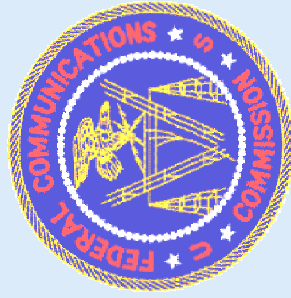




# Interference Temperature Update



**Bruce Franca, Deputy Chief  
Office of Engineering and Technology  
May 18, 2004 - UTC Telecom 2004**



# Interference Temperature

## Background

- ★ **Interference Temperature Concept Raised in November 2002 Spectrum Policy Task Force Report**
  - One of 39 specific recommendations
  - To improve the way radio spectrum is managed
  - New approach to interference avoidance/protection
- ★ **November 2003 – NOI/NPRM adopted by FCC**



# Interference Temperature Concept

## Why New Concept?

- ★ **Dramatic increase in the demand for spectrum**
  - Mobile Phones
  - Unlicensed Applications
  - Broadband
- ★ **Rapid changes and advances in technology**
  - Digital processing
  - New modulation techniques
- ★ **Desire to promote increased technical and service flexibility**
  - Use of market forces to drive new services/technology



# Interference Temperature Concept

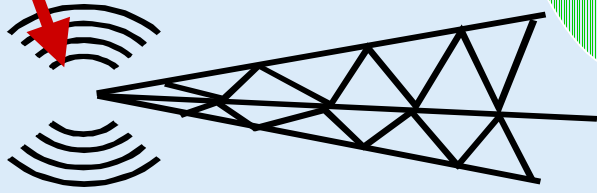
## Why New Concept?

- ★ **Need better ways to manage the spectrum**
- ★ **Less reliance on “command and control”**
- ★ **SPTF recommended, as a long-term strategy, to shift the paradigm for assessing interference to one based on:**
  - **Real-time measurements**
  - **Consideration of actual RF environment**
  - **New “Interference Temperature” metric**



# Interference Avoidance

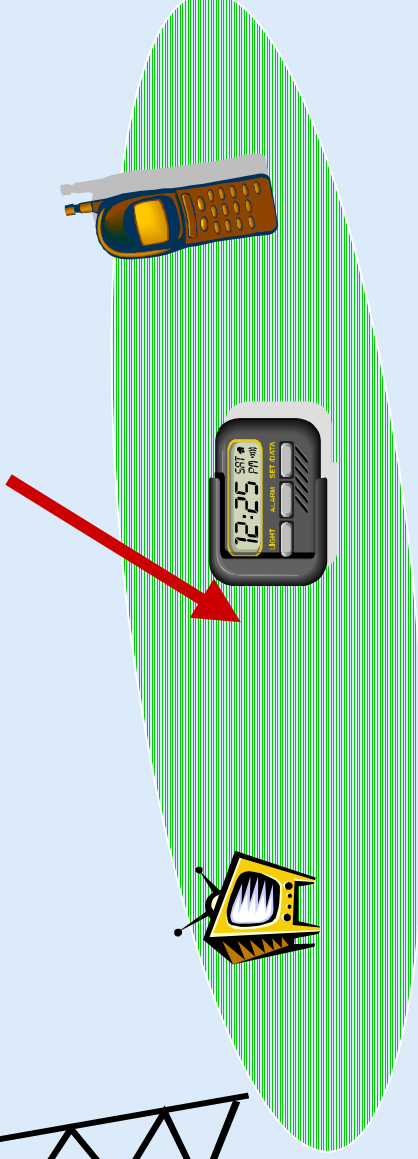
*It doesn't matter what the signal level is here!*



**Interference  
Temperature**



*It matters what the signal level is here!*

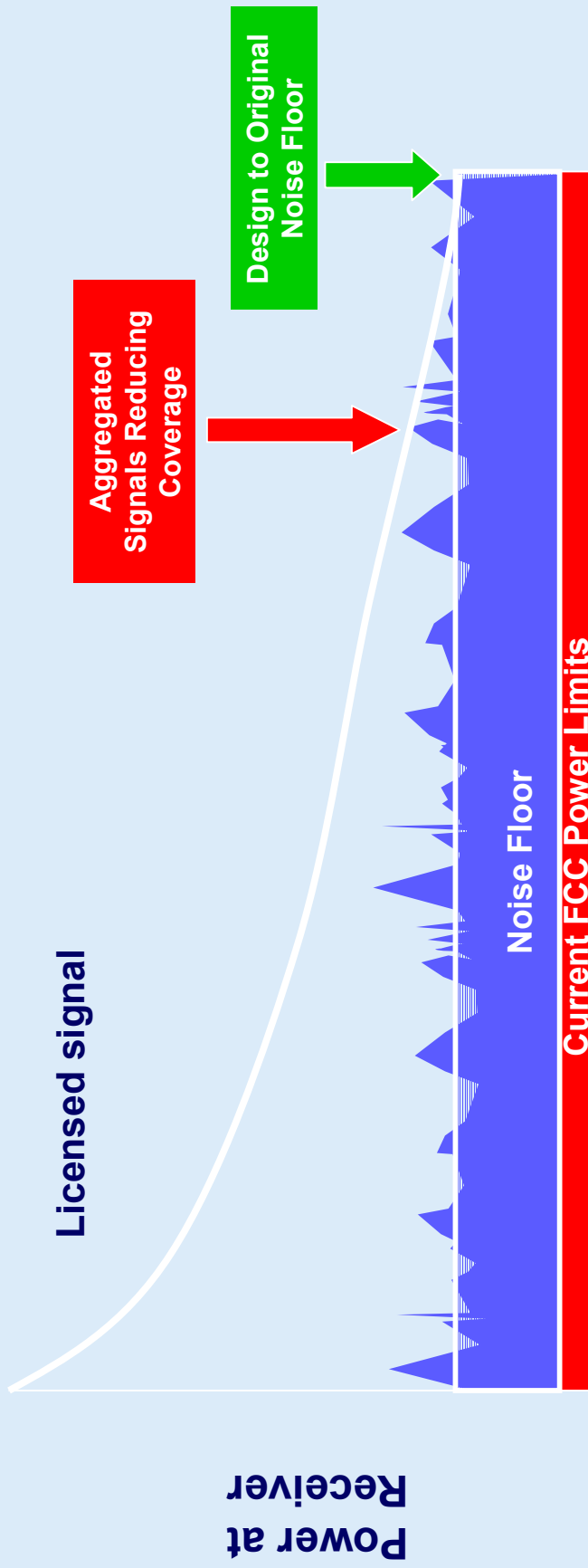


**Define "interference temperature" – total RF energy from both ambient noise and other sources (I+N)**



# Interference Avoidance

Tolerance of Interference - Today



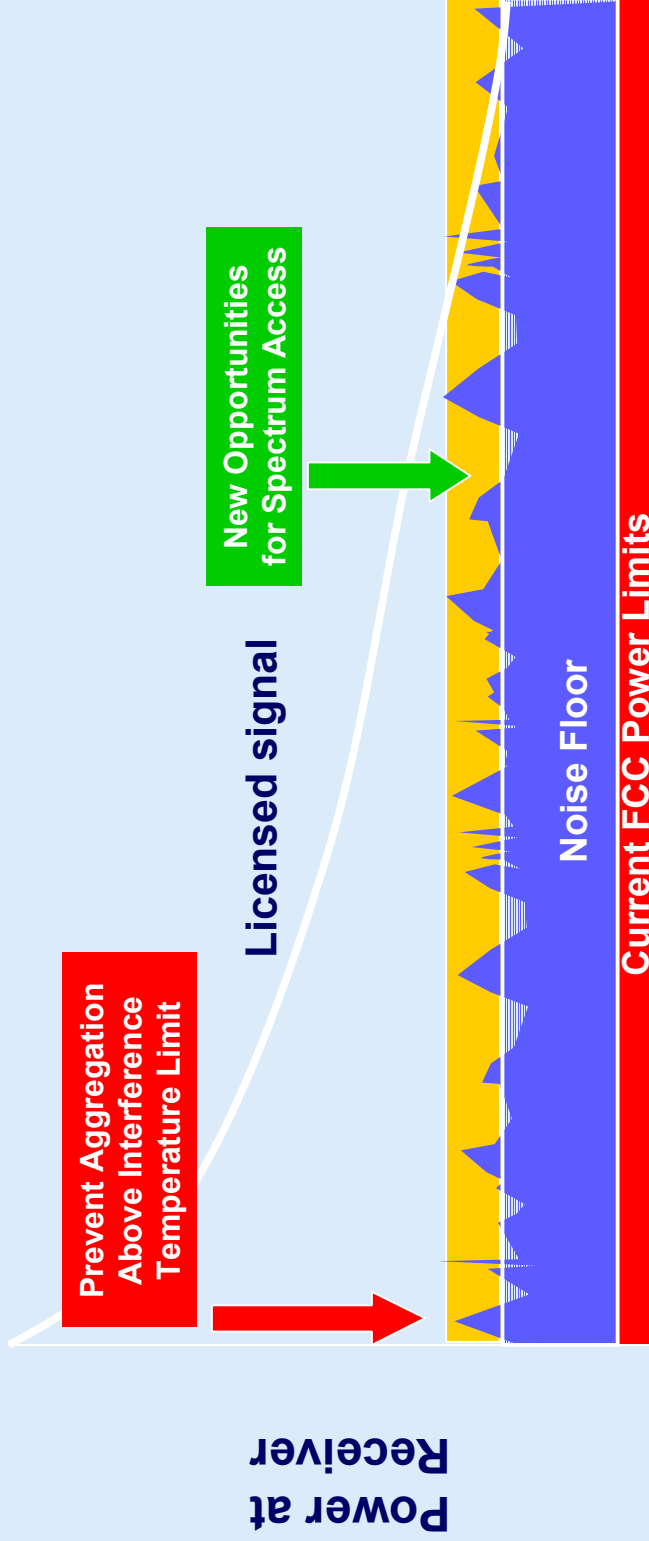
**Distance from licensed transmitting antenna**

- \* **License Holders Design System to Operate down to the Noise Floor**
- \* Any additional interfering signals (including aggregation of unlicensed devices) can cause degradation



# Interference Avoidance

Tolerance of Interference - Future



**Distance from licensed transmitting antenna**

- \* **Quantify acceptable levels of interference**
- \* More Certainty for Licensees
- \* More Opportunity for Consumer Devices



# Interference Temperature Concept

## How Does This Work (NOI)?

- ★ **Interference Temperature defined as**
  - RF power generated by undesired emitters and noise sources that are present at receive system per unit bandwidth
  - $(I + N)/BW$  or units of Kelvin
- ★ **Real-time RF Measurements?**
  - Device measures and makes TX decision
  - Multiple devices in a network measure
  - Use of monitoring stations
- ★ **Determining the Noise Floor?**
  - Definition
  - Measurement (consistency/currency)





# Interference Temperature Concept

## Potential Experiments (NPRM)

- ★ **Two bands chosen**
  - 6525-6700 MHz (FS & FSS)
  - 12.75-13.15 GHz (FS, FSS & BAS/CARS)
- ★ **Satellite Uplink**
- ★ **Fixed Point-to-Point**



# Interference Temperature Concept

## Potential Experiments (NPRM)

- ★ **Satellite Uplink Case**
  - Simplest example of concept
  - Satellite “sees” entire service area (CONUS)
  - Increase in # devices yields uniform increase in noise
  - No near/far device or hidden node problem
- ★  $\Delta T/T \leftrightarrow$  **Interference Temperature**
- ★  $\Delta T/T$  used by ITU for coordination of Satellite Systems



# Interference Temperature Concept

## Potential Experiments (NPRM)

- ★ **Fixed Point-to-Point Case**
  - “Listen before transmit” approach with Dynamic Frequency Selection (DFS) and Transmitter Power Control (TPC)
  - DFS threshold could serve as effective “interference temperature limit
  - Likely geographic separation between unlicensed device and fixed receiver
  - 100 meter separation = 89 dB attenuation at 6 GHz and 95 dB at 12 GHz
  - DFS thresholds similar to UNII/ Wi-Fi at 5 GHz



# Interference Temperature Concept

## Potential Experiments (NPRM)

- ★ **Satellite Monitoring of Spectrum Occupancy**
  - Satellites now being used for real-time, remote monitoring of geophysical, meteorological and environmental conditions
  - Potential use of satellites for real-time spectrum occupancy information?
  - Possible monitoring of  $\Delta T/T$ , I/N, C/I, C/I+N
  - Commercial provision of such information