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An Innovative Signal Distribution System That Allows EMI-Free Communications For Navy Ships

Mike Maiuzzo
Liberty University

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ASSURING MISSION SUCCESS

An Innovative Signal Distribution System That Allows EMI-Free Communications For Navy Ships

*Ted Harwood, Sentel Corporation
Rich Adams, SPAWAR Systems Center, Pacific
Mike Maiuzzo, Liberty University*

San Diego, California
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BACKGROUND

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- **Navy Ship Communications Systems Have Cosite EMI Problems Due to:**
 - **Adjacent-Signal EMI**
 - Receiver Nonlinear Desensitization
 - Cross Modulation
 - Reciprocal Mixing
 - Transmitter Noise
 - **Out-of-Band EMI**
 - Transmitter Spurious Emissions/Harmonics
 - Receiver Spurious Responses
 - **Intermodulation Products**
 - Structural Generated IM Products
 - Receiver IM Products
 - Transmitter IM Products

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**BASELINE TECHNOLOGY:
COLLOCATED
VHF FREQUENCY HOPPING EMI**

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Range of Victim Receiver on Command and Control Vehicle

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**MISSION CRITICAL
TECHNOLOGY**

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- Eliminate EMI Issues
- Manage Up To 16 SINCGARS, 24 HAVEQUICK
- Maintain Receiver Range
- Smaller Footprint
- Smaller Numbers of Antennas
 - 1 Transmit
 - 1 Receive
- JTRS Compatible

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RF DISTRIBUTION GENESIS

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- SENTEL IRAD In Collaboration With SPAWAR FOR VHF SINGARS (1999 – 2003)
- SPAWAR SBIR PH I/II/III FOR UHF LOS/HAVE QUICK (2004 – Present)

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COMB LIMITER COMBINER (CLIC)

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CLIC Loss = 0 dB

The CLIC Objectives:

- Increase Number of Receivers Connected to a Single Antenna
- Mitigate Interference With Limited Impact on Receiver Sensitivity

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COMB LIMITER AMPLIFIER COMBINER (CLAC)

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TX ant

output bandpass filters

BPF

power amp

BPF

input bandpass filters

BPF

power amp

BPF

linear combiner

Hopping Filter

Tx₁

Hopping Filter

Tx₂

Hopping Filter

Tx₃

Hopping Filter

Tx_n

Replaces High Power Amplifier (HPA) And Multicouplers

The CLAC Objectives:

- Increase Number of Transmitters Connected to a Single Antenna
- Mitigate Interference With Limited Impact on Transmitter Efficiency and Power
- Statistically Keep One Signal In One Amplification Path At One Time

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IM GROWTH WITH # OF USERS

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MONTE CARLO SIMULATION RESULTS

APPROX # OF SINGULAR CHANNELS CONTAINING AT LEAST ONE IM PRODUCT

— 3rd-order

- - 5th-order

NUMBER OF ACTIVE TRANSMITTERS IN THE SAME AMPLIFIER
(OR ANY NONLINEAR DEVICE) AT THE SAME TIME

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Speaker Name

MATLAB EMC Analysis Model (MEMCAM)

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- Model Utilizes Standard MATLAB C Code
- Models CLIC / CLAC Architecture At Component Level
 - Evaluates Linear and Non Linear Characteristics Similar To JSC Cosite Analysis Model (COSAM)
 - Propagation Path
 - Receiver Selectivity and Susceptibility
 - Receiver Adjacent Signal (RAS)
 - Transmitter Emission Spectrum
 - Transmitter Adjacent Signal (TAS)
 - Intermodulation Products
 - Transmitter and Receiver
- Allows Trade-Offs At Component Level To Determine Optimum System Performance
- Validated Using Measured Data

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MEMCAM VALIDATION

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UHF SIZE WEIGHT AND POWER (SWAP)

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LEGACY
(24 UHF LOS - OA-9277/SRC)

AM-7584/USC-61
(24 100 W Amps)

(6) OA-9277/SRC
(24 Radio/6 Antennas)

5 Racks >> 1 2/3 Rack

AILES
(24 HQ)

(1) AILES
(24 Radio/2 Antennas)

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SUMMARY

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- **CLIC-CLAC Offers Solution To Frequency Hopping and Wideband Cosite EMI Issues For Legacy and New Waveforms**
 - **SINGGARS (30 MHz – 88 MHz) & HAVEQUICK (225 MHz – 400 MHz)**
 - Validated By Analysis And Component Measurements. Final Prototype VHF And UHF Hardware Demonstration Scheduled Dec 08
 - **2 MHz – 30 MHz**
 - HFRG Is Obsolete And Out Of Production
 - CVN21/CVN-78 Requires HF Suite
 - **450 MHz – 2.0 GHz**
 - SPAWAR Presently Has Several SBIR Contracts For CLIC Applications For EW Systems
- **Validated MATLAB Model (MEMCAM) Allows Early Identification of Cosite EMI Issues And Allows Performance / Cost Trade Space Determination**

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