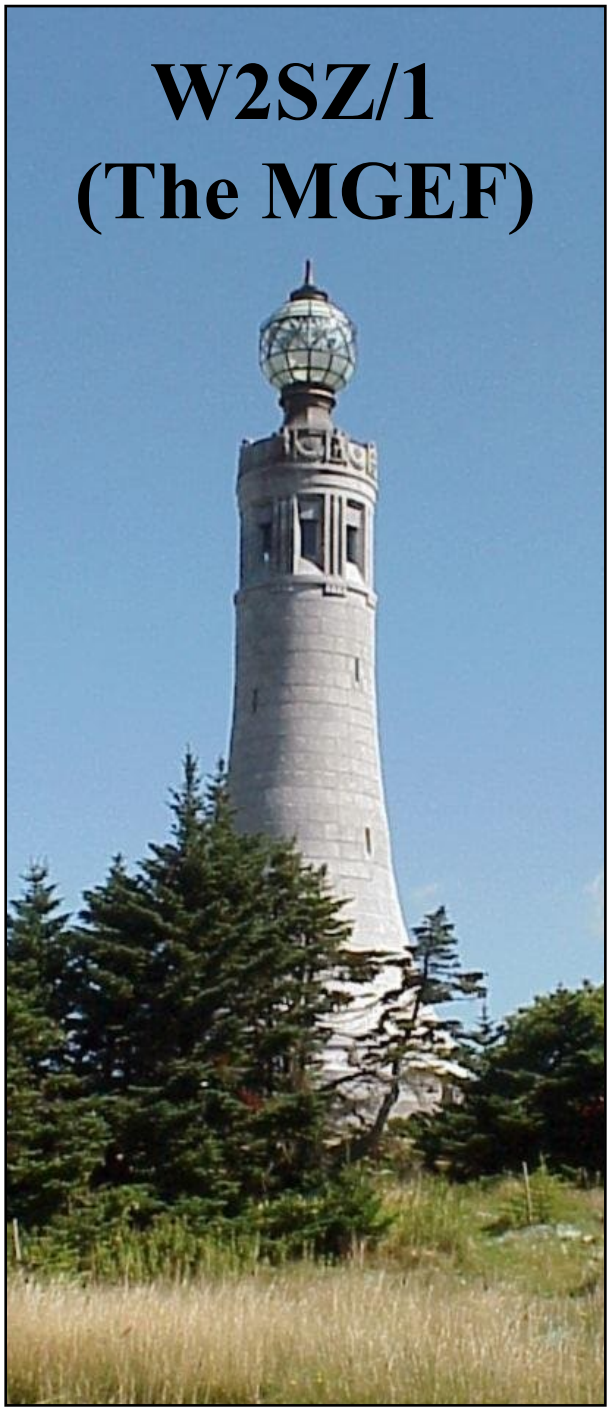
Range Calculation

- Assume State-of-the Art Station
  - Not the Bleeding Edge, But V Good
- Assume Approx. Same Effort Is Spent On All Bands. (Ant. Size)
- Assume Ultimate Range Limited By Troposcatter, Not Openings
- Use KA1GT Troposcatter Link Calculator To Determine Range
- Ignore 50 MHz - (An Anomaly)

TROPOSCATTER AND LOS LINK BUDGET CALCULATOR - KA1GT

STATION PARAMETERS	STATION #1	STATION #2	Scat Ang = 4.53
Antenna Height (m asl)	20	20	
Obstruction height (m asl)	0	0	TOA #1 = -0.12
Distance to obstruction (km)	0	0	horizon limited
Transmitter power (W)	700	700	
Transmitter line loss (dB)	0.5	0.5	TOA #2 = -0.12
Receiver noise figure (dB)	0.5	0.5	horizon limited
Receiver line loss (dB)	0.5	0.5	
Antenna gain (dBi)	18.7	18.7	
Antenna noise temperature (K)	300	300	
Receiver Bandwidth (Hz)	1000	1000	
Receive system sensitivity (dBW)	-191.6	-191.6	
Frequency (MHz)	432		
Distance between stations (km)	709		
N value of refractive index (~310)	310		

	YEH	ITT	CCIR	COLLINS
Path Loss =	238.2	234.6	229.4	238.5
S/N ratio at station 1 =	0.0	3.6	8.8	-0.3
S/N ratio at station 2 =	0.0	3.6	8.8	-0.3



The "Balanced" Station

- Roughly Equal Effort, Each Band
- On VHF, Same Length Yagi - 17'
- On Microwave, One Size Dish-6'
  - Except Smaller When Too Sharp
- State of the Art Transmit Power

  144 = 1500; 222 = 1500; 432 = 700

  903 = 100; 1296 = 100; 2&3G = 20

  5760 = 10; and 10,368 = 10 watts
- State of the Art Receivers

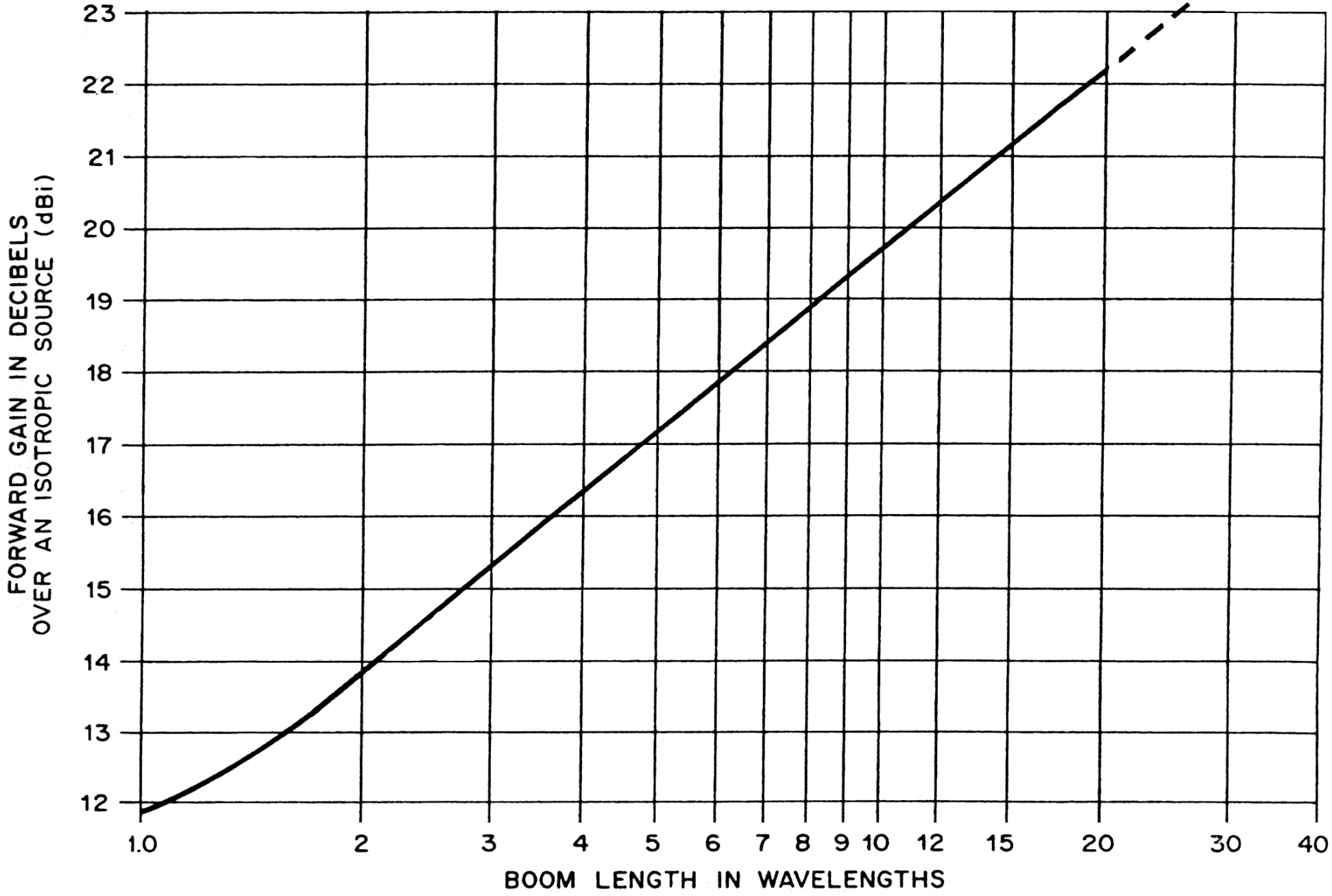
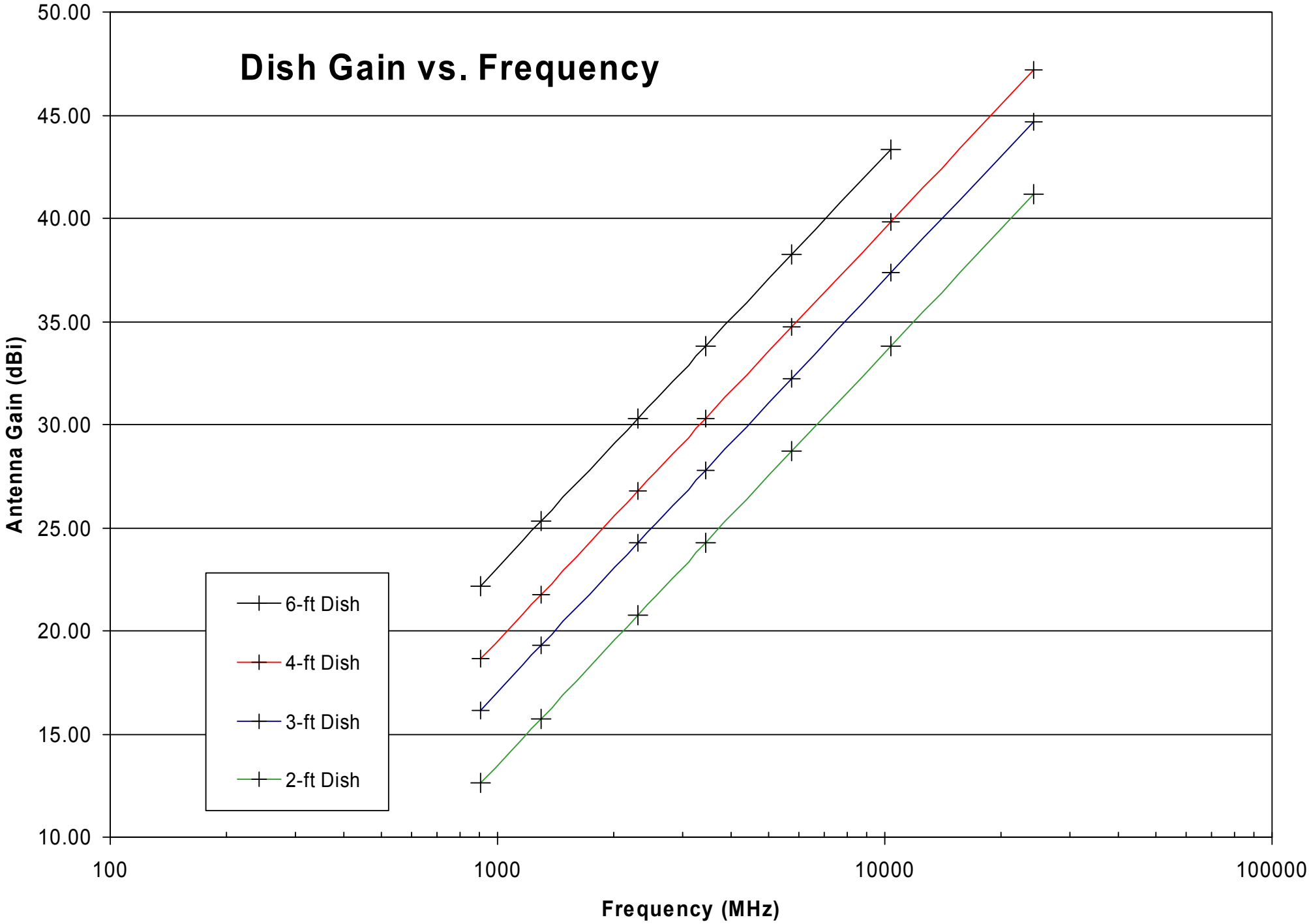


Fig 25—This chart shows maximum gain per boom length for optimally designed long Yagi antennas. (From 1991 ARRL Handbook, Pg. 33-16)

VHF/UHF Yagi Specifications

Band (MHz)	Directive Systems Part Number	No. of Elem.	Boom Length (wl)	Boom Length (Inches)	Gain (dBi)	Beam Width (deg)	Notes
50	DSFO50-5	5	0.88	208	11.7	45	
144	DSFO144-12	12	2.54	208	14.8	34	
222	DSFO222-16	16	3.89	207	16.2	31	
432	DSFO432-25	25	7.57	207	18.7	22	


Dish Gain vs. Frequency
Antenna Gain (dBi)
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
100
1000
10000
100000
Frequency (MHz)
6-ft Dish
4-ft Dish
3-ft Dish
2-ft Dish

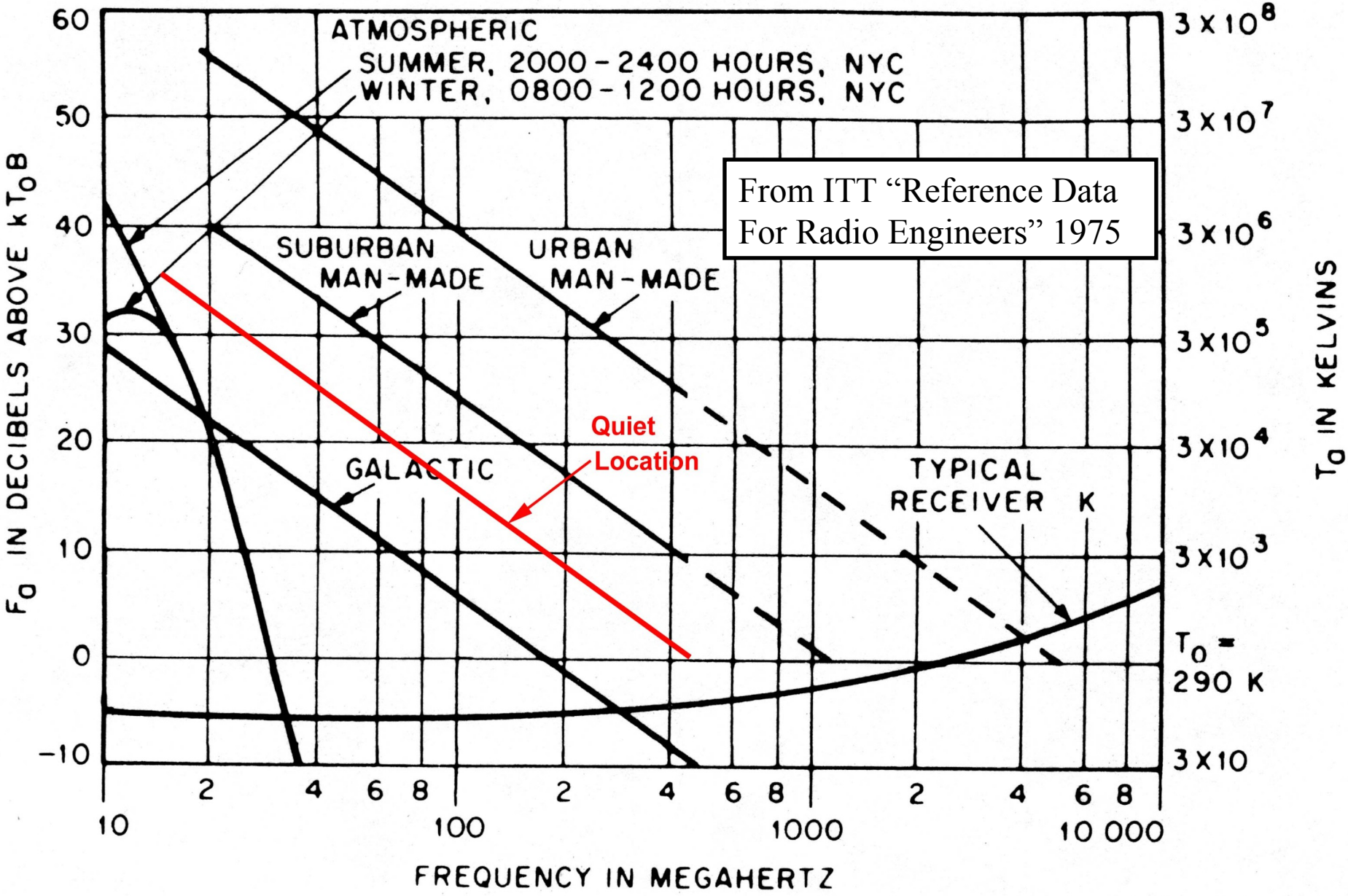
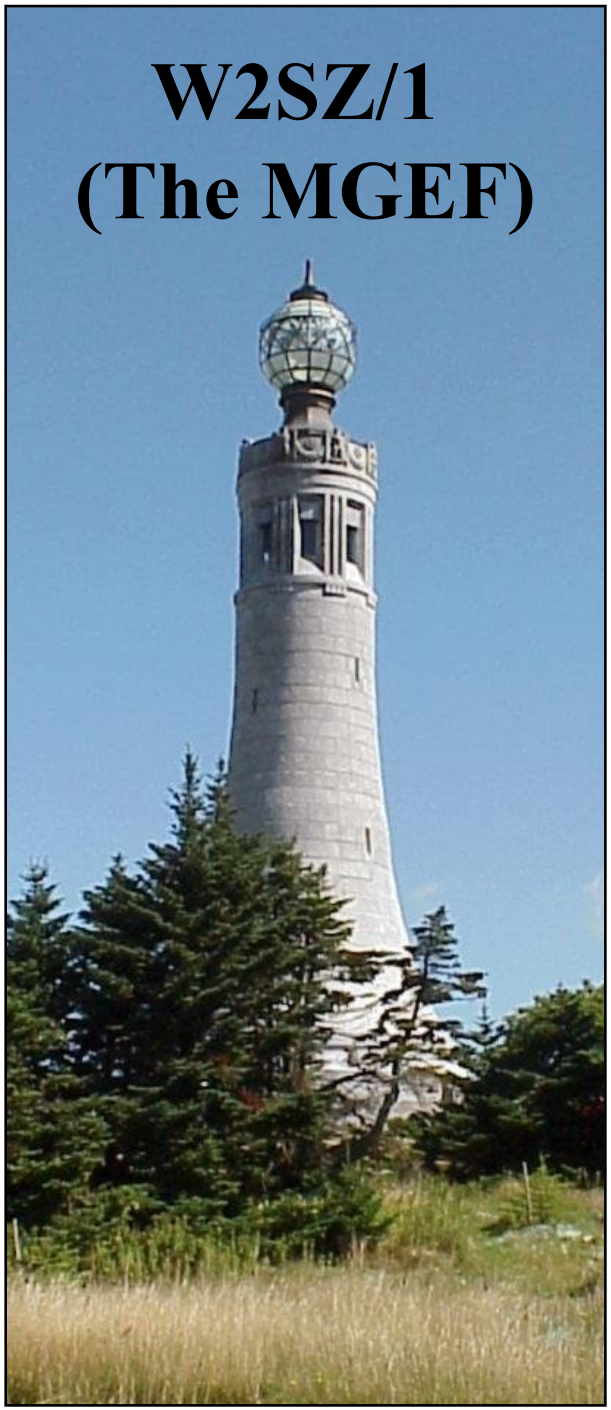


Fig. 1 -- Median values of average noise power expected from various sources (omnidirectional antenna near surface)

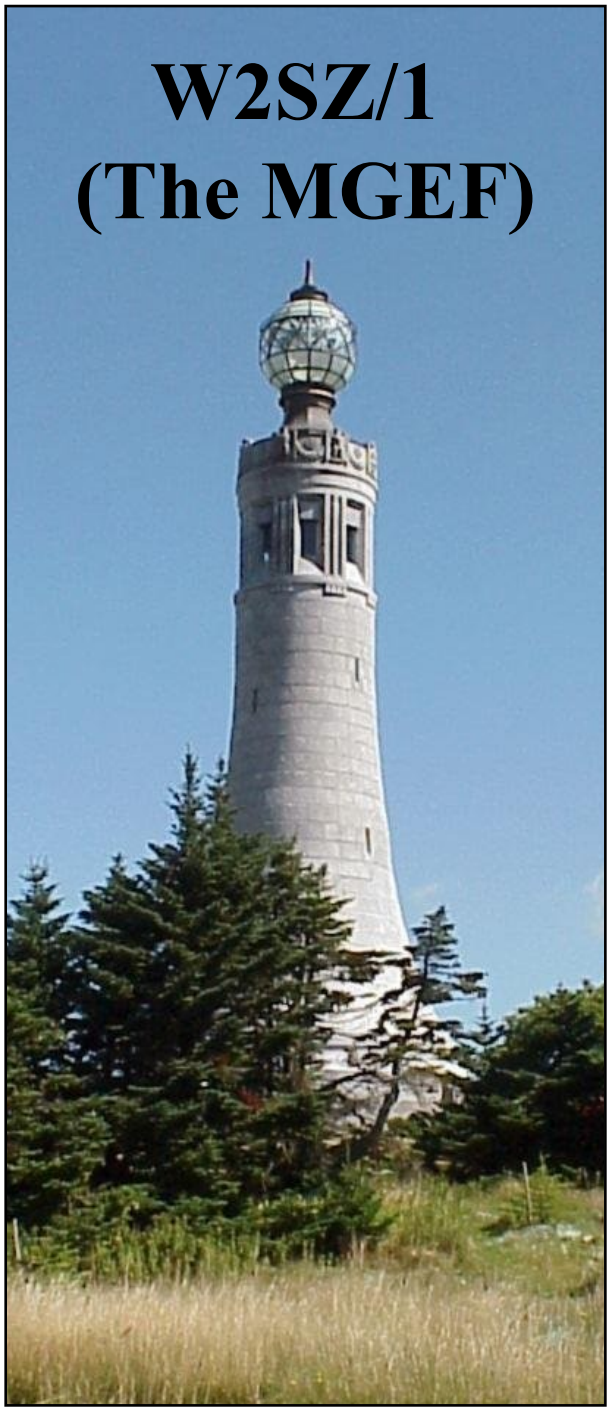
Range and Score Value vs. Band

	Frequency Band								
Station Parameter	**144**	**222**	**432**	**902**	**1296**	**2304**	**3456**	**5760**	**10G**
Antenna Temp (k)	4600	1830	300	150	150	150	150	150	150
Antenna Type	12 el Y	16 el Y	25 el Y	Dish	Dish	Dish	Dish	Dish	Dish
Ant Boom or Diam.*	17' 4"	17' 4"	17' 4"	6*	6*	6*	6*	4*	2.5*
Antenna Gain (dBi)	14.8	16.2	18.7	22.2	25.3	30.3	33.8	34.7	35.8
Transmit Power (W)	1500	1500	700	100	100	20	20	10	10
Calc. Range (km)	700	712	709	579	591	524	529	420	357
Relative Value (QSOs)	1	1.03	1.03	0.68	0.71	0.56	0.57	0.36	0.26
Relative Value (Grids)	1	1.03	1.03	0.68	0.71	0.56	0.57	0.36	0.26
Relative Value (Score)	1	1.07	1.05	0.47	0.51	0.31	0.33	0.13	0.07



What Do Range Calcs. Tell Us?

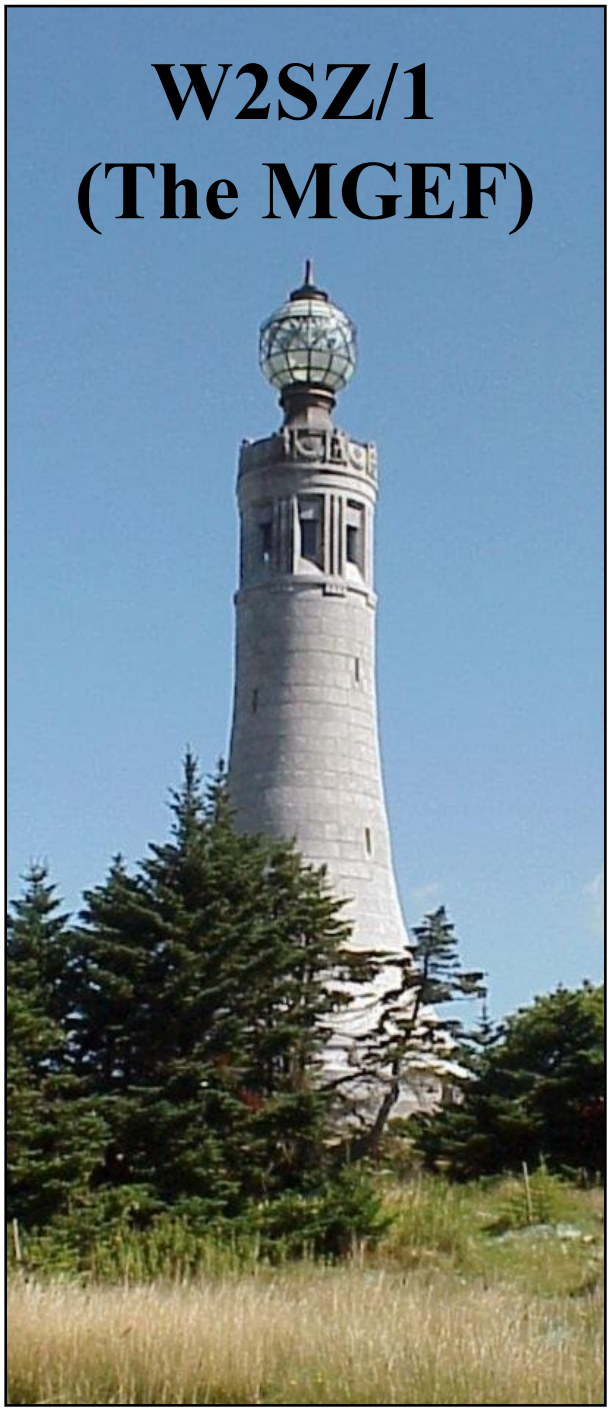
- Range of 144 - 432 **All** ~ 700km!
  - Counter-Intuitive? Not Really.
  - Remember, "Same Effort" Station
  - Does Not Include ++ Propagation
  - Does Not Include No. Of Hams On
  - Does Not Include Ease Of Pointing
  - Does Not Include Vegetation Losses
  - Why??
    - Ant Gain Goes Up With Frequency
    - Noise Goes Down With Frequency
    - Results Would Favor 144 MHz Just A Little, With Only "Galactic Noise"



What Do Range Calcs. Tell Us?

On 903 - 1296, Range ~ 585 km.

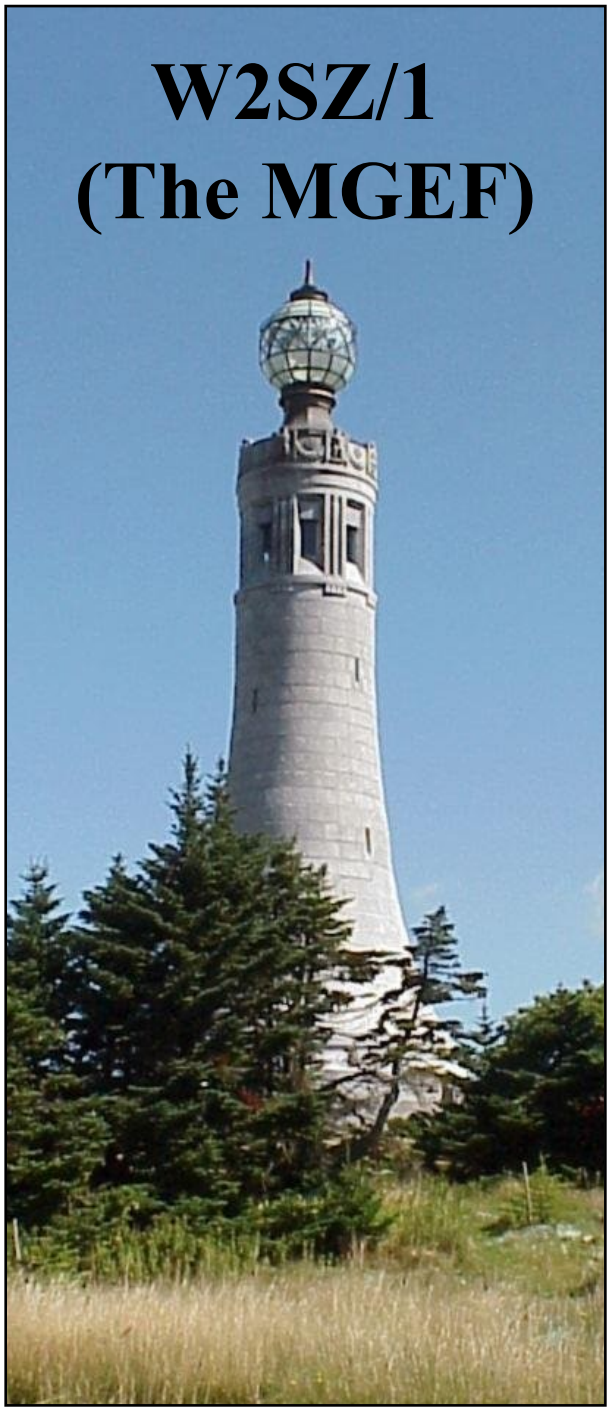
- Pretty Large Compared to VHF!
  - Remember, State of the Art Station
  - Pretty Big Antenna -Sim. to 4 Loopers
- Decrease Mainly Due To Power
- Best Range ~ 83% of 144 - 432
  - At Most **Only 70%** Of VHF QSOs
  - At Most **Only 70%** Of VHF Grids
  - At Most **Only Half** Of VHF Score
- Does Not Include Few Hams On Air
- Does Not Include Pointing Difficulty



What Do Range Calcs. Tell Us?

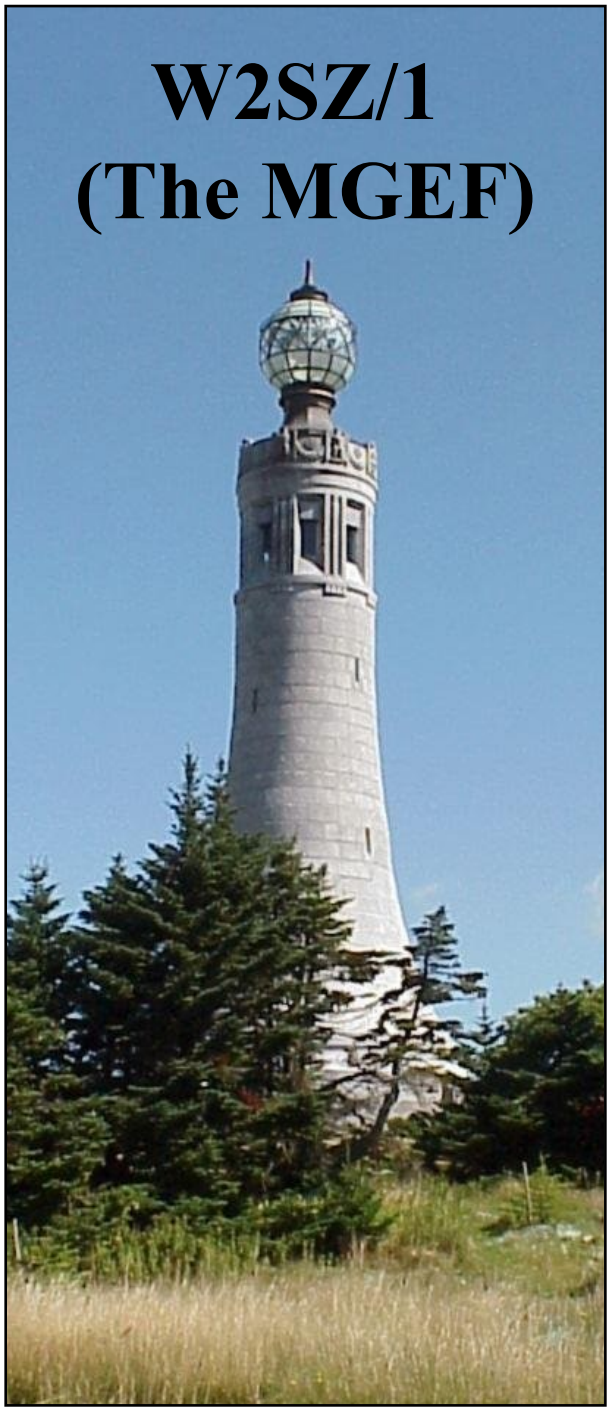
2304 and 3456 Range ~ 525 km

- 6’ Dish Now A VERY BIG Ant!
  - Most Hams Will Choose Smaller
- Power Down to 20 Watts.
- Best Possible Range 75% of VHF
  - At Most **Only 56%** Of VHF QSOs
  - At Most **Only 56%** Of VHF Grids
  - At Most **Only 32%** Of VHF Score
    No Matter How Hard You Tried
    - If EVERYONE Had These Bands.
    - If You Could Successfully Find Them



What Do Range Calcs. Tell Us?

- 5760 = 420 km; 10G = 357 km
- 5760 - 4' Dish; 10G - 2.5' Dish
- QSOs: 36% and 26% of VHF
- Grids: 36% and 26% of VHF
- Score: 13% and 7% of VHF
  - Above True If Everyone Had The Bands
  - If You Could Successfully Point At Them. - Much More Difficult On These Bands.



QSO Points For Level Playing Field Based On Score Effect

Band	Points	Jan	Jun/Sep	
50 MHz		1 ???	1	1
144 MHz		2	1	1
222 MHz		2	2	2
432 MHz		2	2	2
902 MHz		4	4	3
1296 MHz		4	4	3
2304 MHz		6	8	4
3456 MHz		6	8	4
5760 MHz		14	8	4
10 GHz	28	8	4	

SCARY, Isn't It? !!

Current Rules

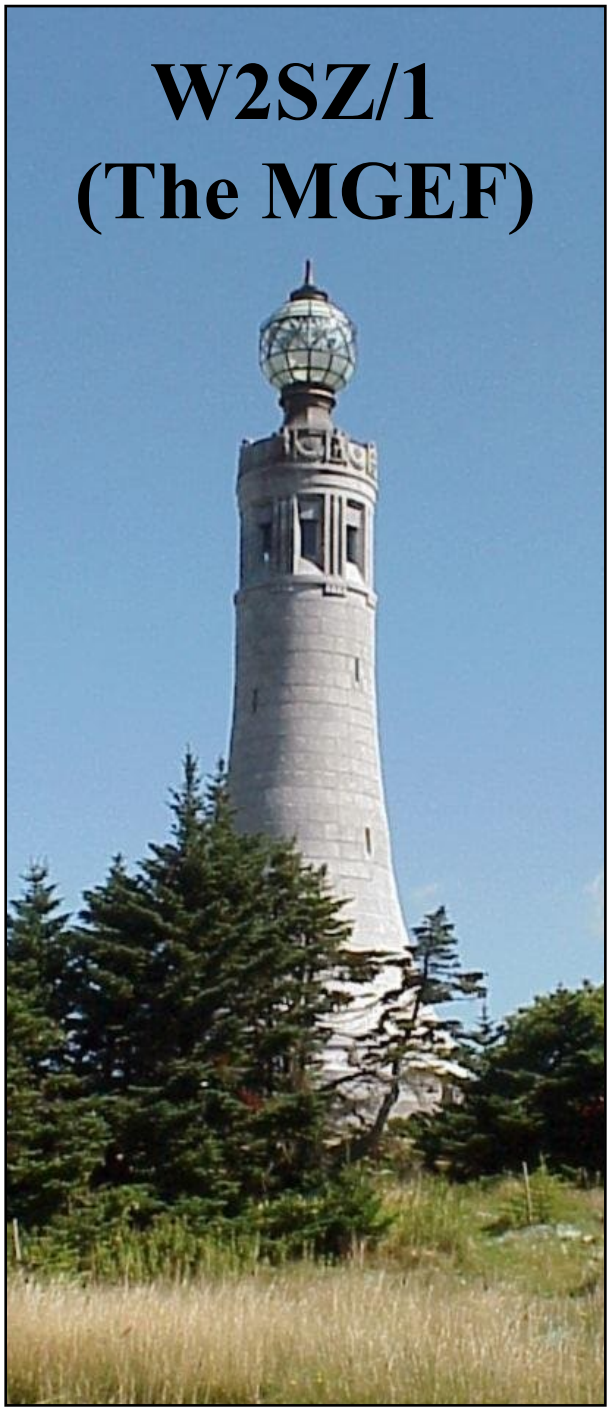
Beamwidth and Difficulty vs. Band

	Frequency Band								
Station Parameter	**144**	**222**	**432**	**902**	**1296**	**2304**	**3456**	**5760**	**10G**
Antenna Type	12 el Y	16 el Y	25 el Y	Dish	Dish	Dish	Dish	Dish	Dish
Ant Boom or Diam.*	17' 4"	17' 4"	17' 4"	6*	6*	6*	6*	4*	2.5*
Antenna Gain (dBi)	14.8	16.2	18.7	22.2	25.3	30.3	33.8	34.7	35.8
Ant. Beamwidth(deg)	34	31	22	13	9.1	5.1	3.4	3.1	2.7
Prob of Finding (%)	0.892	0.742	0.373	0.130	0.064	0.020	0.009	0.007	0.006
Relative Difficulty	1.0	1.2	2.4	6.8	14.0	44.4	100.0	120.3	158.6
Prob in Contest (%)	100	100	100	100	100	39.738	17.661	14.682	11.138
Trying for Whole Contest, once per minute, 33 hours = 1980 minutes.									
* Antennas on 902 and above are parabolic dishes.									

Thank Goodness For Schedules. "Moving Up" FACT OF LIFE!!

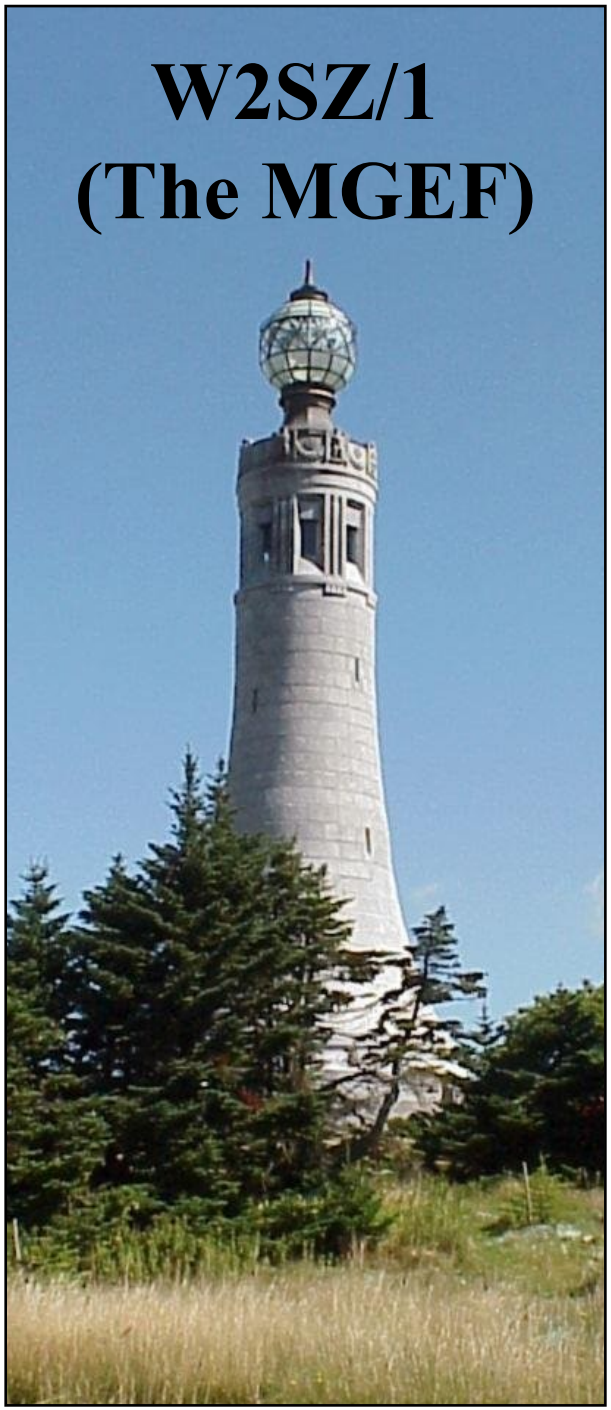
Any/All Possible Means For Scheduling Should Be Allowed!

DON'T TRY TO APPLY HF RULES TO VHF CONTESTS!



Conclusions (1)

- Current QSO Point Values Are About Right – Not Considering:
  - uWave Equipment Difficulties
  - Narrow Beam Pointing Difficulties
  - Foliage Attenuation
  - Lack of People on The uW Bands
  - Incentives To Populate the Bands
  - Real Station Tendency To:
    - Emphasize Low Frequency Bands
    - Use Smaller Microwave Antennas



Conclusions (2)

- May Even Want To Increase Points for Bands 5 GHz and Up
  - Pointing Becomes Limiting Issue
    - Gets Really Hard to Manage Backlash
    - Narrow Antenna Beams Reduce Troposcatter Volume So Signals No Longer Increase With Greater Antenna Gain
    - Means Lower Antenna Gain < Optim.
  - Especially On 24 GHz and Up
    - Water Vapor and Oxygen Absorption Greatly Limit Range
    - 100 km Is a Long, Long Haul