



Defense Information Systems Agency

Department of Defense

High Frequency (HF) Test Facility & Network Modeling Update (July 2006 to January 2007)

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HF Government POC
1 February 2007**



Statement

DISCLAIMER

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Agenda

- **JITC Vision and Mission**
- **High Frequency Test Facility (HFTF) Background**
 - **History**
 - **Facilities**
 - **Standards and Test Capabilities**
 - **Certification History**
 - **Current and Planned Test Support**
 - **Test Activity Summary**
 - **Certifications Issued**
 - **Conformance / Assessment Tests (CY 07)**
 - **Test Procedures**
- **GenetScope / NETSIM 2**



JITC Vision and Mission

Vision: A world-class test and evaluation organization that advances global net-centric testing in support of warfighting capabilities

Mission: JITC provides a full-range of agile and cost-effective test, evaluation, and certification services to support rapid acquisition and fielding of global net-centric warfighting capabilities



High Frequency Test Facility (HFTF) Background

- The High Frequency Test Facility was established in 1989
- The HFTF provides both a testing laboratory and an operational facility, supporting conformance and interoperability testing



HFTF History

- **HF test support began in 1989**
- **Historical HF requirements**
 - MIL-STD 188-110A (30 Sep 1991)
 - MIL-STD 188-141A Notice 2 (10 Sep 1993)
- **Present emphasis on HF requirements**
 - MIL-STD 188-203-1A (May 1982)
 - MIL-STD 188-110B (27 Apr 2000)
 - MIL-STD 188-141B (31 Aug 2001)
 - STANAG 5066 (Version 1.2)



HFTF Facilities

- **Operational Facility**
 - 3 Level SCOPE Command System

- **Conformance and Interoperability Test Laboratory**
 - MIL-STD and STANAG Testing
 - Automated and Manual Testing
 - Legends Test Network
 - 14 Test Management Systems
 - Automated Testing
 - Central Data Management
 - Channel Simulation (HF and Audio)
 - Network Simulation
 - Computer Modeling and Analysis
 - Icepack
 - GenetScope



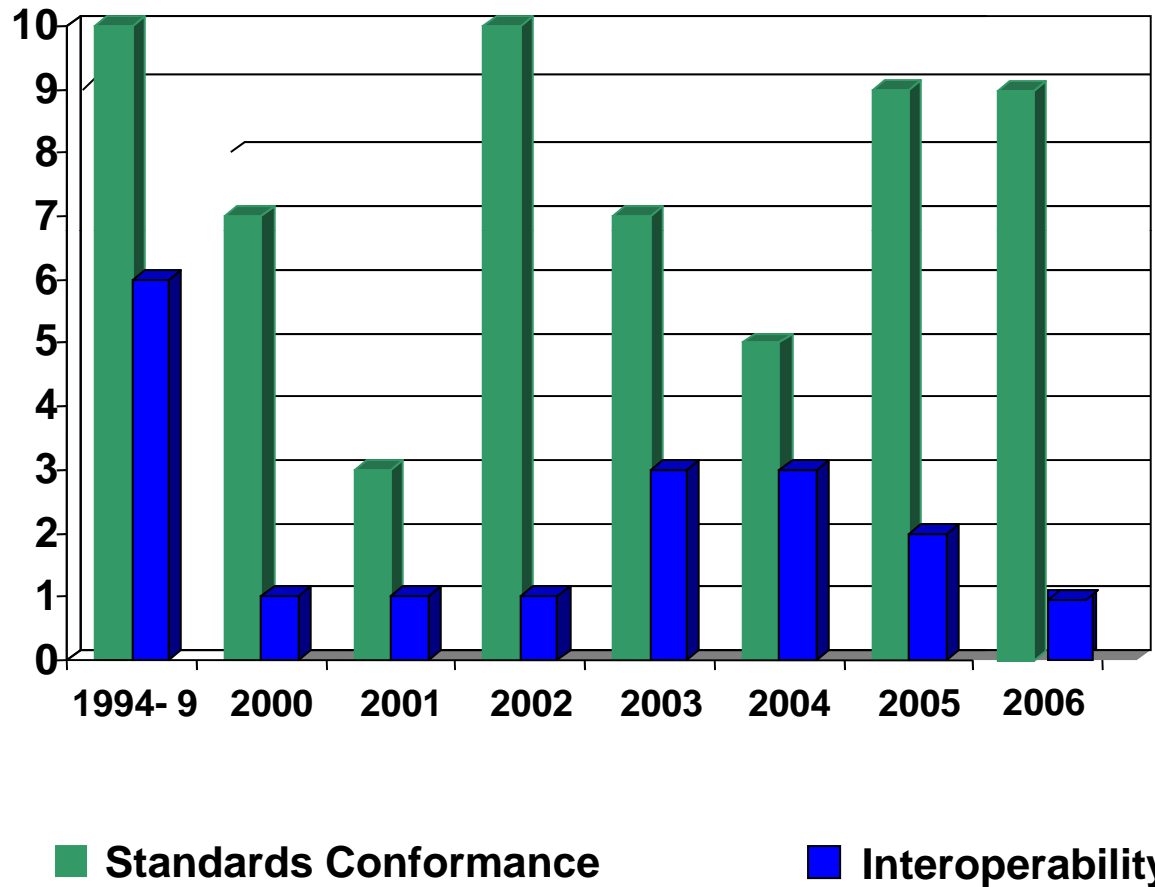


HFTF Standards and Test Capabilities

- **HF Test Plans (Existing or under Development)**
 - **MIL-STD 188-110B (Serial Mode, 39 Tone, and above 2400 bps)**
 - **MIL-STD 188-141B (Basic Radio, ALE, and Link Protection)**
 - **STANAG 4203 (HF Radio Conformance Test)**
 - **STANAG 5511 (HF Radio Conformance Link 11 Requirements)**
 - **STANAG 5066 (Data Protocol for E-mail over HF)**
 - **STANAG 4529 (Narrowband width Serial Mode Waveform)**
 - **STANAG 4285 (Serial Mode Waveform)**
 - **STANAG 4539 (Technical Standards for Non-Hop HF Communication Waves)**
 - **MIL-STD 188-203-1A (Interoperability and Performance Standards for TADIL-A)**



HFTF Certification History





HFTF Current Test Support

- **Current Test Support**
 - **SCOPE Command**
 - **Spiral 2, Type 3**
 - **Genetscope/DEVS**
 - **US Navy AN/URC-131C**
 - **Interop Assessment**



HFTF Planned Test Support

- **Planned CY07 Test Support**
 - **SPAWAR AN/URC-131 MIL-STD 188-141B Interoperability Assessment**
 - **DATRON RT 7700 MIL-STD 188-141B Standards Conformance Certification**



Test Activity Summary (July 06 – January 07)

- **MIL-STD 188-110B**
 - RapidM RM 6 (Sponsored by Datron World Communications)
- **MIL-STD 188-141B**
 - Rockwell Collins HF-121C
 - Harris AN/URC-131C
- **Interoperability Assessment**
 - HF 121C
 - Harris AN/URC-131C
- **Responsible Test Organization for SCOPE Command**
 - Developing updated network model
 - Test plan development
 - Acceptance test support



Conformance Certifications (In Process) (July 06–Jan 07)

- **MIL-STD 188-110B**
 - RapidM RM 6 (Sponsored by Datron World Communications)
- **MIL-STD 188-141B**
 - Rockwell Collins HF-121C
 - Harris AN/URC-131C
- **MIL-STD 188-203-1A**
 - DRC MX-512PA (part of HF-121C)

DISA Conformance / Assessment Tests CY07

- **MIL-STD 188-110B Tests**
 - None
- **MIL-STD 188-141B Tests**
 - Datron RT-7700
- **MIL-STD 188-203-1A Tests**
 - None



HFTF Test Procedures

- **Test Procedures (under development or revision)**
 - MIL-STD 188-110B
 - MIL-STD 188-141B (Appendix C)
 - MIL-STD 188-203-1A
 - MIL-STD 188-148A
 - STANAG 5066



GenetScope / NETSIM 2

HF Radio Simulation on a Worldwide Basis

- **Background**
- **Simulation requirements**
- **GenetScope and NETSIM2**
- **How do you model the world?**
- **Scenario based simulation**
- **Data analysis**



GenetScope / NETSIM 2

The High Frequency Global Communications System supports:

- VIP Fleet - MYSTIC STAR
- U.S. Air Force Global HF System
- Defense Communications System (DCS) HF Entry
- Systema de Informatica y Telecomunicaciones de las Fruerzas Aereas Americanas (SITFAA) - Information and Telecommunications System of the American Air Forces

Communications Support:

- Foreign Dignitaries
- State Department
- White House
- Joint Chiefs of Staff (JCS)
- Defense Information Systems Agency (DISA)
- Air Mobility Command (AMC)
- Air Combat Command (ACC)
- Air Force Space Command (AFSPC)
- U.S. Air Forces Europe (USAFE)
- Pacific Air Forces (PACAF)
- Air Weather Service (AWS)
- United States Navy
- North Atlantic Treaty Organization (NATO)
- Civil Air Patrol
- Department of Homeland Defense





GenetScope / NETSIM 2

- **Simulation Requirements**
 - **The HFGCS is offering expanded capabilities to users**
 - **Voice connection to the DISN**
 - **NIPRNET/SIPRNET Email**
 - **Ground based in addition to Aircraft**
 - **Analysis of coverage**
 - **Analysis of location of new stations**
 - **Analysis of assets**
 - **Equipment**
 - **Antennas**
 - **Channels**
 - **Analysis of new capabilities**
 - **Data Protocols**
 - **MELP**
 - **Terrestrial Network**
 - **VOIP**



GenetScope / NETSIM 2

- **DEVS**
 - Discrete Event System Specification
- **GenetScope (Generic Network Model for Systems Capable of Planned Expansion)**
 - Architecture to simulate complex radio and protocol systems
- **NETSIM 2 (Second Generation HFGCS Model)**
 - Overlay of HFGCS on GenetScope

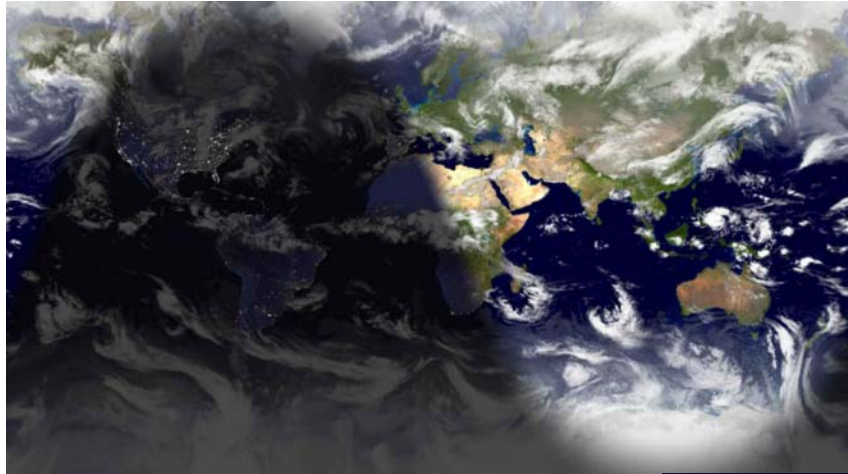


GenetScope / NETSIM 2

- **How do you model the world?**
 - Location
 - Equipment specifics
 - Power
 - Antenna
 - Date
 - Time
 - Sunspot number
- **Propagation?**
 - Predictable using industry standard programs

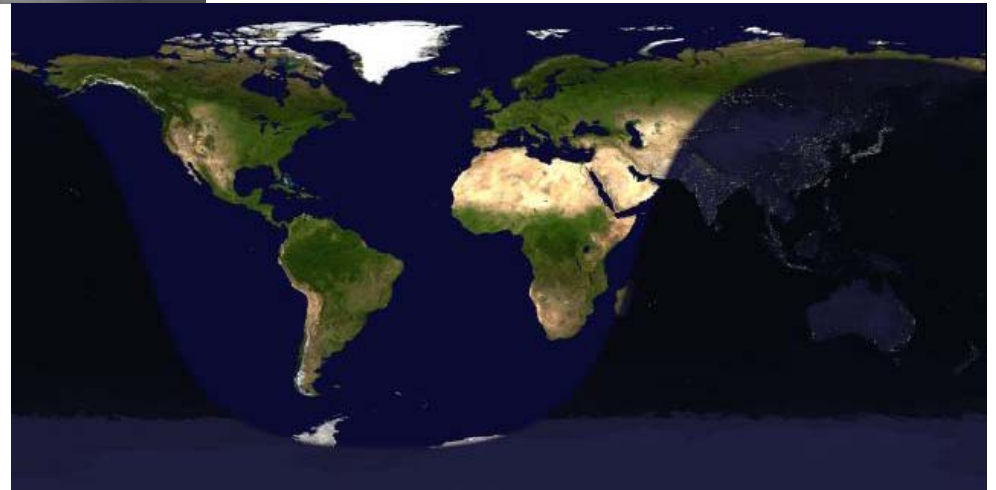


GenetScope / NETSIM 2



Location
Date
Time
Solar Activity
Solar Cycle

Transmit Power
Receive Noise
Bandwidth
Signal to Noise



HFGCS Worldwide Network

Physical Map of the World, April 2005

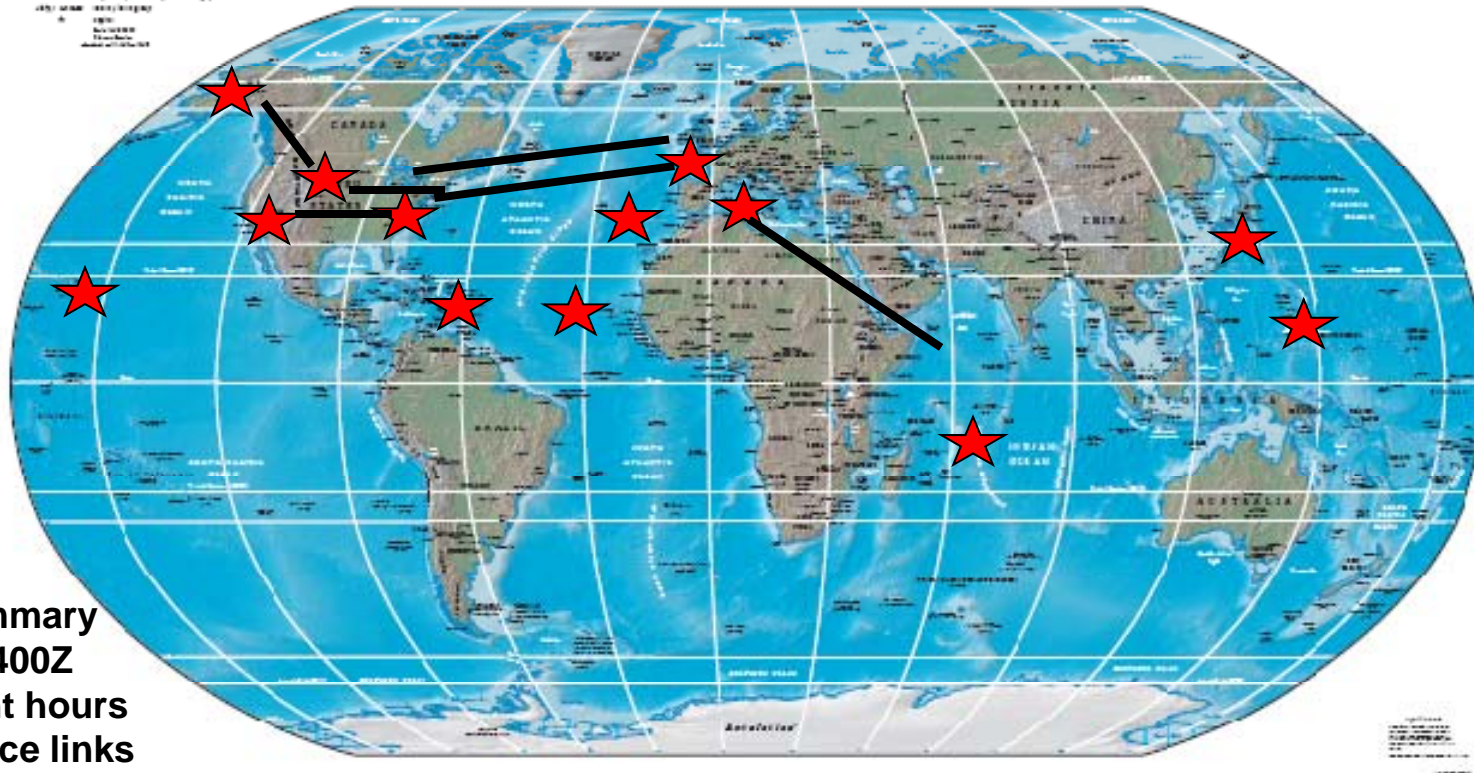




GenetScope / NETSIM 2

HFGCS Worldwide Network

Physical Map of the World, April 2005



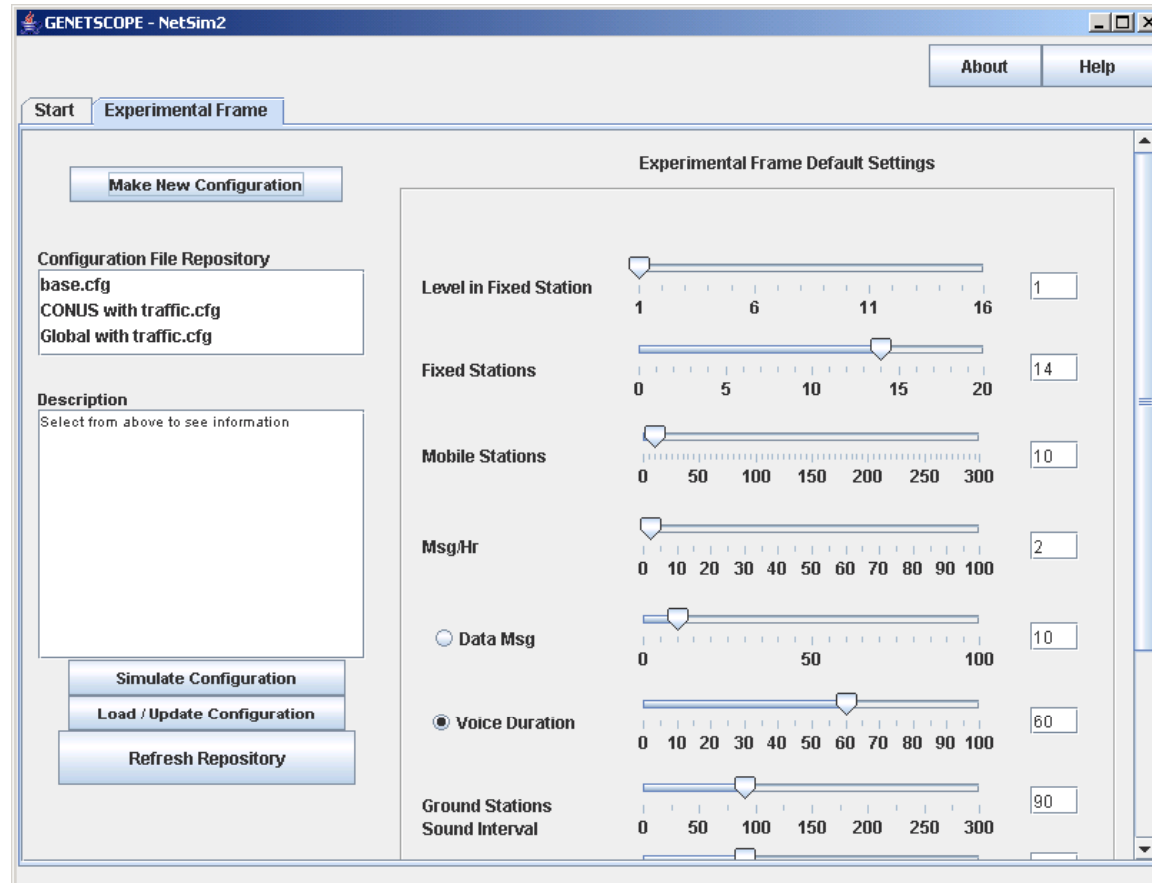
Summary

- 1600-2400Z
- 33 flight hours
- 151 voice links
- 76 links on first attempt
- 10 of 14 stations used
- 6 of 9 channels



GenetScope / NETSIM 2

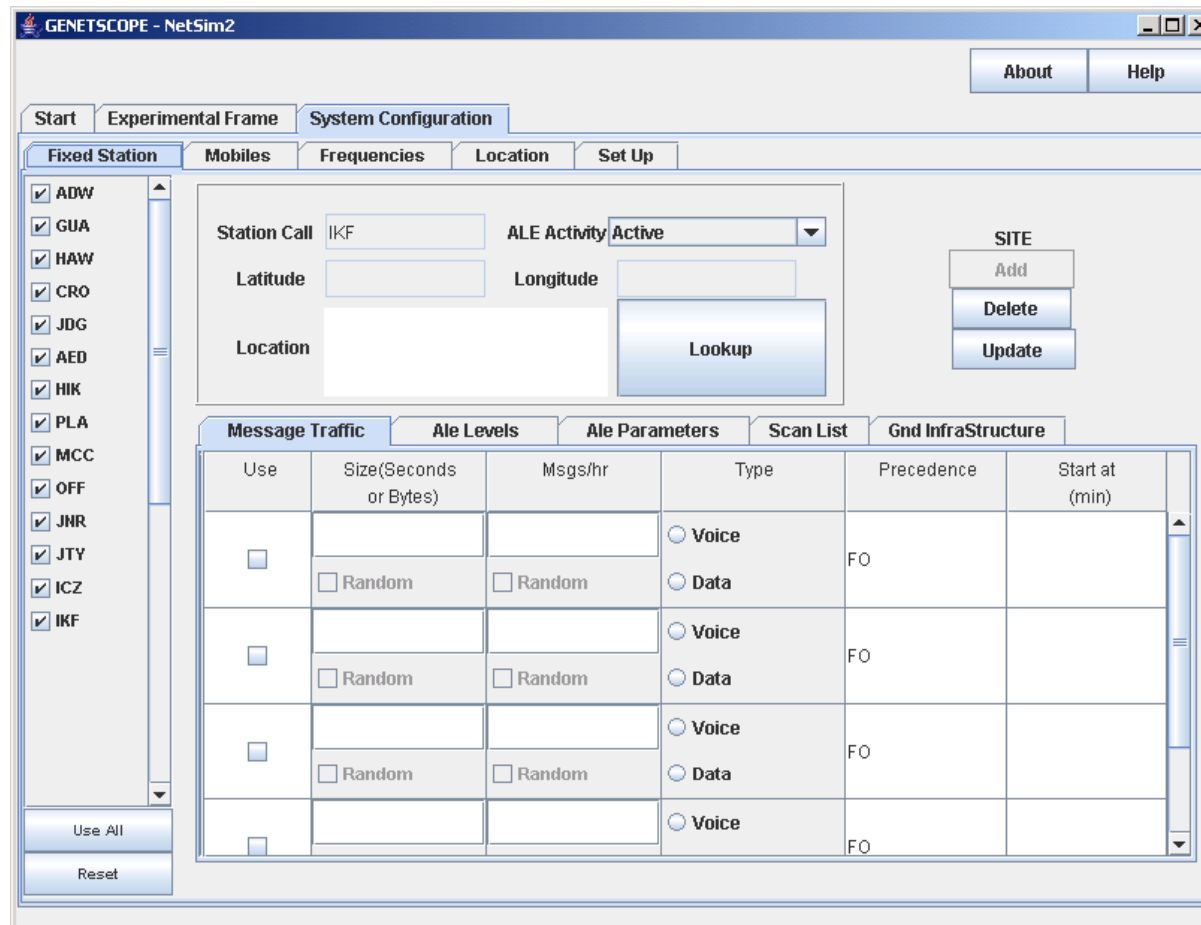
- Experimental frame
 - Scenario plan





GenetScope / NETSIM 2

- Fixed station design





GenetScope / NETSIM 2

- Mobile planning

GENETSCOPE - NetSim2

Start Experimental Frame System Configuration

Fixed Station Mobiles Frequencies Location Set Up

| Air Mobility Command (AMC) | | Special Air Mission (SAM) | Air Combat Command (ACC) | Ground Based Radio System (GBRS) |
|----------------------------|----------|---------------------------|--------------------------|----------------------------------|
| Cargo | Tanker | AWACS E3 | B52 | TALCE |
| C5: 10 | KC135: 0 | VC 25 Air Force 1: 0 | B2: 0 | CAP: 0 |
| C17: 0 | KC10: 0 | E4B: 0 | B1: 0 | Tactical: 0 |
| C130: 0 | | C32: 0 | Fighter: 0 | Other Aircraft: 0 |
| C-130E: 0 | | C37: 0 | | Navy: 0 |
| C-130H: 0 | | | | FEMA /SHARES: 0 |
| C-130J: 0 | | | | State Depart...: 0 |
| C-130J-j30: 0 | | | | |

Attention: The total number of aircraft must be 10. The current number of aircraft is 10.

CAUTION: If loading from previous configuration file, changing the plane Type might result in loss of flight-detail information. You may have to enter the flight details again. Adding new planes in current loaded configuration (if loading an old file) will not result in losing any information.

Enter Details



GenetScope / NETSIM 2

- Automated scenario management
- Traffic generation
- Movement of mobiles between waypoints
- Propagation for any communications requirement anywhere in the world

- Just like the old days

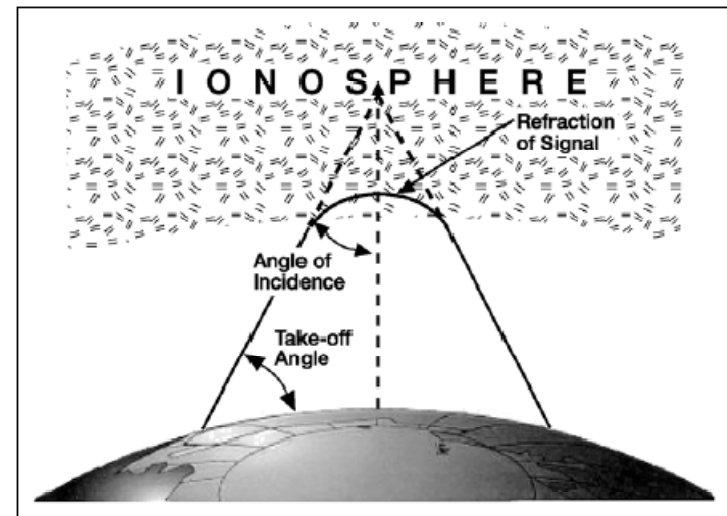


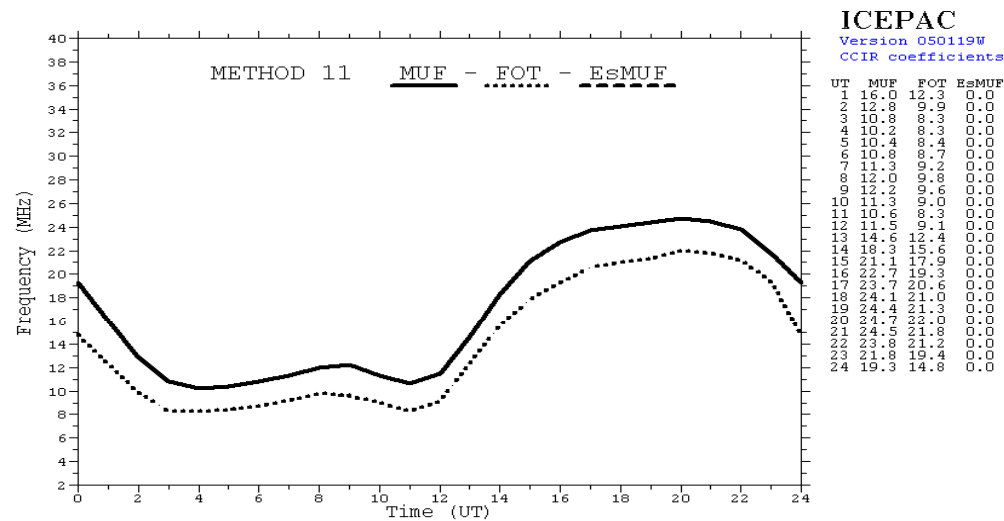
Figure I-2. Incident Angle



GenetScope / NETSIM 2

- Pick two locations
- Select date, time, sun spot number

```
FEB 2006          SSN = 10.      Qeff = 0.0      Minimum Angle 0.10 deg
ANDREWS AFB      FT. HUACHUCA      AZIMUTHS      N. MI.      KM
38.80 N 76.88 W - 31.55 N 110.33 W 265.40 65.72 1687.9 3125.8
XMTR 2-30 2-D Table [DEFAULT\CONST17.VOA ] Az= 0.0 OFFaz=265.4 4.000kW
```



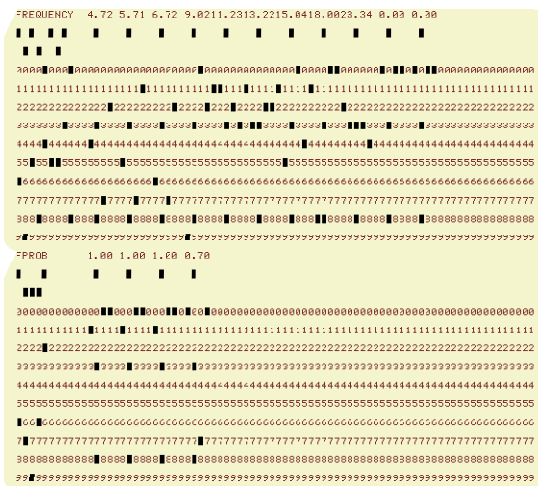
NTIA/ITS



GenetScope / NETSIM 2

- What if you have 14 fixed stations and several dozen aircraft worldwide?
- Repeat the process Over and Over
- The IONCAP prediction program is 30 years old.

IONCAP



30 years ago

DEVSJAVA

```
public void InsertSelfEvent(EventStruct theEvent_) {
    EventStruct theEvent = NewEvent().clone(theEvent_);
    theEvent = theEvent_;
    int entity = theEvent.EventEntity;
    double eventTime = doubleFormat.niceDouble(theEvent.EventTime);
    theEvent.srcEntity = entity; //by saurabh
    arrived.put(new doubleEnt(eventTime), theEvent);

    holdUntilNextJob();
}
```

Today



GenetScope / NETSIM 2

- **Propagation program output for each communications attempt**

- FEB 2006 SSN = 10. Qeff= 0.0 Minimum Angle 0.10 deg
- ANDREWS AFB FT. HUACHUCA AZIMUTHS N. MI. KM
- 38.80 N 76.88 W - 31.55 N 110.33 W 265.40 65.72 1687.9 3125.8
- XMTR 2-30 2-D Table [DEFAULT\CONST17.VOA] Az= 0.0 OFFaz=265.4 4.000kW
- RCVR 2-30 2-D Table [DEFAULT\SWWHIP.VOA] Az= 0.0 OFFaz= 65.7
- 3 MHZ NOISE = -114.0 DBW REQ. REL = .90 REQ. SNR = 25.0 DB
- MULTIPATH POWER TOLERANCE = 3.0 DB MULTIPATH DELAY TOLERANCE = 0.100 MS
-
- 1.0 16.0 6.1 7.2 9.7 11.9 13.7 15.4 17.7 21.6 25.9 0.0 0.0 FREQ
- 1F2 2F2 2F2 2F2 1F2 1F2 1F2 1F2 1F2 1F2 - - MODE
- 4.1 12.7 13.1 14.1 1.8 2.3 3.1 4.1 4.1 4.1 - - ANGLE
- 10.9 11.1 11.1 11.1 10.7 10.8 10.8 10.9 10.9 10.9 - - DELAY
- -101 -87 -87 -90 -103 -102 -99 -111 -150 -214 - - S DBW
- -139 -127 -129 -133 -135 -137 -138 -140 -143 -145 - - N DBW
- 38 40 42 43 32 35 40 29 -8 -70 - - SNR
- 14 -2 -2 5 10 13 12 23 60 121 - - RPWRG
- 0.74 0.92 0.93 0.84 0.70 0.71 0.76 0.58 0.05 0.00 - - REL
- 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 - - MPROB



GenetScope / NETSIM 2

- **Scenario based simulation**
- **A small scenario**
 - 6 stations
 - 2 aircraft
 - 9 channels
 - 1 hour
- **Results**
 - 217 ALE activities (sound, listen, call)
 - 54 transmissions (sound, link)
 - 723 calls to the prop program
 - 2 ALE links
- **2 hours to run**



GenetScope / NETSIM 2

- **A large scenario**
 - 14 stations
 - 100+ aircraft
 - 9 channels
 - **24 hours**
- **Results**
 - 10,000+ ALE activities (sound, listen, call)
 - 5,000 transmissions (sound, link)
 - 100,000 calls to the prop program
 - 500 ALE links
- **72 + hours to run**



GenetScope / NETSIM 2

Define Fixed Stations and Mobiles

Fixed Station

```
F ADW 38.817 -76.867 -114 A Andrews
ALE 1
RT 1
PA 1
ANT 1
Bcast
#T 0 2 60 10 V ~2 msg/hr to gnd ~1.0 minutes ea
C 2 4 8 10 11 14 17 AFALE
```

Mobile

```
M 150 35.466 -97.533 S C5 455684
T 0 3 60 10 V
T 0 1 20 250 D
L ADW OFF MCC HIK AED
W 0.1 35.466 -97.533 A CITY OK USA TINKER AFB USAF
W 4 39.166 -75.533 S DOVER DE USA DOVER AFB USAF
C 2 4 8 10 11 14 17 AFALE
```



GenetScope / NETSIM 2

GENETSCOPE - NetSim2

About Help

Start Experimental Frame Run/Simulate

Run Abstract Model Resume Simulation Pause Terminate

Debugging mode Debugging mode

Simulating configuration file: **CONUS with traffic** SSN: **32** Threshold SNR (dB): **-6** Start Time (GMT): **16:00:00**
 Default Scanlist: **AFALE** Ground Station Sounding Interval (min): **90** End Time (GMT): **01:00:00**

Obtained Statistics at (hh:mm:ss): **00:00:59.3** from start of simulation time

Last Transmission at: 00:00:35.332
 Sound transmitted by ADW on channel 6

Last Sound heard at: 00:00:41.067
 By station 155 Level 1 from station ADW on channel 6 with LQA score of 29

Total transmissions: **1**

Total Heard Sounds: **4**

Best SNR detected so far: **16.999** dB on Channel **6** at 00:00:38.283

Total Messages (includes retransmission)

| | | | | |
|-------|-------------|---|-----------|---|
| Voice | Transmitted | 0 | Delivered | 0 |
| Data | Transmitted | 0 | Delivered | 0 |

Total Stations

| Active | Silent | Off | No Traffic (Mobiles) |
|-------------|-------------|-----|----------------------|
| OFF HIK HAW | 155 154 153 | | |
| ADW ICZ CRO | 152 151 150 | | |
| IKF JDG JTY | 159 158 157 | | |
| PLA JNR GUA | 156 | | |

NOTE:
 The Simulation Clock above should be continuously advancing. If it is not advancing for more than 60 seconds, the system is in locked-in mode.
 Kindly run the simulation again in Debugging mode and report it to the ACIMS development center.



GenetScope / NETSIM 2

- **Data Analysis**
 - 5 user logs
 - Importable into excel

ALE Log

| Sta | Level | At Time | on | Sta | Status | | | |
|-----|-------|--------------|----|------|--------|-------------|----------------|-----------|
| 1 | 1 | 00:00:33.133 | | Ch:6 | to:0 | Listening | | |
| 1 | 1 | 00:00:35.332 | | Ch:6 | to:0 | Sounding | | |
| 150 | 1 | 00:00:36.283 | | Ch:6 | to:0 | Reading Snd | SNR (dB): 19.0 | Score: 36 |
| 11 | 1 | 00:00:36.783 | | Ch:6 | to:0 | Reading Snd | SNR (dB): 23.0 | Score: 44 |
| 10 | 1 | 00:00:39.783 | | Ch:6 | to:0 | Reading Snd | SNR (dB): 28.0 | Score: 50 |
| 150 | 1 | 00:00:41.067 | | Ch:6 | to:0 | Reading Snd | SNR (dB): 19.0 | Score: 36 |
| 11 | 1 | 00:00:41.567 | | Ch:6 | to:0 | Reading Snd | SNR (dB): 23.0 | |



GenetScope / NETSIM 2

Channel Log

| Chnl | Start time | End time | Src | Dest | Power | |
|------|--------------|--------------|-----|------|-------|--|
| 6 | 00:00:35.332 | 00:00:41.793 | 1 | 0 | 36.0 | |
| 9 | 00:01:24.418 | 00:01:30.879 | 6 | 0 | 36.0 | |
| 4 | 00:02:24.845 | 00:02:31.306 | 11 | 0 | 36.0 | |
| 6 | 00:03:57.252 | 00:04:03.713 | 11 | 0 | 36.0 | |
| 3 | 00:05:21.99 | 00:05:28.45 | 10 | 0 | 36.0 | |
| 9 | 00:07:31.685 | 00:07:38.146 | 7 | 0 | 36.0 | |
| 5 | 00:07:41.791 | 00:07:48.252 | 150 | 0 | 26.0 | |

Linking Log

| Src | Dest | Chnl | Qual | Start Time | End Time | Time taken |
|-----|------|------|------|--------------|--------------|------------|
| 150 | 10 | 4 | 50 | 00:26:00.20 | 00:26:13.191 | 12.99 |
| 150 | 10 | 4 | 48 | 00:46:00.199 | 00:46:13.19 | 12.99 |



GenetScope / NETSIM 2

LQA Log (Link Quality Analysis – Used for Channel Selection)

LQA Table from ALE 190 level 1 at station 150 at hour1

| Sta | Ch | 1, | 2, | 3, | 4, | 5, | 6, | 7, | 8, | 9, |
|-----|----|----|-----|-----|-----|----|-----|----|----|----|
| ADW | | 0, | 0, | 0, | 33, | 0, | 26, | 0, | 0, | 0, |
| AED | | 0, | 0, | 0, | 0, | 0, | 0, | 0, | 0, | 0, |
| HIK | | 0, | 0, | 0, | 0, | 0, | 0, | 0, | 0, | 0, |
| MCC | | 0, | 0, | 0, | 0, | 0, | 25, | 0, | 0, | 0, |
| OFF | | 0, | 45, | 41, | 46, | 0, | 0, | 0, | 0, | 0, |
| JNR | | 0, | 0, | 0, | 0, | 0, | 0, | 0, | 0, | 0, |

LQA Table from ALE 182 level 1 at station JNR at hour1

| Sta | Ch | 1, | 2, | 3, | 4, | 5, | 6, | 7, | 8, | 9, |
|-----|----|----|----|----|-----|----|-----|----|----|----|
| ADW | | , | , | , | 29, | , | 33, | , | , | , |
| AED | | , | , | , | , | , | , | , | , | , |
| HIK | | , | , | , | , | , | , | , | , | , |
| MCC | | , | , | , | , | , | , | , | , | , |
| OFF | | , | , | , | , | , | , | , | , | , |



GenetScope / NETSIM 2

Message Log

| Msg ID | Dest | Src | Pri | Len(s) | Time Req | Established | Done at | If Failed |
|--------|------|-----|-----|--------|--------------|--------------|--------------|-----------|
| 150000 | 10 | 150 | 10 | 60 | 00:26:00.098 | 00:26:13.289 | 00:27:13.486 | VOICE |
| 150001 | 10 | 150 | 10 | 60 | 00:46:00.099 | 00:46:13.289 | 00:47:13.487 | VOICE |

Prop Log (used for propagation validation)

Listening at station: ADW to: 152 at: 00:00:35.499

Running PropString: DynPropString: 16 4 2006 32114 ADW 38.81N 76.86W 152 47.61N 117.3W

4.7 5.7 6.7 9.0 11.2 13.2 15.0 18.0 23.3 0.0 0.0 FREQ

-96 -58 -28 -2 2 -10 -1 -37 - - SNR

Frequency 15.04 MHz index: 6 SNR value for Freq[6]= -10.0



GenetScope / NETSIM 2

- **GenetScope / NETSIM2**
 - Completed Phase 1 of development 16 April 2006
 - Beta provided to the Air Force for review
- **Phase II (February 2007)**
 - Modeling of entire station
 - (up to 16 radios)
 - Different antennas
 - Connection to DISN
 - Multiple missions
 - Traffic generation
 - Email and data protocols
- **Phase III**
 - Distributed processing



JITC

POC / Web Page Information

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GLOBAL ALE Network:
Callsigns: JTF, JTA, and JTC

JITC's Homepage:
<http://jitic.fhu.disa.mil> with link to HFTF web page or
<http://jitic.fhu.disa.mil/it/cert.htm>

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www.disa.mil
