DCS Technical Team

and how you can help

"All bands all the time"

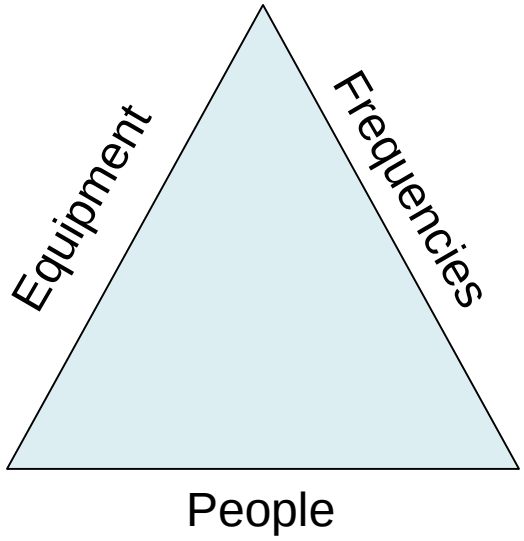
Deane Bouvier
N5DQ, Staff 50

7/20/2015

Presentation at Tech Team web site:
http://www.qsl.net/w6lmt/2015-07-20_DCS_TT4DCOs.pdf

DCS Technical Team Scope

- Primary function of the DCS Technical Team
  - Hands-on support to CFMB
  - Recommend resolutions to day-to-day technical issues
  - First contact to recommend equipment and frequency resolutions for DCS operations



- What that means is
  - The Technical Team is responsible for guiding 2 of the 3 primary elements to provide disaster communications to LA County

Primary Tasks

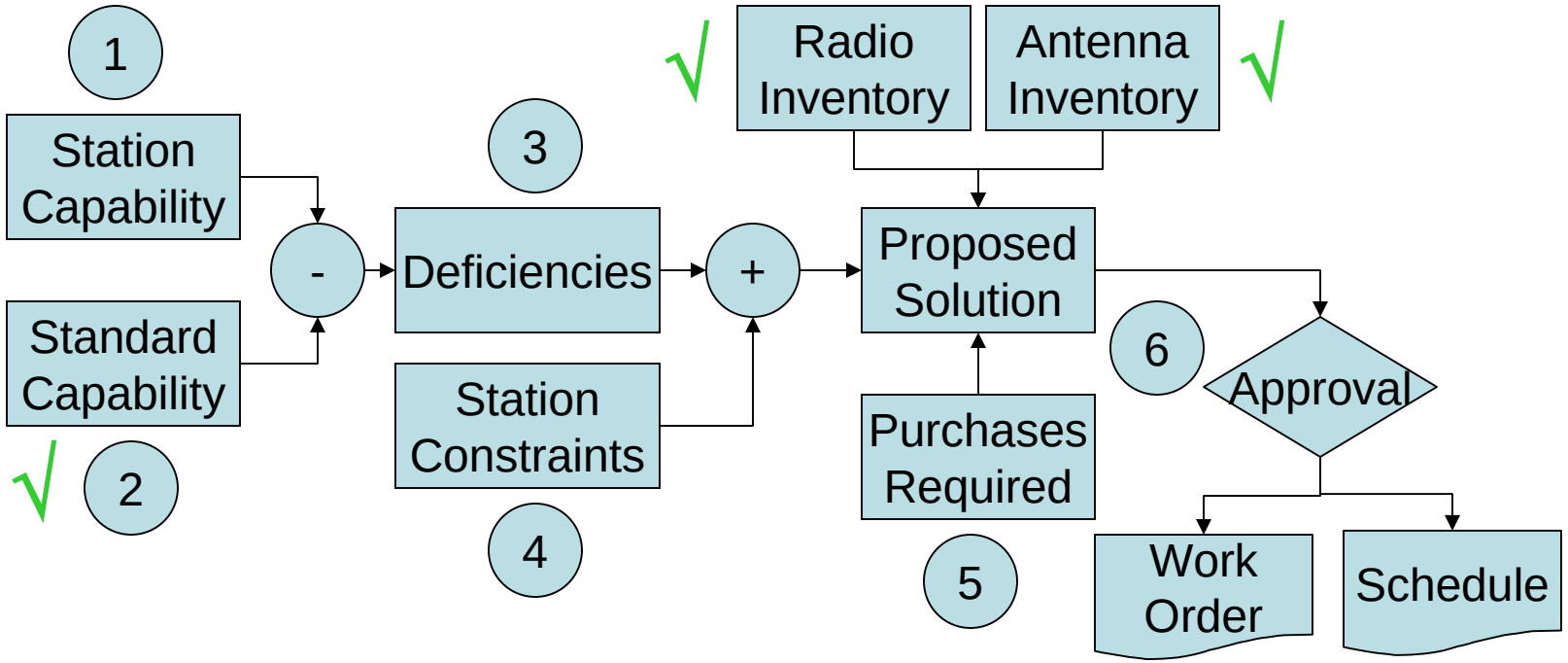
- Collect all current outstanding technical needs and issues for County-wide DCS operations and recommend solutions
  - Identify equipment and frequency issues in conjunction with DCOs
  - District capability should include the ability to communicate with contract/contract city radio organizations as well as the County
- Objective: Cover all bands from 1.8 to 450 MHz
  - Simultaneous operation on 2m, 220, 6m and 10m
  - Plus 70cm coverage to communicate with contact/contract cities
  - Support NVIS on HF
- Make maximum use of current equipment inventory
- Research, recommend and document equipment to CFMB for purchase when needed
- Maintain the full county DCS frequency matrix, and recommend changes as needed. Generate a new concise tactical frequency naming convention
- First priority equipment issues, second priority revise the frequency plan

Who Are We?

- Most stations have a primary and an alternate Technical Team Member assigned
- Technical Team Members
  - Deane Bouvier S-50 Lead
  - Eric Christensen M-02
  - Jim Glancy N-01
  - Norm Goodkin K-04
  - Steve Ioerger F-01
  - Keith Prebble S-12
  - Mark Stevenson K-220
  - Norm Thorn T-219
  - Dick Rath S-3 CFMB
- Technical Team Members will contact the DCOs to work the equipment and frequency issues for their stations
- DCOs should contact their Technical Team Member directly if you see issues
  - If there is no primary member assigned contact your alternate

	Stations	Primary	Alternate	DMA
2	ELA		N-01	E-N
3	SLA	S-50	T-219	G
4	NWK		N-01	E-N
5	TEM	S-12	M-02	D
6	SCT	F-01	K-04	B
7	ALT	M-02	S-12	C
8	SDM	S-12	M-02	D
9	WHD	K-220*		A
11	LAN	F-01	K-04	B
12	CVS	M-02	S-12	C
13	LKD	N-01		E-S
14	IDT	S-12	M-02	D
15	PRV		N-01	E-N
16	CAS	N-01		E-S
17	LMT	S-50	T-219	G
18	AVA	T-219	S-50	F
21	CEN		N-01	E-N
22	LHS	K-04	K-220	B
23	CER	N-01		E-S
26	PLM	F-01	K-04	B
27	MDR	K-220*		A
28	CPT	N-01		E-S
29	WAL	S-12	M-02	D
95	AERO	N-01	T-219	CW
	EOB	T-219	S-50	CW
	SCC	T-219	S-50	CW

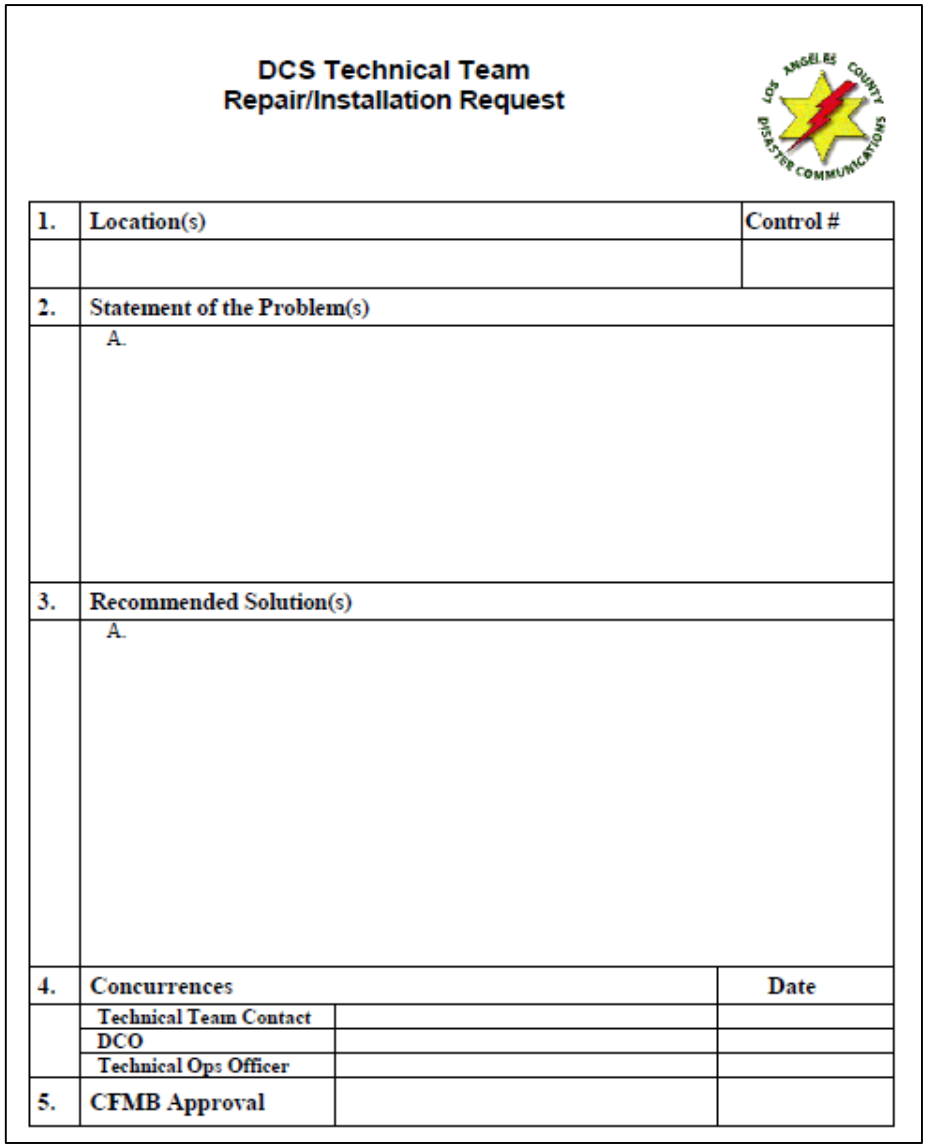
Process to Develop Solutions to Radio and Antenna Deficiencies



- Proposed Solution documented on the Tech Team repair form for CFMB approval

Repair Request Form

- Form documents problems and recommended solutions
- Concurrence from DCOs – no surprises
- Completed forms submitted to CFMB for approval and posted on the web site
- CFMB prioritizes tasks with ISD

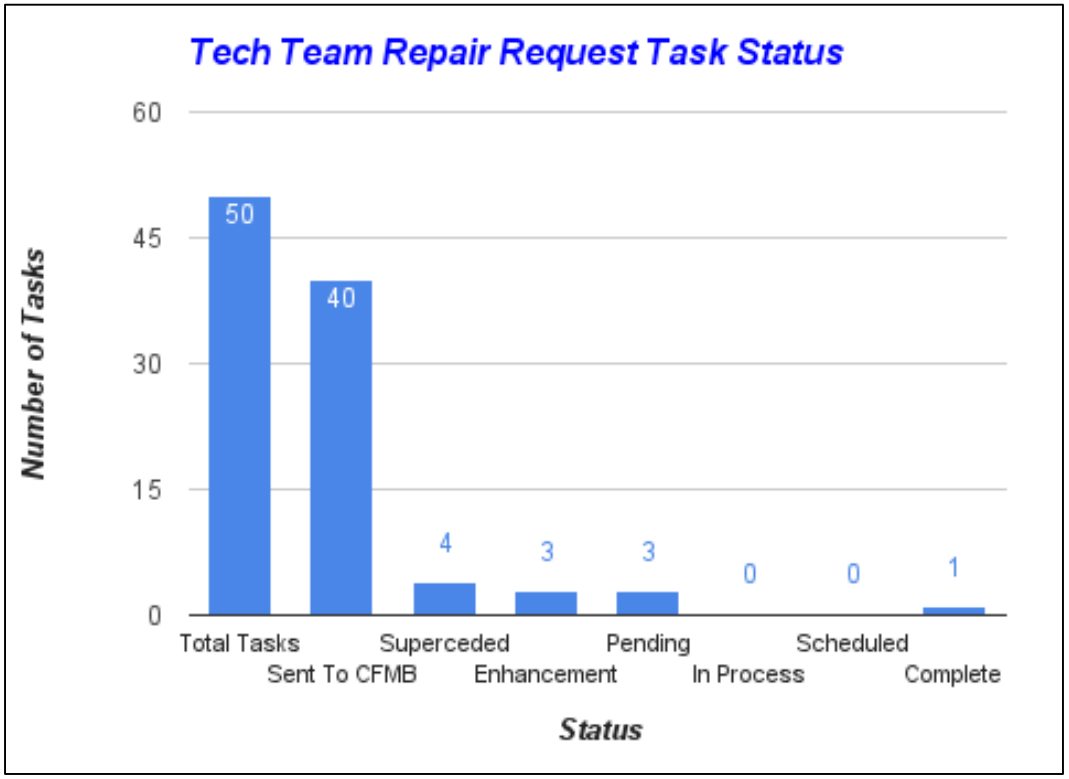


DCS Technical Team
Repair/Installation Request

1.	Location(s)	Control #
2.	Statement of the Problem(s)	
	A.	
3.	Recommended Solution(s)	
	A.	
4.	Concurrences	Date
	Technical Team Contact	
	DCO	
	Technical Ops Officer	
5.	CFMB Approval	

Repair Request Status

- Tech Team members have evaluated most stations and prepared Repair Requests were needed
- Individual problems are tracked in case there are issues with particular parts of the request
- 50 tasks generated, 40 in the queue, 1 completed
- More expected to be scheduled shortly
- “New” 145.300 Tait repeater on Mt. Disappointment



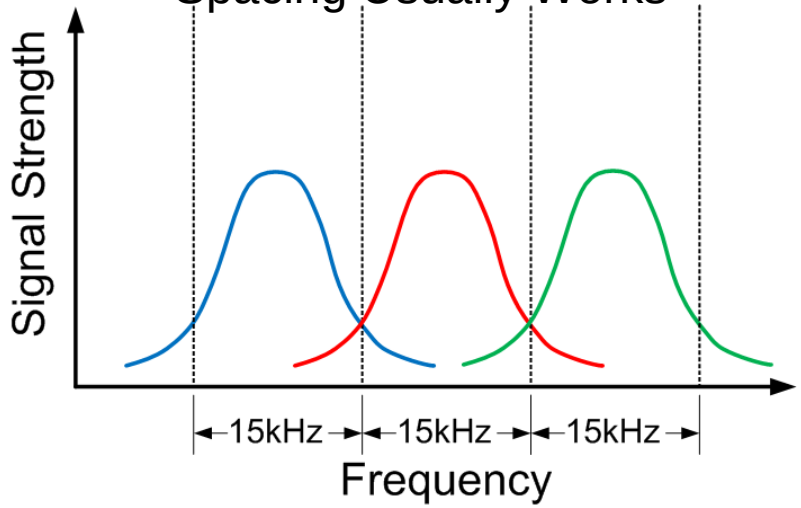
- Contact your Tech Team member regarding the specifics for your particular station

Frequency Planning

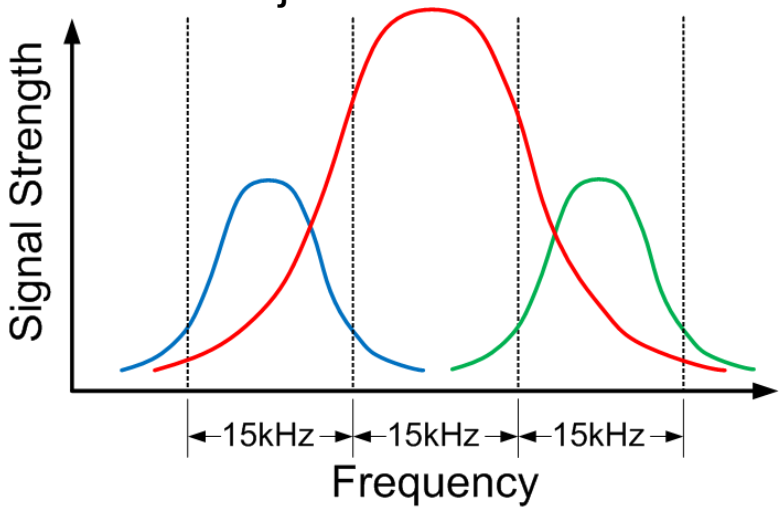
- Plans should conform with the recognized band plans
  - Once the current usage is compiled, identify non-conformances and recommend solutions
  - Then adopt standard naming conventions so that we all know where to find each other
- Ultimate goal to develop standard “code plugs” for the equipment in use
- There are no clear frequencies so smart geographic separation with tone squelch will be required for frequency reuse
  - These are standard techniques in commercial frequency coordination
  - 2 meters will probably be the toughest

Two Meter Example

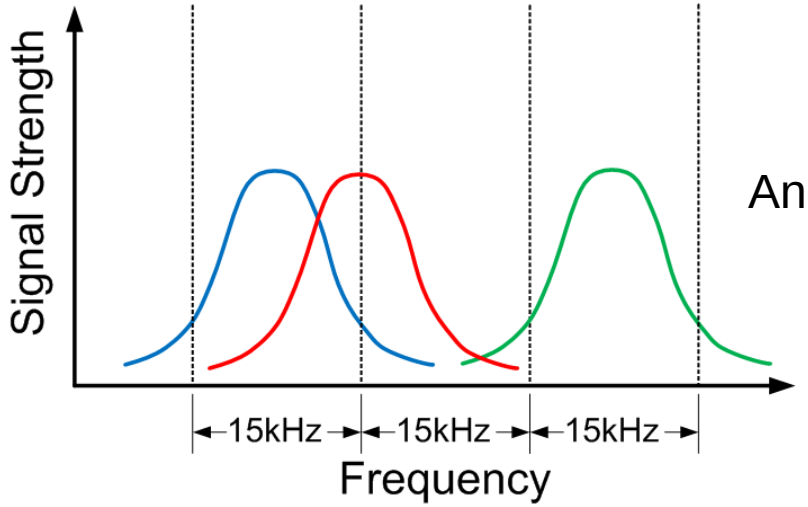
TASMA's 15kHz Channel Spacing Usually Works



Unless There Is A Very Strong Adjacent Station



Or Someone Doesn't Follow The Rules



And That Shouldn't Be DCS!

2011 Frequency Plan 2m Issues

				Offset	PL	Comment	Conflicts
2	ELA	146.520					National Simplex, not advised
3	SLA	145.610				No members	* 5/10 kHz off channel
4	NWK	145.500					* 10 kHz off channel
5	TEM	146.445	√				
6	SCT	146.790		-0.600	123.0	New 147.555	* "New" is 5 kHz from 2 DSTAR repeater outputs
7	ALT	pending				No members	
8	SDM	147.570					* DSTAR repeater output
9	WHD	145.580					* 5/10 kHz off channel
11	LAN	145.200					* Repeater output
12	CVS	145.540	√				
13	LKD	146.460					Fixed simplex aux stations (internet links, remote base, etc.)
14	IDT	144.300					* 10 kHz off channel
15	PRV	145.500					* 10 kHz off channel
16	CAS	146.145		+0.600	156.7	K6CHE/R	
17	LMT	145.585	√		156.7		
18	AVA	147.555					* 5 kHz from 2 DSTAR repeater outputs
21	CEN	147.510	√				
22	LHS	147.510	√			Updated	Was 147.555
23	CER	pending					
26	PLM	145.200					* Repeater output
27	MDR	145.610					* 5/10 kHz off channel
28	CPT					No Members	
29	WAL	147.570					* DSTAR repeater output
95	AERO	146.745					* K6CHE Long Beach repeater input

Other Significant Issues

- 10m

Input (MHz)	Output (MHz)
29.52	29.62
29.54	29.64
29.56	29.66
29.58	29.68

29.63

Simplex (MHz)	Notes
29.50	SCRRBA Plan Only
29.60	National Simplex

29.50 is our only choice

- 6m

50.62	Digital (Packet) Calling

  - Lowest FM simplex is 51.50 MHz, let's start with that
  - There are others

Do Districts need 6m simplex?

- 220 MHz
  - 2011 Plan still had assignments below 222 MHz
  - Only 9 simplex channels

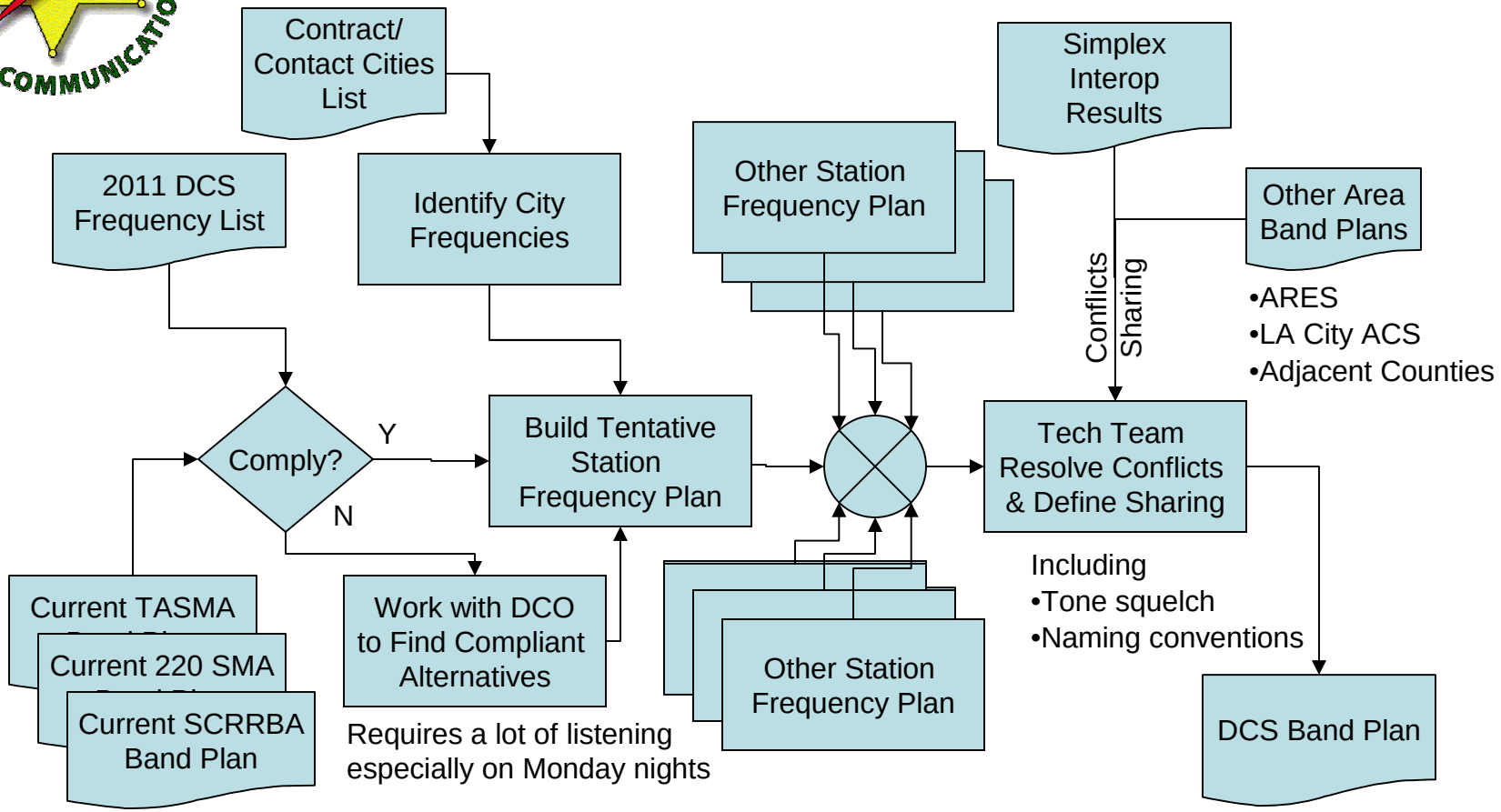
222.120 – 222.140
223.400 - 223.520

How many 220 simplex channels are really needed?

- 440 MHz
  - 2011 Plan had nothing on 440; no county repeater
  - Only 3 - 5 simplex channels

If your contract/contact cities are on 440 you need it

Frequency Plan Development Process



- Each Tech Team Member builds tentative frequency plan for each assigned station
- Start with 2m and then apply to the other bands
- Tech Team as a whole assembles the County-wide plan and resolves conflicts
- Each band to eventually have the standard code plug to be deployed

Interoperability Matrix

DISASTER COMMUNICATIONS SERVICE
DISTRICT SIMPLEX COMMUNICATIONS INTEROPERABILITY MATRIX

DISTRICT	2	3	4	5	6	8	9	11	12	13	14	15	16	17	18	21	22	26	27	29	95	
2 EAST LOS ANGELES																						
3 SOUTH LOS ANGELES																						
4 NORWALK																						
5 TEMPLE																						
6 SANTA CLARITA	Q0		Q0	Q0		Q0	?	Q0	Q0	Q0		Q0	Q3	Q3	Q0		Q0		Q0	Q0	Q0	6/1/2015
8 SAN DIMAS	Q5		Q3	Q5	Q0		Q5	Q0	Q5	Q4		Q4	Q3	Q5	?		Q0		Q2	Q5	?	6/1/2015
9 WEST HOLLYWOOD																						
11 LANCASTER																						
12 CRESCENTA VALLEY																						
13 LAKEWOOD	Q5		Q5	Q5	Q2	Q5	Q5	?	Q5			Q5	Q5	Q5	Q2		Q3		Q1	Q5	Q5	6/1/2015
14 INDUSTRY																						
15 PICO RIVERA																						
16 CARSON																						
17 LOMITA	Q5		Q5	Q5	Q4	Q5	Q4	Q0	Q5	Q5		Q3	Q5		Q0		Q0	Q0	Q1	Q5	Q5	6/8/2015
18 AVALON																						
21 CENTURY																						
22 LOST HILLS / MALIBU																						
26 PALMDALE																						
27 MARINA DEL REY																						
29 WALNUT	Q2		Q5	Q4	Q0	Q5	Q0	Q0	Q2	Q5		Q0	Q4	Q5	Q4		Q0	Q4	Q0		Q3	6/8/2015
95 AERO BUREAU																						
		NA						NCS 6/1	NCS 6/8		NA					NA		NA 6/1				

Signal Strength Key

Heard On The Repeater But Not On The Input	Q0
Weak Unreadable	Q1
Weak Barely Readable	Q2
Weak Readable; Some Noise	Q3
Good Readable; Little Noise	Q4
Loud Clear, Full Quieting	Q5
Nothing Heard	Blank
Not Applicable (Not on the Air)	NA

Frequency: 147.870

Where frequency agile radios are missing, matrix symmetry can be used

Help Us Help You

- Work with your Tech Team Member on equipment and frequency issues
- If there is no primary Tech Team member assigned, nominate a technically qualified member from your district
- If you need to find a new simplex frequency, start listening
  - Consider geographic and frequency separation
- Listen to 29.50 and 51.50 from your areas
- Identify if you need a local 6m or 220 simplex frequency
- Collect simplex interoperability data on Mondays to identify frequency sharing opportunities – due by 8/12
  - Your Tech Team Member can provide you the spreadsheet
  - Send him the compiled spreadsheet

Backup Material

- Bandwidth Considerations
- Empirical Data
- Frequency Sharing Considerations

Bandwidth Considerations & Carson's Rule

- In practice, strong FM signals whose carriers are closer than 20 kHz present a problem
- Why? The approximate occupied bandwidth of an FM signal from Carson's rule is at least 16kHz {16K0F3E}
  - $CBR = 2(\Delta f + fm)$
    - where Δf is the peak frequency deviation, and fm is the highest audio frequency modulated
  - ± 5 kHz peak deviation, and a maximum audio frequency of 3 kHz, requires an approximate bandwidth 2(5+3) = 16 kHz
    - Any modulated signal has an *infinite* number of sidebands, but 98% of the power is within the bandwidth defined by Carson's rule
    - Setting the arbitrary definition of occupied bandwidth at 98% still means that the 2% of the power outside the band is ***only about 17 dB*** *less* than the energy inside $10 \log \left(\frac{0.02}{0.98} \right)$
- Also Carson's rule does not apply well to digital signals

LMT Alternate 1 Spectrum
~1940 Monday, 24 October 2011

- Here are some spectrum shots when operating
- Granularity of display is 5 kHz steps
- Neither MDR or WHD seemed to be operating that night
- San Bernardino ECS has a net from the Running Springs area on 145.570. They can be heard very well.
- Strong signals 15 kHz apart would work only with decent geographic separation
- Smaller spacing between TASMA channels is really asking for trouble

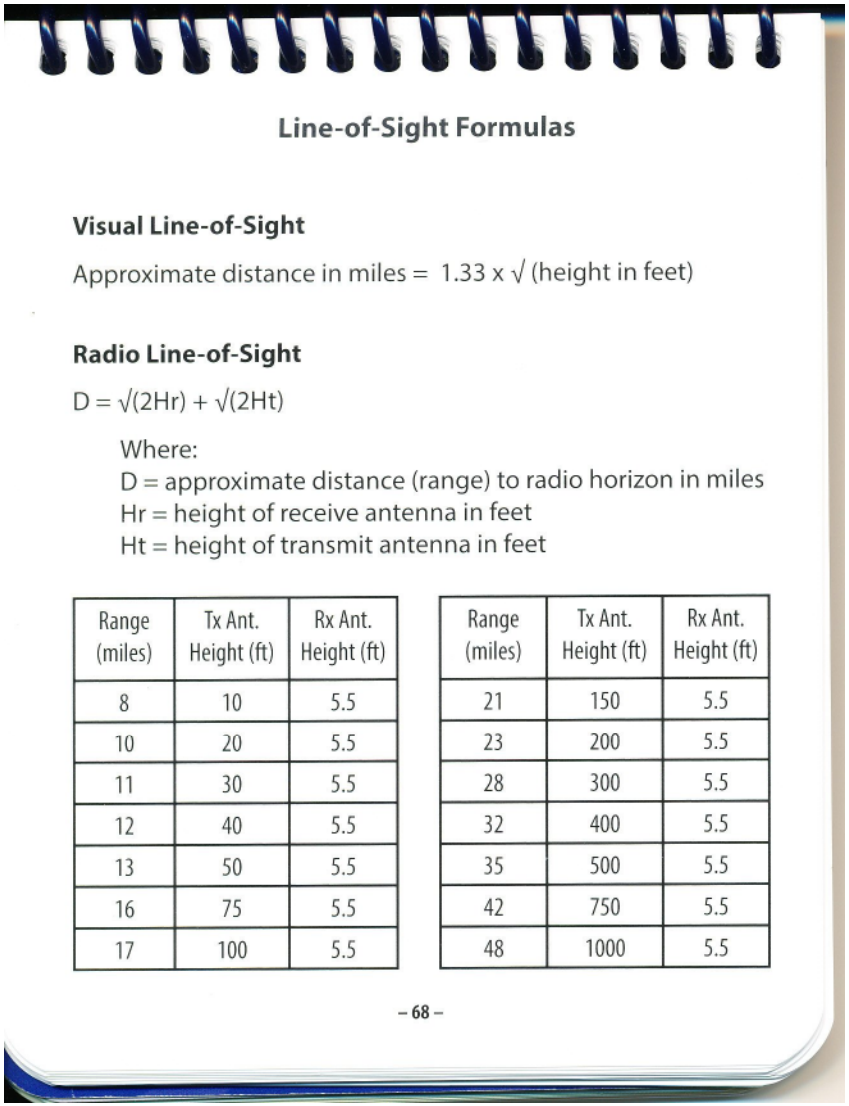
Some TASMA Coordinated Simplex Freqs

145.510
145.525
145.540
145.555
145.570
145.585
145.600
145.615

Data taken at N5DQ home station in Southwest Torrance
Expect stronger signals using the tower antennas at LMT

Frequency Sharing Considerations

- Frequency and geographic separation are required for success
- Consider radio line of sight when sharing frequencies
- The formula is great but better to use empirical data collected by the simplex interoperability exercise
- We will also use tone squelch on simplex
- Our DCS plan will be self consistent, compliant with the coordination entity band plans and considerate of other groups who use the band



Line-of-Sight Formulas

Visual Line-of-Sight

Approximate distance in miles = 1.33 x √ (height in feet)

Radio Line-of-Sight

$D = \sqrt{(2Hr)} + \sqrt{(2Ht)}$

Where:
D = approximate distance (range) to radio horizon in miles
Hr = height of receive antenna in feet
Ht = height of transmit antenna in feet

Range (miles)	Tx Ant. Height (ft)	Rx Ant. Height (ft)
8	10	5.5
10	20	5.5
11	30	5.5
12	40	5.5
13	50	5.5
16	75	5.5
17	100	5.5

Range (miles)	Tx Ant. Height (ft)	Rx Ant. Height (ft)
21	150	5.5
23	200	5.5
28	300	5.5
32	400	5.5
35	500	5.5
42	750	5.5
48	1000	5.5

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