## Satellite Contact Report Analysis & Prediction (SCRAP) Instruction Manual

William H. Bytheway k7tty@arrl.net 14 November 2003

## Intro to SCRAP

Satellite Contact Report Analysis & Prediction (SCRAP) is a tracking, report, analysis, prediction and 3-D real time display program. It tracks and predicts passes of satellites based on the geographical location of the ground station, the current date and time and Keplerian orbital data for the satellites of interest to the ground station. The software is capable of tracking over 2000 satellites real-time, as well as producing contact reports. In addition to the satellites, it provides ground labeling for over 260 countries and 2265 cities. The user is able to pick from 27 different

map textures, and apply islands, lakes, rivers, US states, coastal lines and national boundaries lines.

The project started out as a challenge integrating satellite tracking technology into a 3-D display of the Earth. Additional features were later added for fun. I've invested many hours in the development and test already. The satellite tracking technology has



proven to be quite a challenge to me, but the results are impressive. Therefore SCRAP is what amateur radio operators would consider a goldmine in satellite viewing and it's still free. It's available in the public domain as shareware.

SCRAP is similar to Analytic Graphics STK, Aerospace SOAP, Predict and InstantTrac software. Software was developed using Microsoft Visual C++, OpenGL and modified version of Glut DLL. The executable has been packaged in a zip file and placed in the public domain. It has been tested on Windows 95, 98, 2000 and ME.

## Supported Computer Platforms

SCRAP is not for the underpowered computer. In order to propagate ephemeris for each of the satellites it displays and reports on, it performs millions of floating-point calculations every

second. Therefore, the minimum recommended platform is Windows 98 or better running a Pentium Processor 500 MHz or greater, 256 Mbytes RAM and a graphics accelerator card with OpenGL support. Of course it helps to have at least 1024x768 resolution.

For example, test results on a Windows 98 500 MHZ Pentium shows that it takes about 5 seconds to calculate 200 satellite vehicle positions and display the results. If your processor does not meet the minimum recommended horsepower it is suggested you should keep the maximum number of satellites at a minimum. This can be done at run-time via a command-line entry.

SCRAP does not access the Windows registry or place any hidden files on your system. It does have TCP/IP code for downloading TLE and APRS data from the Internet.

## Installation Instructions

SCRAP is distributed using WinZip has all of the directory information and files needed for a basic startup of the program. To extract the files, use WinZip to create a folder/directory called "SCRAP" and unzip the contents. Create a startup icon next and place it wherever you find convenient on your hard drive.

Scrap creates several directories on your disk

- 1. UserData This is where you store the two line orbital elements and scrip files used by SCRAP. This manual will discuss these scrip files later
- 2. Images SCRAP uses TGA images of the Earth for display on the 3-D display. If you wish to add additional textures of the Earth, this is where they go.
- 3. GITexfont Supporting fonts used by OpenGL and GLUT.
- 4. Vector Data Vector data files used to draw boarders for countries, states, rivers and lakes. The basic binary data from the Pospeschil Micro World Data Bank II was generated using a trial-version of a program called Idrisi to convert the pairs of the '.vec' and 'dvc' files into '.vct' and '.vdc' (these are also binary files).

The display is organized into panels as shown in the picture below, thus allowing the user to control SCRAP's features. In summary these functions are:

Initialize	Allows the user to load in the various TLE files, and to download new TLE files from the Internet
Earth View	Selection of viewpoint to include country, satellite, QTH, etc. and to select the
	Earth Orthographic projection overlay map, and display options
Target QTH	Select the QTH to be used for pass predictions and reports
Sim Time	Define a simulation and step time other than current UST time.
Ephemeris	Set the SGP propagation model and view the position and velocity of satellites
TLE Viewer	View the decoded TLE parameter in classic Orbital Elements.
Pass Reports	Produce predicted orbit pass reports, visible passes and solar illuminations.
APRS	Download APRS stations via Internet. Locations can be used for prediction and
	display.
Multi Track	Display current and upcoming passes in real time
Antenna	Future enhancement for Az/El rotor control. This option is still being developed.

The following sections will discuss in further detail each of these functions.

## Initialization Page

SCRAP 1.26	Satellite C	ontact Rep	ort Analysis	& Predic	tion		200 g B 1	_ 🗆 ×
Coordinated Universal Sat 15Nov03 00:46:3	Tme 17			Antenna OFF	Look ang	les for QTH \6ED	Sun Az 245.6 El -2.7	Moon 2.5 -18.0
Initialize   Earth View   Ta	nrget QTH   Sim Time   en ts	Ephemeris	TLE Viewer	Pass Rep	orts APRS	Multi Track Babble Box	Antenna   /	Astro
Load TLE	Add 3.0\SatView\UserData\	amateur.tle	Conn	ections	Adding the fr 0 - A0-7 1 - A0-10 2 - U0-11 3 - U0-14 4 - A0-16 5 - D0-17 6 - W0-18 7 - L0-19 0 - 20-20	ollowing satellite	18	
Refresh List	Download TLE Fil	es	Abort T tle-new.tle		8 - FO-20 9 - RS-12, 10 - UO-22 11 - KO-23 12 - AO-27	'13		

SCRAP opens with an initialization page as shown. The top left window is used to load Two Line Orbital Element files into the application. Pressing the "Load TLE" button brings up a file box allowing you to load any one of a number of satellite TLE files. Checking the "Add" button allows you to keep the existing selection and add additional satellites to the application.

SCRAP extracts valid NASA format 2-line Keplerian element (TLE) sets from the TLE input file, which may contain other text of various kinds. It removes the miscellaneous text commonly added by network e-mail and bulletin transmission. It can remove lines of text before, after, or between element sets, but not between the lines of a single element set. It can remove text on the same lines as the element sets, before or after the element sets, provided that the three lines of the element set all begin in the same column.

In addition, SCRAP allows you to add additional TLE sets from additional files to the existing set. Keep in mind that it does not check for redundant satellites in the batch.

Pressing "Refresh List" loads a scrip file into the buffer, at which time you can download the latest TLE data from the Internet. You can this text file called "Internet.lst" in the UserData directory and add or delete scripted items. Simply input the URL followed by an output file name on each line.

### Earth View

🥶 SCRAP 1.26 Satellite	Contact Rep	ort Analysis & Predict	ion	and the second	_ 🗆 ×
Coordinated Universal Tme Sat 15Nov03 00:50:18		Antenna OFF	Look angles for QTH AA6ED	Sun Az 246.2 El -3.3	Moon 3.4 -17.9
Initialize Earth View Target QTH SimTime	Ephemeris ]	TLE Viewer   Pass Repo	ts APRS Multi Track	Antenna A	stro
Select desired viewpoint database source C Country C QTH C Sun C City C GMT C Moon C Satellite Select desired viewpoint location		Earth texture list Earth_Natural.tga	Islands I Cities Lakes I Coun Rivers I Coas US States I Natio	▼ itries t Lines inal Boundries	
		FootPrint Contact Cone	Ephemeris _	2-D Map	

From the Earth View panel you can select the Earth orthographic projection of your choice. Your selection is then loaded into SCRAP and the Earth is displayed in it's own window. On slower computers this may take several seconds. The check boxes allow you to select display attributes on the Earth display. The View Point and Latitude/Longitude Offset allows you to select from a number of options for choosing your viewpoint. If you select a satellite, you are positioned above the satellite and the Earth rotates under your location.

The Earth-Simulation 3-D model was written by Ohad Eder Pressman in 2001 and placed in the public domain. The program is based on a large sphere, with a selected Earth map texture overlaid on the surface. You can rotate the Earth, zoom-in, etc. using the mouse and control key. Map textures of the Earth can be changed at any time during the run.

The GLUT extension to OpenGL is required for the 3-D display window controls. Since multiple processing threads are used for ephemeris prediction and display control, a modified version is provided that is SCRAP friendly. GLUT source code is in the public domain.

11/14/03

## Target QTH

🥹 SCRAP 1.26		Satellite Cor	ntact Re	port Analys	s & Predict	ion		_ 🗆 ×
Coordinated Unive Sat 15Nov03 00:	rsal Tme 53:59				Antenna OFF	Look angles for QTH	Sun Az 246.9 El -3.9	Moon 4.2 -17.9
Initialize Earth View	Target QTH	SimTime   Ep	ohemeris	TLE Viewer	Pass Repor	ts   APRS   Multi Track	(   Antenna   A	stro
Select source C Countries C Cities C QTH C APRS	Select spe	cific target to b AA6ED Degrees 47.437 -122.189	Minu	TH home tes 0.0 0.0				

The original PREDICT tool performed all of its predictions based on a user input QTH, I've modified it so that the user can specify multiple QTH locations. This panel allows you to change the default QTH location to any city, country or QTH of your choice. The QTH control file stored in "UserData' is called qth.lst and has the format of callsign, longitude, latitude, elevation and GMT offset in hours.

I've added the capability for the user to assign any country, city, or APRS station to be the new QTH. You can easily move from location to location to predict and display satellite contacts for any location. The Target QTH display allows you to select various QTH locations to be displayed on the Earth's surface. You can select from predefined country or city data, a QTH file where you define your specific locations, or download APRS data from the Internet and use that location. The selected QTH is then used for creating pass prediction reports, the real-time Multi-Track display and for antenna rotor control.

SCRAP provides ground labeling for over 260 countries and 2265 Cities. In addition, the user is able to pick from 27 different map textures, apply island, lake, rivers, US states, coastal lines and national boundaries linesNote: If you activate the antenna rotor control, you are not allowed to change the QTH. This was done to prevent you from selecting a new QTH during a contact, thus forcing the antenna to slew from the current contact.

## Simulated Time

🥺 SCRAP 1.26	Satellite Contact Report Analysis	& Predictio	n		
Coordinated Universal Tme Sat 15Nov03 00:58:17		Antenna OFF	Look angles for QTH AA6ED	Sun M Az 247.7 El -4.5	loon 5.2 17.8
Initialize Earth View Target Q	TH SimTime Ephemeris TLE Viewer	Pass Report	APRS   Multi Track	Antenna   Astro	<u>а</u> .
Set the simulated date	<b>_</b>	- Simulation	n Control		
<ul> <li>Modified Julian Date</li> <li>Julian Date</li> <li>GPS Week / Sec</li> <li>Calendar Date</li> <li>Set S</li> </ul>	52957.698518518519 2452958.198519 220 492352.000 14Nov2003 ▼ 16:45:52 ÷ imulation Start Time	Time	Step (sec) Start	1.0	

No tracking program is complete unless you can input any date time condition and set a fast forward or backwards time step. This panel allows you speed up reality.

The ability to control simulated time is provided to allow you to fast forward the simulation to get a perspective in fast motion of what the satellites are doing. You can also set a negative step time and run the simulation in reverse. The various time formats were provided for flexibility in setting up the simulation. All displayed times are in UST (GMT), but the user has the option of specifying times in GPS, MJD, JD or calendar formats.

Keep in mind that all times are in UST (GMT)

SCRAP 1	.26	Sate	llite Contact	Report a	Analysis	& Predic	tion				_ 🗆
Coordina	ated Univer	sal Tme		-	1.56	Antenna	Look a	ingles for l	QTH	Sun	Moor
Sat 15	Nov03 00:5	59:39				OFF		AACED		Az 247.9	5.9
						UFF	1	AAOED		EI -4.8	-17.
nitialize   E	arth View	Target QTH Sim	Time Epheme	eris TLE	Viewer   F	Pass Repo	orts APR	S Multi	Track A	ntenna 🗎 A	stro
		0 A 10	Pos	ь v	ь		Vel	0.0	0.0	~ ¬	
		Satellite	Magnitude	Pos-X	Pos-Y	Pos-2 N	1agnitude	Vel-X	Vel-Y	∖Vel-∠	
Propaga	ation Model	A0-10	20538.7	1048.0	-19976.2	4657.2	4 8522	3,8201	-2.8569	-0.8882	
		A0-16	7160.1	5353.2	-459.2	4732.8	7 4626	-4 9585	-1.0119	5 4845	-
		A0-27	7184.5	5078.8	-1628.8	-4813.6	7.4415	4.2194	-2.8644	5.4193	
		A0-40	65266.2	19740.9	61586.7	8778.0	1.1089	-1.0410	0.3608	0.1261	
Select p	propagation	A0-49	6998.4	-1585.0	6720.0	1143.2	7.5690	-2.9505	-1.8433	6.7221	
CCDAD	) be used by	AO-7	7829.4	7673.8	196.9	1540.6	7.1367	-1.3344	-1.5127	6.8457	
SURAF		DO-17	7167.6	6972.0	629.5	1539.2	7.4581	-1.4949	-1.2412	7.2005	
		FO-20	8127.6	-1636.0	-3846.6	-6970.3	6.8057	-4.0858	-4.2761	3.3672	_
0.00	0	FU-29	7659.9	2352.7	6391.3	3505.7	7.1072	0.0481	-3.3183	6.2848	
U SG	F	GU-32	7198.7	-6183.U	-30/4.5 2000 c	-2034.5	7.4408	1.3379	1.9593	-7.0524	
🕘 S G	P4/SDP4		6760.2	5323.6	-3063.6	2033.3 1011 C	7 6770	-2.3371	0.2261	5.8444 5.000	
C SG	P8/SDP8	K0.23	7692.6	3385.7	-1951.6	6654.7	7.1956	-0.4276	6.8636	2 1178	
C Fas	of	K0-25	7160.9	-171.4	-1047.1	7081.8	7 4601	-6.8351	2 9769	0.2675	
100	24.	LO-19	7151.1	-4446.7	-1545.9	5382.8	7.4703	-5.7262	-0.2540	-4.7909	
		MO-46	6991.3	2092.8	4513.2	4912.2	7.5545	-2.3605	5.7528	-4.2900	
		NO.44	7170.0	2560.6	1337.2	6562.4	7 4525	.1 9296	7 1 8 5 5	.0.7514	

## Ephemeris Propagation Model

**SCRAP** 

The main ephemeris engine is Dr. T. Kelso's Pascal's SGP, SGP4, SGP8, SDP4 and SDP8 satellite ephemeris propagation routines. These models were borrowed from SPACETRACK REPORT NO. 3, Models for Propagation of NORAD Element Sets, Felix R. Hoots, Ronald L. Roehrich, December 1980.

This panel displays the current ephemeris vector data for position and velocity. In addition it allows you to switch ephemeris models in real-time. Normally you should never have to leave the SGP4/SDP4 model, but it's interesting to switch between the other models and observe the differences.

Borrowed from SPACETRACK REPORT NO. 3, Models for Propagation of NORAD Element Sets, Felix R. Hoots, Ronald L. Roehrich, December 1980.

Five mathematical models for prediction of satellite position and velocity are available. The first of these, SGP, was developed by Hilton & Kuhlman (1966) and is used for near-Earth satellites. This model uses a simplification of the work of Kozai (1959) for its gravitational model and it takes the drag effect on mean motion as linear in time. This assumption dictates a quadratic variation of mean anomaly with time. The drag effect on eccentricity is modeled in such a way that perigee height remains constant.

The second model, SGP4, was developed by Ken Cranford in 1970 (see Lane and Hoots 1979) and is used for near-Earth satellites. This model was obtained by simplification of the more extensive analytical theory of Lane and Cranford (1969) which uses the solution of Brouwer (1959) for its gravitational model and a power density function for its atmospheric model (see Lane, et al.

1962).

The next model, SDP4, is an extension of SGP4 to be used for deep-space satellites. The deep-space equations were developed by Hujsak (1979) and model the gravitational e?ects of the moon and sun as well as certain sectoral and tesseral Earth harmonics which are of particular importance for half-day and one-day period orbits.

The SGP8 model (see Hoots 1980) is used for near-Earth satellites and is obtained by simplification of an extensive analytical theory of Hoots (to appear) which uses the same gravitational and atmospheric models as Lane and Cranford did but integrates the di?erential equations in a much different manner.

## **Two Line Orbital Elements**

1.26	20.02	Satellite Contact I	Report Analysis	& Predicti	ion		
hated Unive	ersal Tme			Antenna	Look angles for QTH	Sun M	100
5Nov03 01	:01:42			OFF	AA6ED	Az 248.3	6
					1	EI -5.1	-17
Earth View	] Target Q	TH SimTime Ephemer	ris TLE Viewer	Pass Repor	rts   APRS   Multi Track	Antenna Astro	5
ORAD Two	b Line Orbita	al Elements			EPOCH Tme	· · ·	
A0-49			-		Thu 06No	v03 21:14:43	
1 27605	J 02058A	03310.88521810 .00000	 1357 00000-0 776	76-4 0 291	2 [20]	02	
					Year 20		
2 27605	64.5523 12	23.5252 0051589 6.1326	5 354.0394 14.716	95988 4726	58 Day	310.885218	
Elements –							
Number	27605	Sem iMajor Axis (km)	7033.726509	Dec	cay Rate (rev/day2)	0.000004	
esignator	02058A	RAAN (deg)	123.525200	Меа	an Motion (rev/day)	14.716960	
Number	291	Eccentricity	0.005159	Nddot.	/6 Drag (rev/day3)	0.000000	
Number	4726	Mean Anomaly (deg)	354.039400	Argume	ent of Perigee (deg)	6.132600	
		1		DOT ID D		0.000070	
E	226 ated Unive Nov03 01 Earth View RAD Two AO-49 1 276050 2 27605 Elements – Number Signator Number	.26           ated Universal Time           iNov03 01:01:42           Earth View         Target Q           DRAD Two Line Orbita           [A0-49           1 27605U 02058A           2 27605           64.5523 12           Elements           Number         27605           signator         02058A           Number         291	25         Satellite Contact           ated Universal Tme         iNov03 01:01:42           Earth View         Target QTH         SimTime         Epheme           DRAD Two Line Orbital Elements         A0-49         1         27605         64.5523 123.5252 0051589         6.1320           2 27605         64.5523 123.5252 0051589         6.1320         Elements         Image: Signator         02058A         RAAN (deg)         Image: Signator         Image: Signator         Image: Signator         A726         Image: Signator         Image: Signator	25         Satellite Contact Report Analysis           ated Universal Tme         iNov03 01:01:42           Earth View         Target QTH         SimTime         Ephemeris         TLE Viewer           DRAD Two Line Orbital Elements	25         Satellite Contact Report Analysis & Predict An	26       Satellite Contact Report Analysis & Prediction         ated Universal Tme       Antenna       Look angles for QTH         Nov03 01:01:42       OFF       AA6ED         Earth View       Target QTH       SimTime       Ephemeris       TLE Viewer       Pass Reports       APRS       Multi Track         Itematical Elements       Itematical Elements       Itematical Elements       EPOCH Tme       Thu 06No         1       27605       64.5523       123.5252       0051589       6.1326       354.0394       14.71695988       47268       Day         Elements       Itematical Elements       Itematical Elements       Decay Rate (rev/day2)       Itematical Elements       Decay Rate (rev/day2)         Number       27605       Sem iMajor Axis (km)       7033.726509       Decay Rate (rev/day2)       Mean Motion (rev/day3)         Number       291       Eccentricity       0.005159       Nddot/6 Drag (rev/day3)       Nddot/6 Drag (rev/day3)	26         Satellite Contact Report Analysis & Prediction

In order to give SCRAP the best performance, one should download the latest TLE files from the Internet using the "Initialize" panel. SCRAP extracts valid NASA format 2-line Keplerian element (TLE) sets from the TLE input file, which may contain other text of various kinds. It removes the miscellaneous text commonly added by network e-mail and bulletin transmission. It can remove lines of text before, after, or between element sets, but not between the lines of a single element set. It can remove text on the same lines as the element sets, before or after the element sets, provided that the three lines of the element set all begin in the same column.

In addition, SCRAP allows you to append additional TLE sets from input files to the existing set. Keep in mind that it does not check for redundant satellites in the load.

TLE data is downloaded using a pre-built script file. Pressing the download button initiates TCP/IP connections to the TLE source, and in a matter of a minute or so, you have downloaded the latest files set.

## Satellite Pass Reports

🥹 SCRAP	1.26	Satellite (	Contact Rep	oort Analysi	s & Predicti	on		_ 🗆 ×
Coord Sat	dinated Universal 15Nov03 01:02:4	Tme 6			Antenna OFF	Look angles for QTH AA6ED	Sun Az 248.5	Moon 5 6.2
						,	El -5.3	2 -17.8
Initialize	Earth View Ta	rget QTH   SimTime	Ephemeris	TLE Viewer	Pass Report	ts APRS Multi Track	Antenna	Astro
Pass	s Prediction Repor	t						
NO	-44	•						
0	Orbit Passes							
C	Visible Passes							
0	Solar Illumination							
0	Spare							
	Start	End						
141	Nov2003 🔽	16Nov2003 💌						
	C 1 D							
	Generate Pre	dict Report						
			1					

Satellite contacts in the program's database are calculated at a once/second rate. Separate windows are used to display current passes and upcoming passes. SCRAP also can create text-format reports of predicted passes. The satellite pass report options were originally developed and used in the PREDICT tool written by John A. Magliacane, KD2BD. John's report format was rewritten and integrated into SCRAP with some minor modifications.

Tracking data is also displayed for satellites in contact range. The name, azimuth heading, elevation, sub-satellite point latitude (in degrees North) and longitude (in degrees West) positions are provided, along with the slant range distance between the satellite and the ground station (in kilometers).

The Visible Passes report option displays the satellites in sunlight where the ground station is under the cover of darkness.

Solar illumination prediction report indicates how much sunlight a particular satellite will receive in a 24-hour period. This information is especially valuable to spacecraft designers and satellite ground station controllers who must monitor spacecraft power budgets or thermal conditions onboard their spacecraft due to sunlight and eclipse periods. It can even be used to predict the optimum times for astronauts to perform extra-vehicular activities in space.

## Automatic Packet Reporting System

CRAP 1.26	2.5.4 55 <sup>11</sup>	Satelli	te Con	tact Report Analysis & Prediction 📃 🗖
Coordinated U	Iniversal Tme			Antenna Look angles for QTH Sun Moor
Sat 15Nov03	3 01:03:27			Az 248.6 6.3
				OFF AA6ED
				EI -0.3 -17.0
<i>8</i> 2		100	10	and the second
hitialize   Earth V	iew Target	QTH SimTir	me Ep	hemeris TLE Viewer Pass Reports APRS Multi Track Antenna Astro
Down	oload APBS c	lata from Inter	net (or e	enter your own ADDBESS · POBT )
Dom	1000 AF 115 C	lata nom men	nector e	Internet Stop
				Download Download
22012				
<ul> <li>Display Contro</li> </ul>	d			
Callsign	Lattitude	Longitude	Alt	Comments Clear Load "AprsData.TXT" Count 939
AAOSM	44.083	-92.525	0	PHG5100/Tonv in Rochester, MN -MN0LMR0CHESTE-240-<530>
AA0ZC-3	38.657	-92.776	Õ	PHG5230/WinAPRS 2.5.1 - MOMONTIPTON - 251 - < 530>
AA3H	41.392	-82.022	0	01.32W_272/011gt051P000h82b10083.DsVP
AA4L	37.285	-80.104	0	PHG5130/WinAPRS 2.5.1 -VAROASALEM -251-<530>
AA71-9	36.154	-115.144	1994	000/000/A=001994
AA7ZV	47.163	-122.348	0	PHG4200/Joun in Puyallup -WAPIEPUYALLUP-261-<530>
AA9MM-11	37.563	-87.691	0	PHG6480/W-R-T-KY Digi Dixon, Ky.
AA9QF-14	33.620	-84.478	0	28.65Wu074/047/Mic-E/M2/In Service>
14045777	29.912	-95.582	0	PHG5030XASTIR-Linux 1.1.4
AB4EZ-7	20,002	-84.689	0	PHG6294/AB4WS@arrl.net + OAKBROOKKYBOOFLORENCE-251-<
AB4EZ-7 AB4WS	33.003		0	2m-In gateway in Durant OK {UIV32}
AB4EZ-7 AB4WS AB5CC	34.046	-96.379	0	
AB4EZ-7 AB4WS AB5CC AB5JY	34.046 35.940	-96.379 -96.860	ő	AB5JY's APRS Station (Agra, Ok) {UIV32N}

The project takes an interesting twist on this addition. The Automatic Position Reporting System (APRS) developed by Bob Bruninga, WB4APR, is used for tracking and digital communications with mobile GPS equipped stations with two-way radio (ref. http://www.aprs.org). SCRAP provides an Internet access that downloads APRS station information residing on multiple WEB servers as defined by the APRS Protocol published by the Tuscon Amateur Packet Radio Corporation.

The APRS protocol is not a very straightforward design, as multiple venders have added their own unique twists. SCRAP in its current form can only decode the simple latitude, longitude and altitude of most stations and attempts to display the broadcasted comments. Compressed APRS data fields are not supported.

To use the Internet download feature, select the desired WEB server and press "Internet Download". If the counter does not increment, try another server, not all servers in my current list provide the proper protocol. Most servers will never disconnect, so the SCRAP design lets you determine when enough stations have been added to the list. You can go to multiple servers and add more stations as desired.

A file import option has been added that allows the user to import a text file dump of the Internet APRS servers. This is useful for displaying locations without the need for an Internet connection.

CRAP 1.26	a series and a series of the s	Satellit	e Conta	ct He	port Analg	vsis & F	redictio	n				_ [
Coordinated Unive	ersal Time 11.00					An	itenna	Look angl	es for QTH	9	Sun	Moo
34010N000000	.11.35					C	DFF	Γ ΑΑ	6ED	EI	-6.6	8. -17.
nitialize Ì Earth View	Target OTH	SimTim	e Ì Ephe	emeris Ì	TLE View	er   Pas	s Reports	APRS	Multi Track	Antenn	a Ì As	tro Ì
Current Pass	Az	EI	Lon	Lat	Range	Alt	Eclipse Depth	Squint Angle	Orbital Phase	0rbit		
A0-7 A0-10 U0-22 I0-26	73.9 223.7 215.0 15.5	9.0 31.1 2.1 13.6	279.1 208.2 222.4 247.7	47.7 10.2 26.0 63.3	3674 18500 2973 2129	1463 16096 758 807	-1.6 -106.9 -40.4 -11.4	0.0 0.0 0.0 0.0	93 93 243 177	32695 12562 64704 52841		
NO-45 Predicted Pass	219.7 Az	49.8 El	233.2 Lon	43.3 Lat	1013 Range	804	-25.4 GMT Time	0.0 e	102 Rise	11088		
RS-12/13 D0-17 A0-27 S0-42 POSAT F0-29 U0-14 U0-11 W0-18 U0-36	104.8 58.7 147.3 207.2 146.2 30.8 158.8 165.3 184.5 59.4	-1.0 -1.9 -19.3 -19.9 -23.1 -17.1 -62.4 -69.3 -73.5 -73.0	274.3 283.6 263.1 216.9 266.1 344.7 303.9 350.2 69.3 26.9	32.7 54.5 -0.2 -0.7 -5.3 64.1 -71.9 -80.0 -78.4 -26.3	3830 3500 6013 5829 6618 6599 12167 12594 13040 12854	Sat 15 Sat 15	5Nov03 0 5Nov03 0	1:12:08 1:13:49 1:18:39 1:18:58 1:20:21 1:20:24 1:40:49 1:47:04 1:51:23 2:04:38	00:00:34 00:02:15 00:07:04 00:07:24 00:08:47 00:08:49 00:29:15 00:35:30 00:39:48 00:53:03		-	

This panel was inspired by the PREDICT program with some differences. The top window shows the current potential contacts. The bottom display shows the upcoming contacts. Probably the most useful number on this display is the time until rise of the next contact. Satellites are sorted by rise time.

# Multi-Track

SCRAP

## Antenna

🥹 SCRAP 1.26	Satellite Contact Report Analysis & Prediction	
Coordinated Universal Tme Sat 15Nov03 01:13:16 Initialize Earth View Target (	Antenna Look angles for QTH Sun M Az 250.3 EI -6.9 QTH SimTime Ephemeris TLE Viewer Pass Reports APRS Multi Track Antenna Astro	foon 8.6 -17.6
Comm Port Control Setup None COM 1 COM 2 COM 3 COM 4 COM 5 COM 6 COM 7 COM 8	Select QTH from Target QTH menu   Name   AA6ED   Degrees   Minutes   Lattitude   47.437   0.0   Longitude   -122.189   0.0    Stert  Stop	

This antenna feature allows the user to control an azimuth-elevation rotor for a real-time contact. Elevation angles are suppressed until the angle rises above zero. The QTH is selected from the "Target QTH" panel, and once you start this display, you cannot change the QTH until you stop the action.

The precision function allows you to update the rotor with data less than one degree accuracy. Data is sent to the rotor once per second.

The Icon will change from an antenna (currently shown), OFF or LOS for loss of signal. The Icon is also displayed in the upper section.

## Earth Image Control



Use the mouse and it's left-button to rotate earth. Hold down Ctrl before you hit the left mouse button to scale the earth. Right-Click the window to get the options menu. Note that options are controllable by keyboard too.

```
SCRAP
```

## Numbers

Following are some basic numbers you might find interesting

NUM_SATELLITES	It's been said that SCRAP can handle up to 2000 satellites. At runtime the default is 500. If you wish to increase the number then include a command line parameter that defines the total number you wish to support, i.e. "c:\SCRAP\Scrap.exe 2000" for 2000 satellites. Just remember that the more satellites you add to the list, the slower the overall application runs.
NUM_COUNTRIES	There are 267 countries included in the database latitude/longitude.
NUM_CITIES	A total of 2267 cities are included in the database with latitude/longitude.
NUM_QTH	You can specify up to 50 unique QTH locations in the user-defined "QTH.lst" file. This file is stored in the UserData directory.
NUM_APRS	For some odd reason, included is space for up to 30,000 world-wide APRS stations in the dynamic database.

## Public Domain Sources

- 1. PREDICT written by John A. Magliacane, KD2BD <u>kd2bd@amsat.org</u>, <u>http://www.qsl.net/kd2bd/predict.html</u>.
- 2. The C source code ported from NORAD's Spacetrack report #3, which included FORTRAN source for SGP, SGP4, SDP4, SGP8 and SDP8. According to a statement in that report, the document is free of copyrights and open to unlimited public distribution. Information found at <a href="http://www.projectpluto.com/sat\_code.htm">http://www.projectpluto.com/sat\_code.htm</a>.
- Two line orbital elements (TLE) are posted daily from Dr. TS. Kelso's CelesTrack website at <u>http://www.celestrack.com/</u>. The OpenGL Utility Toolkit (GLUT) Programming Interface API Version 3 Mark J. Kilgard Silicon Graphics, Inc. November 13, 1996, downloaded at <u>http://www.opengl.org/developers/documentation/glut/</u>.
- NASAWASH NASA-Format Keplerian Element Set File Cleanup, updated 8 Mar 2002, Copyright 1995 Paul Williamson, KB5MU. All Rights Reserved, permission given for non-commercial purposes. Source and description found at <u>http://www.mustbeart.com/software/nasawash.html</u>.
- 6. 3-D Earth-Simulation, Ohad Eder Pressman, 2001. Source code creates the Earth sphere and map textures with rotation, zoom-in, etc. control, <a href="http://ohad.visual-i.com/exper/exper.htm#earth">http://ohad.visual-i.com/exper/exper.htm#earth</a> .
- 7. Equidistant Cylindrical maps from NASA/GSFC are copyright-free by Dave Pape, <u>pape@evl.uic.edu</u>. Maps can be found at <u>http://www.evl.uic.edu/pape/data/Earth/</u>.
- 8. The GNU General Public license for software distribution can be found at <u>http://www.gnu.org/copyleft/gpl.html</u>.