Russian Air Defence Forces
Voyska Protivo Vozdushnoy Oborony
Войска ПВО   Voyska PVO
and related stations

Designators:

M21   - Russian Air Defense (morse)
M21a   - Ukrainian Air Defense (morse)
RADv   - Russian Air Defense (voice)
UADv   - Ukrainian Air Defense (voice)
M41   - Morse stations, related to M21

Colonel Alexander Drobyshevsky told RIA Novosti that the Russian Air Defense has tracked 102,288 airborne targets in 2001, amongst them were 58,240 foreign aircraft, including 861 fighters and 297 reconnaissance aircraft. Russia's air space has been violated 325 times last year.

BACKGROUND

Shortly after World War II, Protivo Vozdushnoy Oborony (PVO) became a separate branch of the Soviet armed forces. PVO can be translated as Anti-Aircraft Defense.

After various minor changes, a major reorganization of the Soviet Air Force and Air Defence Forces took place between 1978 and 1980. PVO was reorganized in 1981 and its name was changed to Voyska PVO (Air Defense Troops). The Voyska PVO lost its separate command and control system in the reorganization and about half of the fighters and the majority of the flying training system was transferred to the Air Force.

As a part of a drastic reorganization in 1998, the Air Defence Forces were merged with the Air Force. So in fact PVO itself was no longer an independent force by then. The former Moscow Military District had a mixed Air Force/PVO corps. This corps has merged with the former Leningradsky District in 2010. After that yet another reorganisation took place in 2011, a merger between PVO and RKO (rocket-space defence). This merged force is now known as Aerospace Defence Forces. After the merger in 2010 there were PVO units with Head Quarters in Chita, St.Petersburg, Rostov-on-Don, and Khabarovsk. I have no idea what will happen to these facilities now a new reorganization took place.

Radio technical troops operate thousands of air surveillance, early warning, height finding, and fire control radars. They also man 6 large phased-array radars for ballistic missile detection.

Note:
In the past the air defense systems of the other Warsaw Pact countries were integrated in the Soviet network. As a result of that you can still hear similar stations from other Eastern European countries (mainly Ukrainian Air Defense).

M21 MORSE TRANSMISSIONS

Most of the tracking is satellite based now. Most, but not all....

The Morse stations that we can hear on HF proof that there is still some terrestrial activity. The HF Morse systems are partly used as a backup for the satellite systems and probably they are also used for training purposes. Indeed, if you want to keep radar people on the ground up to scratch, this kind of reporting gets in a LOT of training for a lot of people (including Morse).

During the cold war NATO used to fly aircraft parallel to the then Soviet Union borders to deliberately prod the radar tracking stations into activity. This was a good means of quickly recovering grid number changes in the plot messages that the tracking stations transmitted. This gave the NATO monitors a chance to figure out where to start.

How? Well actually it is not as difficult as it looks like. Say you find a lot of tracks starting and finishing in the same place, then obviously there is an airfield there. From there it is just a matter of identifying which airfield. Once you have that, you have a fair idea where to start building your grid. Always a good place to start in the old days was Sheremetyevo Airfield in Moscow; callsign RFNV, on 11312 kHz. It is still there, and still active, though mostly on voice now. However, they famously transmit a weather forecast at hour+10 and hour+40. It was a good station to keep an eye on because of all the aircraft were using it.....and as lucky aside, the Russian Long Range Bomber Force flew exercises on Tuesdays and Thursdays and some of them could be counted on to talk to RFNV.

Later on, the Soviets modernized their equipment which implied that the number of morse and voice transmissions decreased substantially. The new equipment had NATO designation G3C, or SWAMP. This system worked on the principle that the radar operator simply put a light pen on the trace on his radar screen, and this was automatically transformed into a signal that gave the same information as a manual plot, but much faster. It was read automatically by the controlling station and again, plotted automatically on a master screen. Thus the controlling station had a very quick overall view of the sector it was responsible for. The signal was roughly built up as shown in the graphic below.

Gabala Radar, Azerbaidjan
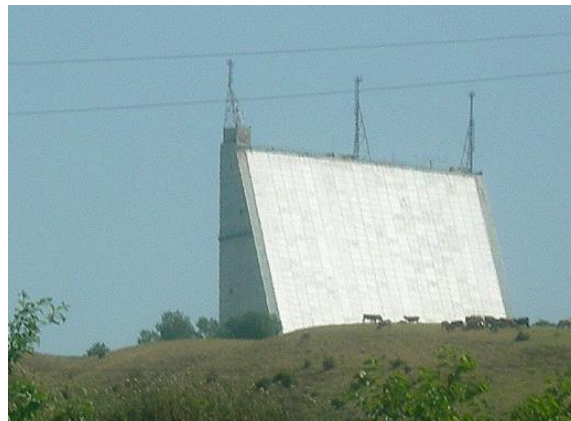
The Morse plots explained.

In the Soviet days the messages were longer than they are now, namely 22 characters versus 15 characters now. This automatically means that the layout of the message is now different than back in the yesteryears. In the past you sometimes had to wait quite a while before you could copy a complete plot. This was caused by the fact that the info in the messages was shortened after it had been sent a couple of times. The first plot messages consisted of a number of codes representing:
- – tracking station
- – track number
- – 7-digit grid
- – identification (friend, foe, unknown, and   other designations)
- – flight level in hectometres
- – time
- – Each track report started with =00

EXAMPLES (see also the graphics below)

Note: zero is transmitted as 'T'.

First an oldie:
= 00 1234 7214328 71 10 2315
= 1234 14329 16
= 1235 14329 16
= 34 14324 17
= 35 14324 17

The initial track report is signified by the "00". The track is designated by the particular tracking station (12) and by track (34 and 35). The track is identified initially as unknown (71), it is flying at a height of 10,000 hectometers (10), and plot is timed at 2315 local time.

In the next two lines, the full track idents are given, but to speed things up, the major and minor square numbers are dropped, as is height info.

In the next two lines, the tracks are abbreviated to just the track numbers, the minimum grid information, and the minutes part of the time.

Lots of variations have been used over the years. For instance, plots on busy stations being given as just the last two digits. Hostile, friendly, passenger. They used a number of digraphs, enough to cover just about every flying object.

Obviously it's an inefficient method of tracking, but it worked well enough to see Gary Powers shot down. It is said that the system is accurate down to about 1 kilometer. For security, once or twice a week the numbers of all the major, minor, and sub-minor squares are changed.

Imagine that the next 6 sections are segments of a map. First we zoom in on one segment and than zoom in on a smaller part of that particular segment, etc. until we are down to the 6th level. The plot in this example would be 7214328

1	2	3
8	9	4
7	6	5

major (1 digit, e.g. 7)

1	2	3
8	9	4
7	6	5

minor (1 digit, e.g. 2)

	0	1	2	3	4	5
1	0	1	2	3	4	5
2	1	0	9	8	7	6
3	2	3	4	5	6	7
4	3	2	1	0	9	8

sub-minor (2 digits, e.g. 14)
(X/Y cordinate, row 1, column 4)

1	2	3
8	9	4
7	6	5

sub-minor more detailed (1 digits, e.g. 3)

1	2	3
8	9	4
7	6	5

sub-minor more detailed (1 digits, e.g. 2)

1	2	3
8	9	4
7	6	5

sub-minor more detailed (1 digits, e.g. 8)

Now the modern 15-character messages. The samples were all logged during the past year. The main difference is that they don't start with =00 anymore. Also missing is the code for "friend or foe". The codes for the tracking station (2 digits), track code (3 digits), grid (7 digits), and the time (2 digits, minutes only) are still there. The altitude also does not appear anymore in the morse version, but can still be heard on the voice channels. So, how should it be read? As you can see in the following explanation, all the assumed missing information is still there.

The messages look like this when sent by the PVO stations:

The following is how the messages should be read:

=13209813134224   = 1 3209 8131342 24
=13641176513420   = 1 2641 1765134 20
=23643901070030   = 2 3643 901 07 00 30
=10117115618152   = 1 0117 1156181 52
=4135113514????   = 4 1351 1351 4
=10478541048146   = 1 0478 5410481 46
=20207501100908"   = 2 0207 501 10 09 08

The figures 1,2,4 etc are codes which reflect the info.
1 is tracking on the four fig track number: 1 3209 8131342 24.
2 is track amplification: 2 3634 901 07 00 30
901 = 1 aircraft of type/ident 9. (9 = Negative IFF)
07 is height 00 is speed (none reported at this time)
08 is bearing from radar station: 2 0207 501 10 09 08

Similarly 501 is 1 aircraft of type/ident 5 (5 = scheduled airliner)
10 is height. 09 is speed and 08 is bearing from radar station.
4 1351 1351 4 = Track dropped on track number 1351.

Idents:

71 (701) is practice traffic

41 (401) is friendly aircraft simulating hostile

21 (201) is positive IFF

31 (301) is border violator

81 (801) is hostile aircraft

51 (501) is scheduled airliner

61 (601) is special interest

91 (901) is negative IFF

On the older format 511 was speed and 510 was height. 190 was track lost. 192 was tracked dropped.

A final note regarding the grid figures (see graphic above). The "Major" part is now always the first two figures of the grid.

Example: 00 1234 5678294 21 80 1645

    56 is Major

    7 is Minor

    8 row

    2 column

    9 is a swiss roll effect within that box

    4 is a further swiss roll effect within that specific box

In between the track reports the PVO stations send time stamp messages. The time used is most of the time the current Moscow time (UTC+3 or UTC+4), but also times from other time zones have been noted. Because the number of digits needed for these messages are far less than the standard 15 characters, a number of question marks are filling the space.

There is apparently no standard layout for the time stamp message as several variations appear. They always start with =99. Despite the differences, the sequence of the items is the same: =99, time, id.

The variations:

=99?1312???????

=992156??0?????

=990030??6?????

=99?1310???8???

=99?0056?9?????

The codes (0, 6, 8, 9) represent the four regional PVO headquarters; St. Petersburg, Chita, Khabarovsk, and Rostov-on-Don. The one without a code might be Moscow. I don't know which code belongs to each station.

I received a couple of pages from a note book that was used by a PVO soldier in 1982. Here is most of the text, translated by an old friend. His comments are between brackets.

140 r/st 160 correspondents
(r/st = radio station)
4452 r/st 4512 r/st 4 correspondents
Iwa, PoluChar, Stalx, Dub
4040 r/st 8 correspondents
Pero - head r/st
Saman - city Vladiwostok
Pedagog - border
Fasha (?Faska) - Dal'neretsjensk
Zasetsjka - bend Ol'ga
Tankist -
Berma - stad Ussurijsk
Lakirowka -

Aircraft types:
532 - type not specified
760 - SR-71
766 - RS-135
829 - Orion
630 - U-2
826 - Fighter (flight deck)
763 - Fighter
463 - Bomber Tu-16
539 - Tu-154
922 - An-12; An-24
822 - Helicopter
212 - Il-62

Signals:
296 - Aircraft on request
843 - Aircraft type
846 - Speed
848 - Altitude
596 - Removed from report
598 - Loss
144 - (unreadable in the document)
146 - Target practice
650 - Circling around
651 - Bording crossing
713 - Fault finding
717 - End fault finding
 50 - Downed
 00 - Attention
382 - Erroneous message

On other pages we found the explanation of a number of reporting codes:

From the index:
    1 Aircraft without signals for recognition
    5 Violator of the flight regime
    8 Practice target
    7 Border violator
    0 Control target
    9 Adversary in the air
    4 Director for malfunctions
183 Nuclear explosion on the ground
189 Nuclear explosion in the air

nrs SR-71 : 58, 59, 60

00 8710 62 7 08 44 5160 06
   843 8710 1 922 06
   846 8710 600 06
   296 8710 08016 06
   598 8710 44
   144 8502 0580 32
   146 4420 50 12

First line:		Fourth line:	
00	Attention	296	Signal request
8710	Number of the target	8710	Number of the target
62	Zone	08016	Request
7	Sector	06	Time
08	Large quadrant		
44	Small quadrant	Fifth line:	
5	Index	598	Loss
1	Quantity	8710	Number of the target
60	Height	44	Time
06	Time		
		Sixth line:	
Second line:		144	(unlclear)
843	Signal type	8502	Number of the target
8710	Number of the target	0580	New number
1	Quantity	32	Time
922	Aircraft type		
06	Time	Seventh line:	
		146	Practice
Third line:		4420	Number
846	Signal speed	50	Destroyed
8710	Number of the target	12	Time
600	Speed		
06	Time		

M21 VARIANTS

The following messages are all M21 variants. As far as I know these messages are not Russian but originate from various former-Warsaw Pact countries or former-Soviet republics. Because of their common past, a number of countries in Central Europe are using systems similar to the Russian PVO system. The problem with the used format is the time. Only the minutes are part of the message, so you cannot see in what time zone they are.

M21a: Variant 1

```
9910449815600   9911249815800   9912249815800   9913249814700
9914249814600   9915249814800   9916249813600   9917249814400
9918249814300   9921249818300   9906249069300   9908249825956
9908249018856   9907241763356   9907241763958   9909249018358
9908249017258   9906249069958   9906249068400   9908249014102
9920245897802   9911245897802   9912245897802   9913249814502
9914249814502   9915249814402   9916249811802   9917245891802
9918245891902   9918245088900   9910245088900   9919245099702
9920245089802   9921249814702   9922249814702   9923249815202
9923249814602   9922249815102   9923249814602   9922249815104
9921249814704   9916249814104   9917249814304   9915245898004
9914245898904   9912245897404   9911245897404   9910245897404
9920245099904   9909249814304   9908249814104
```

M21a: Variant 2

```
6861037295315
6862037.....
6863037287515
6864037381415
6865037392915511800
6866037391415
6861037267317
6862037294417
6863037287117
6864037381817510900
ar ar ar ar ar
```

M21a: Variant 3

```
CQ CQ CQ =311091236236 k
CQ CQ CQ =934609826372 k
CQ CQ CQ =631212736274 k
```

M21 / M21a VOICE STATIONS   (RADv / UADv)

You can find several recordings of these stations on the N&O website.

5097 kHz, 0830 UTC, 16 January 2006.

Mode: USB.
Female operator in Russian.

Text: 00 0001 384 92 in 59 2160 for 1129
438 0001 0484
0484 92 in 64 in 30
438 0484 0483
0483 29 in 69 for 31
0483 92 in 68 for 32 511 0483 700 50
0483 92 in 74 for 33
0483 92 in 79 for 34
0483 92 in 78
2160 for 1135
0483 384 96 in 54 for 36
0483 96 in 52 for 37
0483 96 in 46 510 38... break 510 50 for 38
0483 96 in 47 for 39
0483 96 in 99 for 44 510 0483 20
<etc>

M41 MORSE STATIONS

M41 belongs to the same family as M21. The format is similar to the various M21 variants as described in the document but there are some differences.

The main differences are:
-    The use of tactical callsigns
-    The use of the abbreviations WZD and ABV

WZD stands for the Russian word Wozduh (Воздух) which means AIR and is a radar plotting system. It is also a priority code when it is mentioned in a standard Russian military message.

ABV means "I repeat".

Examples:
-    This one has it all; WZD, ABV and a callsign. This is a typical plot message "LF2O LF2O LF2O ar LF2O LF2O LF2O WZD 722 3002 235 499971 90 05 ABV 722 3002 235 499971"
-    This one is a standard military message with WZD as priority code: "RCJG de RIW QTC 828 22 4 2240 828 = wzd =" followed by 5 figure groups.
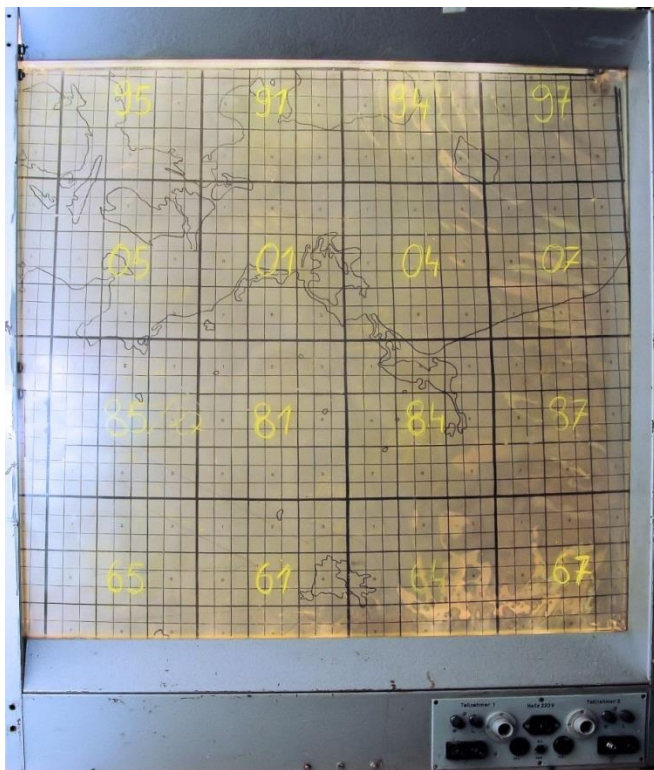
The following callsigns have been noted in the past few years:

37C5, 3AWH, 4K7U, 4SCH, 5EQB, NNO, 8OAW, 8XT2, ANSJ, EBXJ, EHJR, EQM2, F6UC, FNTO, GDSS, GOK2, GWKT, I2JV, KUQJ, L2MU, LF2O, MEW5, NOFJ, ON8A, PMZW, PSNN, PWZW, Q4O6, QJ9M, TRL5, VQK4, WLSB, XL1A, YJW3, YMG8, YTX2

Picture: Wozduh screen
Source: http://www.898vbdbat.nl/

SAMPLE MESSAGES

- EQM2 EQM2 EQM2 EQM2 646667833328 49647
- wzd 72219 49964 15523 11128 72100 1805 abv 72219 49964 15523 11128 72100 1805...
- GWKT GWKT GWKT = ZOP ZDF +
- VVV 3AWH WZD 199499725 4984 212 etc
- RZTK WZD 72266 70655 5F ABV 72266 etc
- LF2O LF2O LF2O ar LF2O LF2O LF2O WZD 722 3002 235 499971 90 05 ABV 722 3002 235 499971 90 05 511 3002 8000 6 ar
- WZD 850258056 2302 8XT2 WZD 850258056 3204 ...
- vvv vvv QJ9M QJ9M QJ9M wzd 7221...
- vvv vvv WLSB wzd 7221959979389 abv 7221959979389..... WLSB WLSB WLSB +

9600248507517   9601248564617   9602875983617   96636000000
9606245875817   9607245063117   9600248565119   9600248569919
9602874592219   9603874596519   9604874519119   9605874518519
9606245865419   9607245064419   9600248564719   9600248564719
9602874687819   9603874095221   9606245867521

FOR ZMB ZMB 444406 = 44972290 rpt
FOR ZMB ZMB 444406 = 44972290 ar

Note:
Sometimes it sends QTCs and XXX messages; no time stamps; time even or odd; no identifier; sometimes messages are preceded by a prefix.

The messages unraveled: 9908249814104

Preamble	Operator	Coordinates		Time
99	082	4981	41	04

8703242592424 8706242533124 8705241.95124 8706242862424
8708242846224 8709242042324 8710242899724 4871087104
8703242599226 4870387034   8704242523826 4870487044
870524258.826 8706242863726 8708242548826 8709242042926
8705242596728 4870587052   870824284.828 8705242042628
8708242897730 8709242046.30 4870987094

The messages unraveled: 8703242599226   4870387034

	Preamble	Station	Operator	Coordinates		Time
		87	032	4259	92	26
	4	87	038	7034		

.... 7761617 43TT 15 17/
722194 94T97 37 9731287 ...T 15 18/
722194 95T82 38 8195167 4TTT 15 19/
722194 95T92 38 T612617 434T 15 2T K

... 1949918233251312871270 0730 J73X J73X J73X ar

XL1A XL1A wzd 7221949579 ... k
NOFJ NOFJ wzd 722194950 ... k
EHJR WZD 72219499601555 54 12872120 1754
= 722 194997115520 7312872300 ...
758 722 1949962 155 274716571 0901 756 K. K84 EEEEE EHJV EEEE

---

xxx paba 17821 poseredryj 9524
xxx paba 17821 poseredryj 9524
xxx paba 17821 poseredryj 9524
xxx kwow don 789 k
xxx kwow tir 703 k
8705268682820
8706268487820
8701268686420
8702368684222

FREQUENCIES

M21	M21	M21	M21a	RADv	UADv	M41
2219.5	4558	5837.5	3430	3374	2762	2507.5
2222	4559	5860.5	3770	4074	3314	2738.5
2317	4560	5873	5223.5	4084	4460.5	3182.5
2738.5	4574.5	5877	5366.5	4144	5131	3301
3199	4577	5918.5	7402	4800.5	5260.5	3835
3213	4613	5920	7689	5097	5765	4055
3222.5	4627	5921.5	7804.5	5190		4397.5
3228	4631	6321.5		5293		4418
3228.5	4631.5	6330		5680		4444.5
3246.5	4632	6374		5696		4484.5
3259.5	4639	6425.5		5899		4485
3281	4802.5	6776		6195		4603
3289	4811	6807.5		6268		4626.5
3292.5	4831	6823.5		6593		4959
3294	4864	6828		6864		4968
3301	4865.5	6864.5		7211		4985
3314	4868	6881.5				4993
3322	4885	6906.5				5078
3323	4950	6935				5125.5
3330	4951.5	6956.5				5210.5
3360.5	4959	6978				5372
3361	5011	6979.5				5400
3363	5015	7000				5402.5
3386	5063	7166				5733.5
3561.5	5097	7190.8				5774
3651	5131	7311.5				5792
3737	5139.5	7373				5804.5
3801	5141.5	7439				7046
3838	5154	7558.5				7048
3947	5195	7633				7664
4013	5198	7794				7782
4014	5201	7808				10158
4015	5220	7834				13482
4032	5221.5	7913.5				
4071.5	5230	7914				
4082.5	5254	7950				
4096	5313	7987				
4133	5315	7994				
4145	5330	8015				
4165	5357	8156				
4171.5	5367.5	8701				
4172	5371	9164				
4191.5	5372	9222				
4246	5468.5	9278				
4391	5690	9951.5				
4496	5731.5	10316				
4505	5772	10336				
4505.5	5784	11096				
4542	5820	12337				

SOURCES / RELATED WEBSITES

WUN, UDXF and various radio monitors   http://www.udxf.nl
Numbers & Oddities   http://numbersoddities.nl
Fritz Nusser   http://www.astrosol.ch/
Войска противовоздушной обороны страны, М., 1968
50 лет Вооруженных Сил СССР, М., 1968
Federation of American Scientists   http://www.fas.org
RIA Novosti http://ria.ru/
Gabala pictures from Wikipedia and the forum on http://www.irandefence.net
Former 898 VbdBat / RadCie   http://www.898vbdbat.nl/
Agentura http://www.agentura.ru
Novaya Gazeta http://en.novayagazeta.ru/
Moscow News http://themoscownews.com/

All information in this document was submitted by independent radio monitors or has been obtained from public available sources and public sites on the web. Wherever data was obtained via the web or elsewhere, references and/or links to these sources have been noted.

Portions of this document may be used in electronic or printed hobby bulletins without prior approval so long as "Numbers & Oddities" is credited as the source. This newsletter may NOT be utilized, partly or wholly, in any other COMMERCIAL media format without the written permission of the Editor. Any breach of this may result in action under international copyright legislation.

Relevant mailing lists:

Utility DXers Forum (utility and spooks related logs)
To become a member go to http://groups.yahoo.com/group/udxf/ and follow the instructions.
Website: http://www.udxf.nl

Spooks (spooks related info and logs)
Go to the web interface http://mailman.qth.net/mailman/listinfo/spooks to subscribe. Fill in the form and follow the instructions that will be mailed to you.