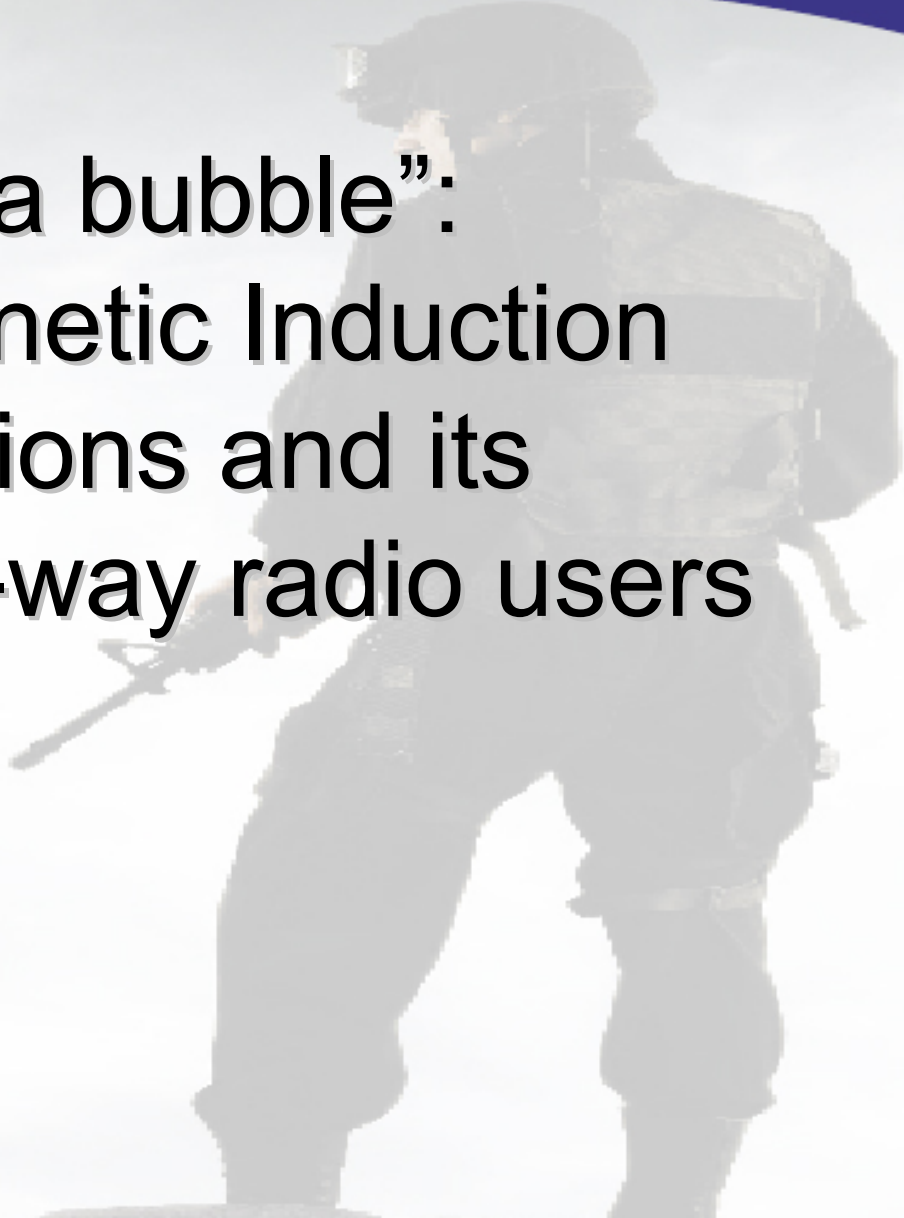
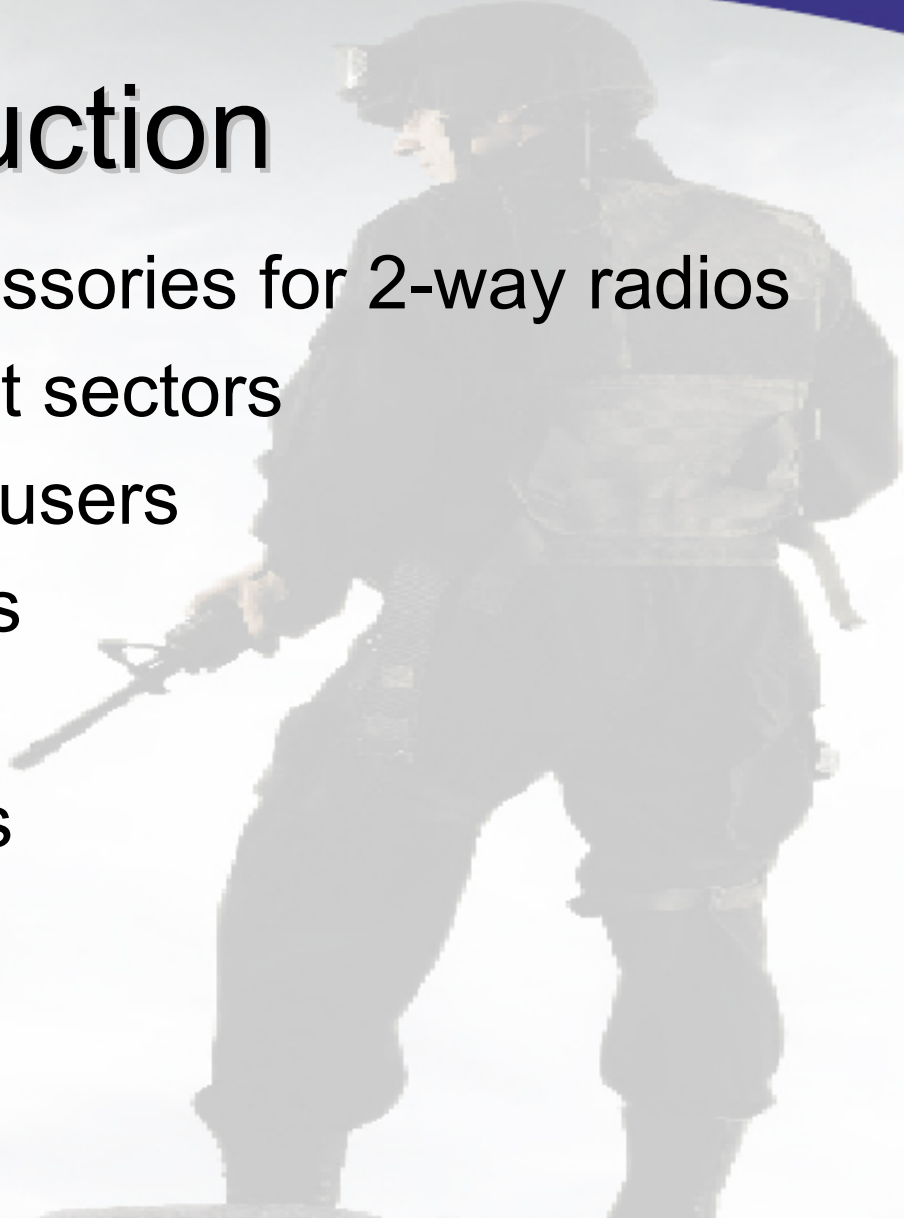


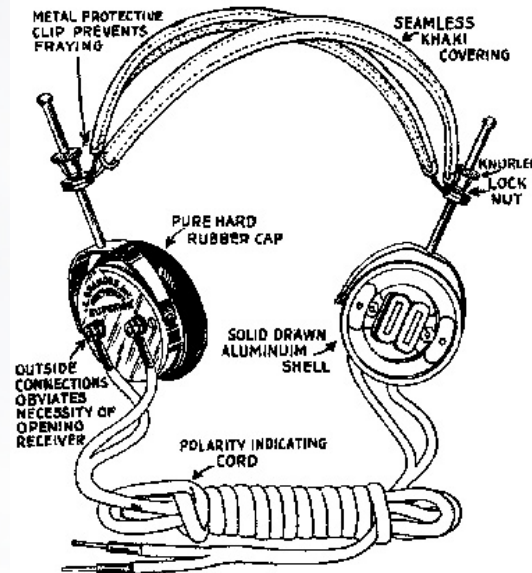
**“Talking in a bubble”:
Near Field Magnetic Induction
Communications and its
implications for 2-way radio users**



Introduction

- Unwiring of audio accessories for 2-way radios
 - Convergence of market sectors
 - Focus on professional users
 - Theoretical foundations
 - Bluetooth vs NFMC
 - Benefits and limitations
- 

Early Headsets



Showing the Exclusive Features of Brandes Superior Head Sets

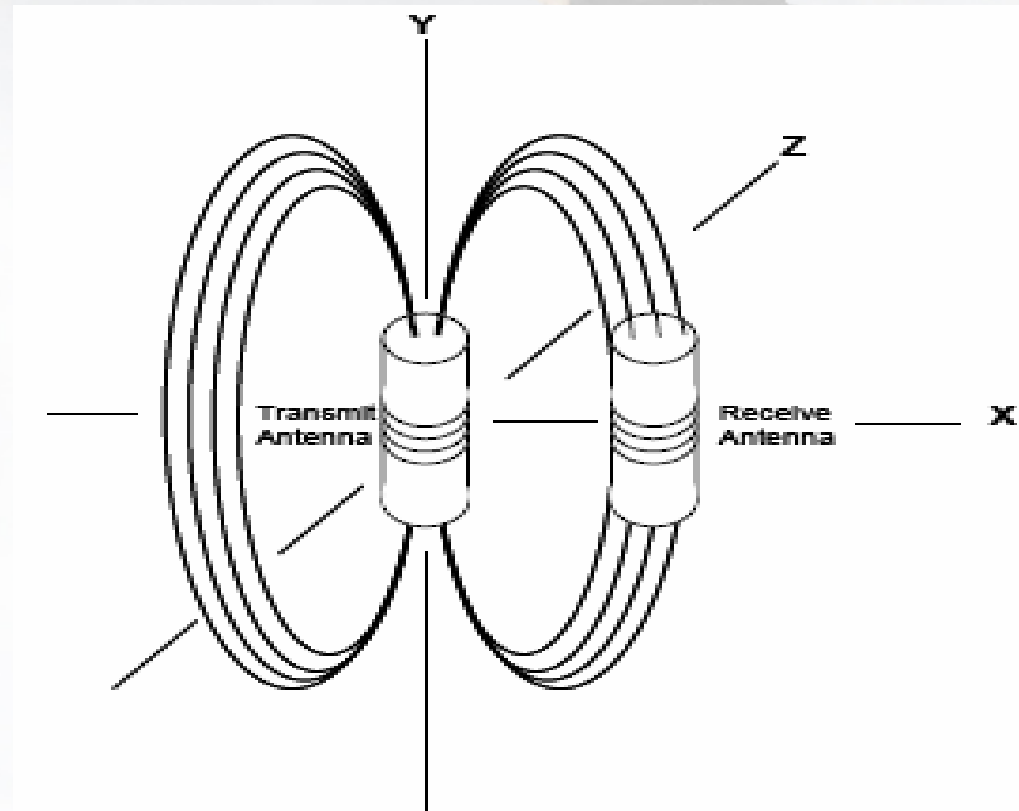
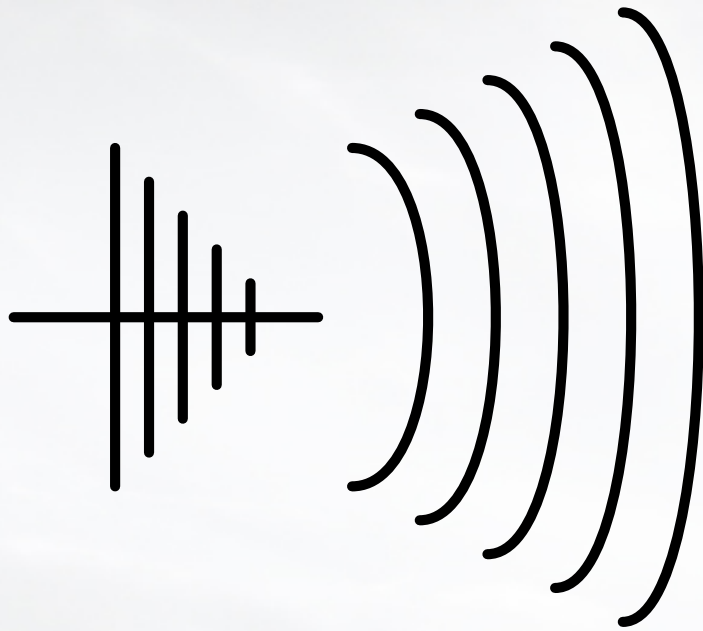


Historical Perspective

- Early headsets - ahead of their time
- Influence of the military
- Adoption by aviation industry
- Demands from Telecommunications industry
- Convergence between professional & consumer sectors



Electric fields vs Magnetic Waves



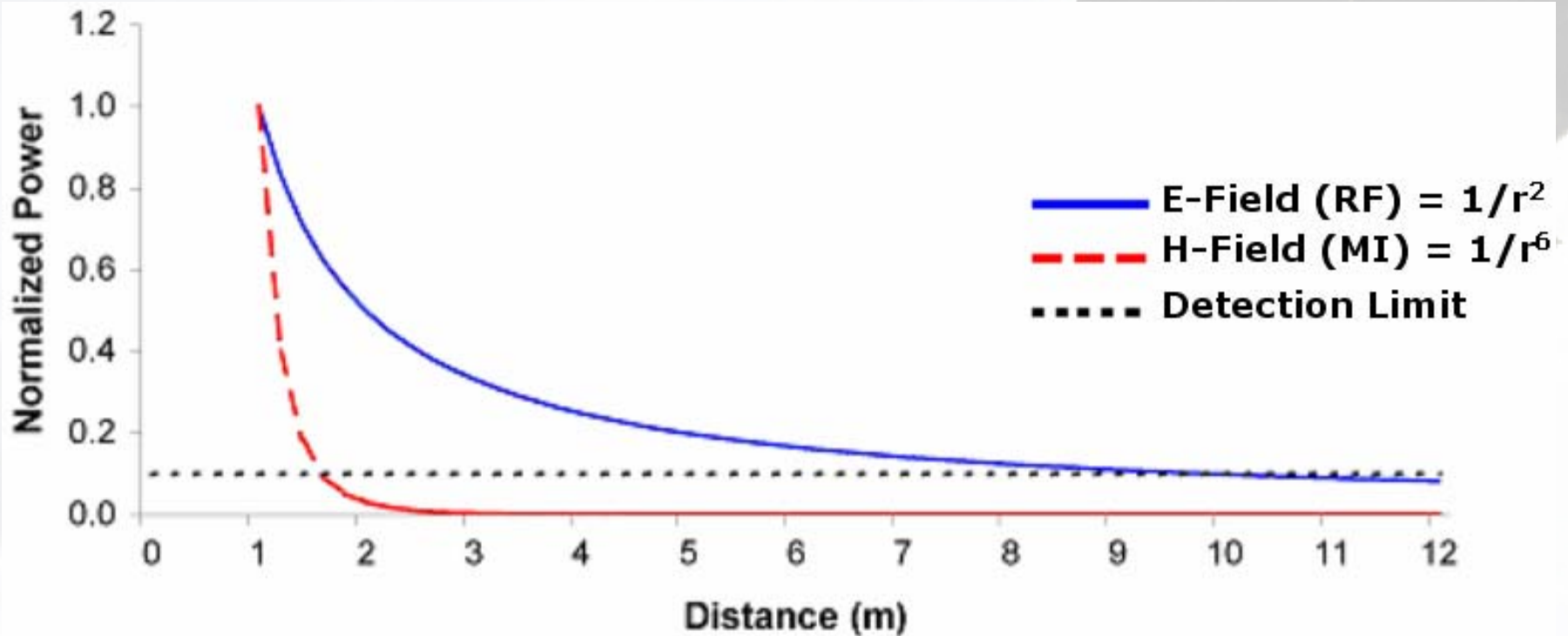
Electric fields vs Magnetic Waves

| Electric fields (E-Field) | Magnetic Waves (H-Field) |
|--|---|
| Transmission of Modulated-RF plane wave through free space | Information transferred by Magnetic Induction rather than energy transmission |
| Relies on energy transfer at the carrier frequency | Most energy stored in magnetic field and not transmitted |
| Higher carrier frequencies required for greater bandwidth | Sufficient bandwidth obtained at lower frequencies |

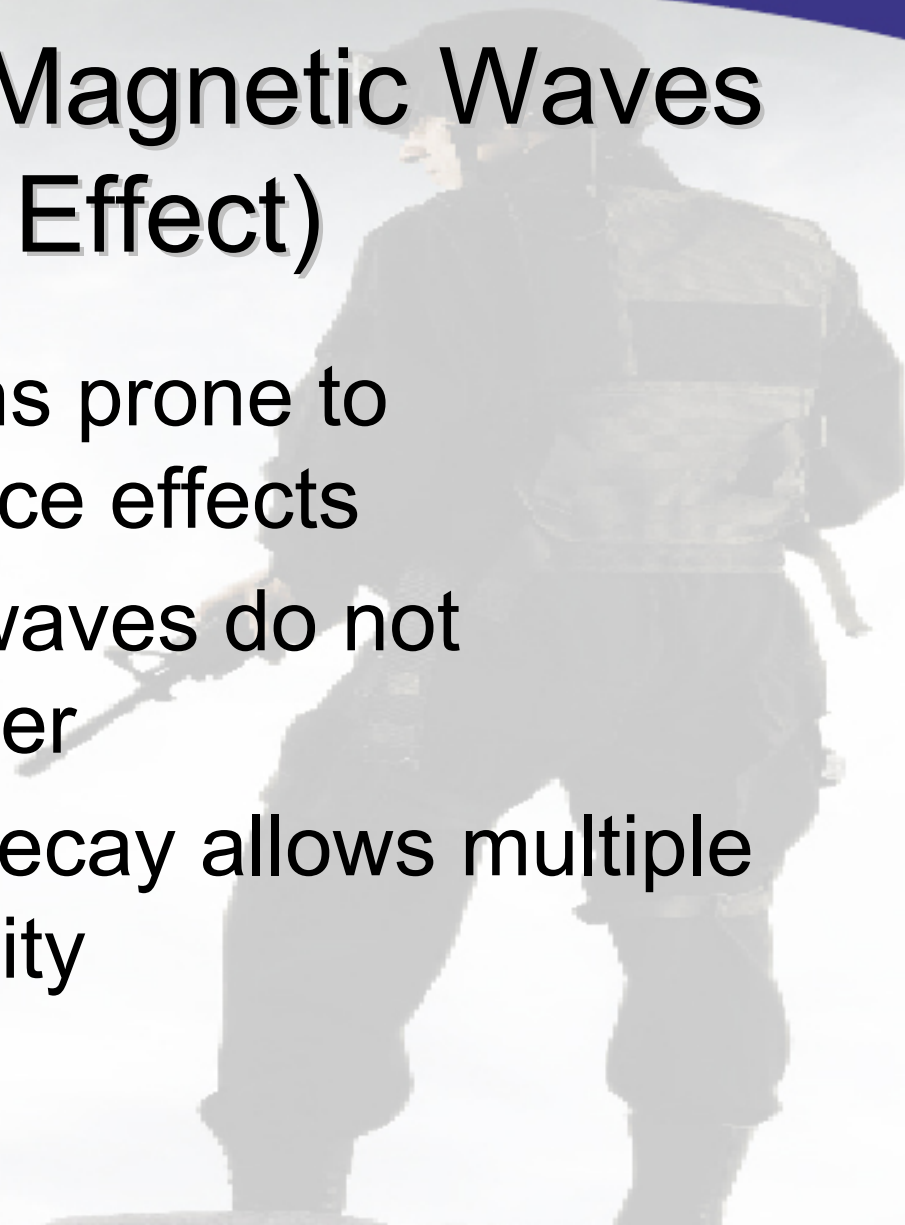
Electric fields vs Magnetic Waves (Interference and Co-Existence)

| Electric Fields (E-Field) | Magnetic Waves (H-Field) |
|---|---|
| Effective range dependant on environment | Electrical characteristics highly predictable and relatively unaffected by their surroundings |
| Simultaneous operation (Co-Habitation) not possible in close proximity to other RF devices operating in the same spectrum | Superior co-existence with RF and other magnetic devices |
| Fading, null points, blocking and/or multi-path signal degradation in the presence of people and obstacles | Magnetic field passes unimpeded through the human body |

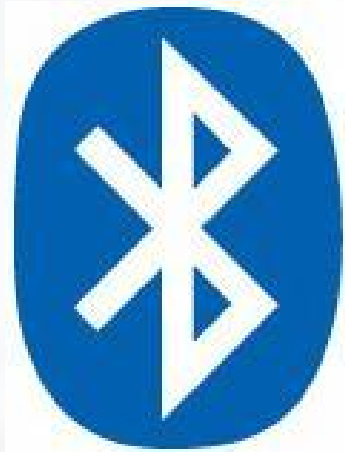
Electric fields vs Magnetic Waves (Propagation and Security)



Electric fields vs Magnetic Waves (Fading Effect)

- Far field transmissions prone to destructive interference effects
 - Near field magnetic waves do not propagate beyond user
 - Rapid signal power decay allows multiple users in close proximity
- 

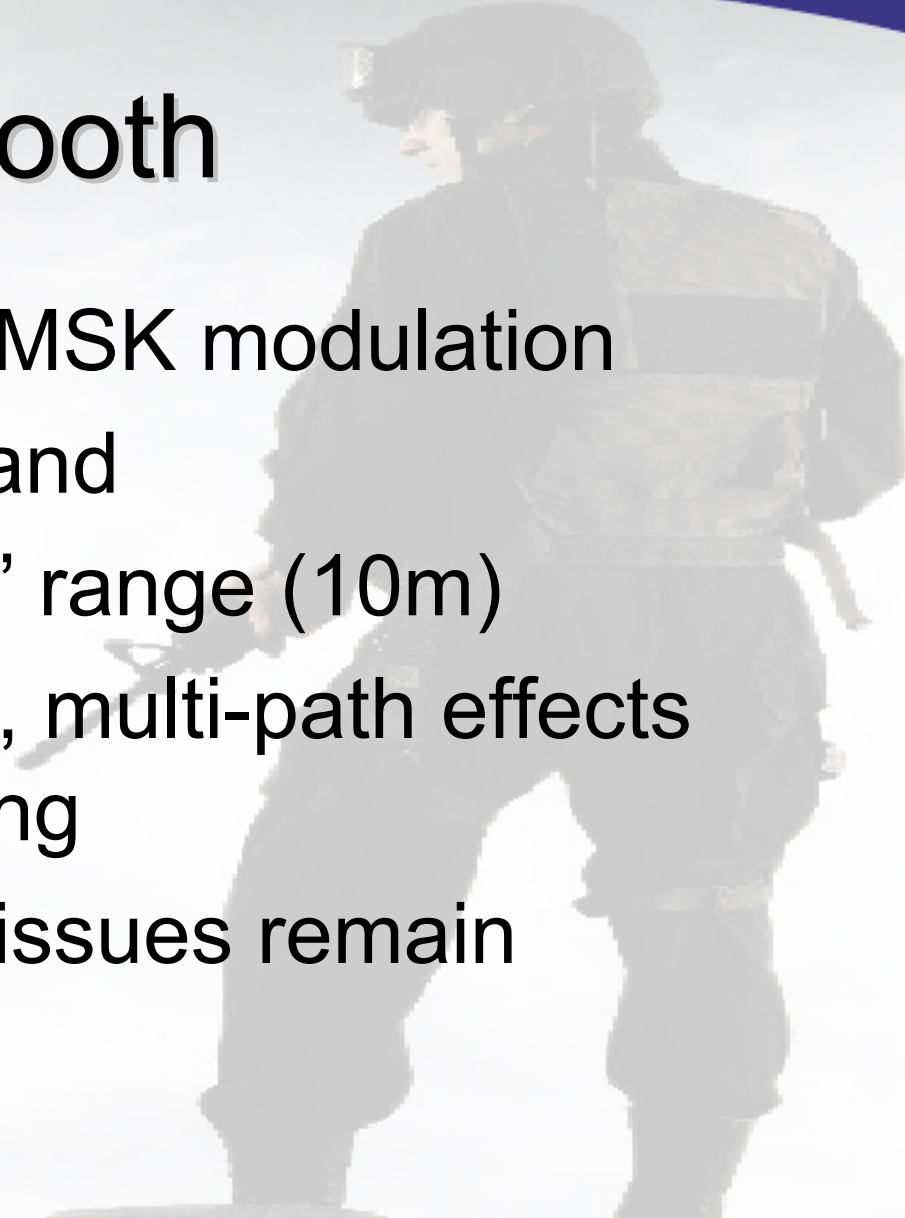
Bluetooth vs NFMC



Typical Bluetooth Headsets



Bluetooth

- Bluetooth employs GMSK modulation
 - Uses 2.4 GHz ISM band
 - Designed to be “long” range (10m)
 - Prone to interference, multi-path effects and spectrum crowding
 - Security and privacy issues remain unresolved
- 

NFMC Headset and Speaker Mic



Near-Field Magnetic Induction Communications (NFMC)

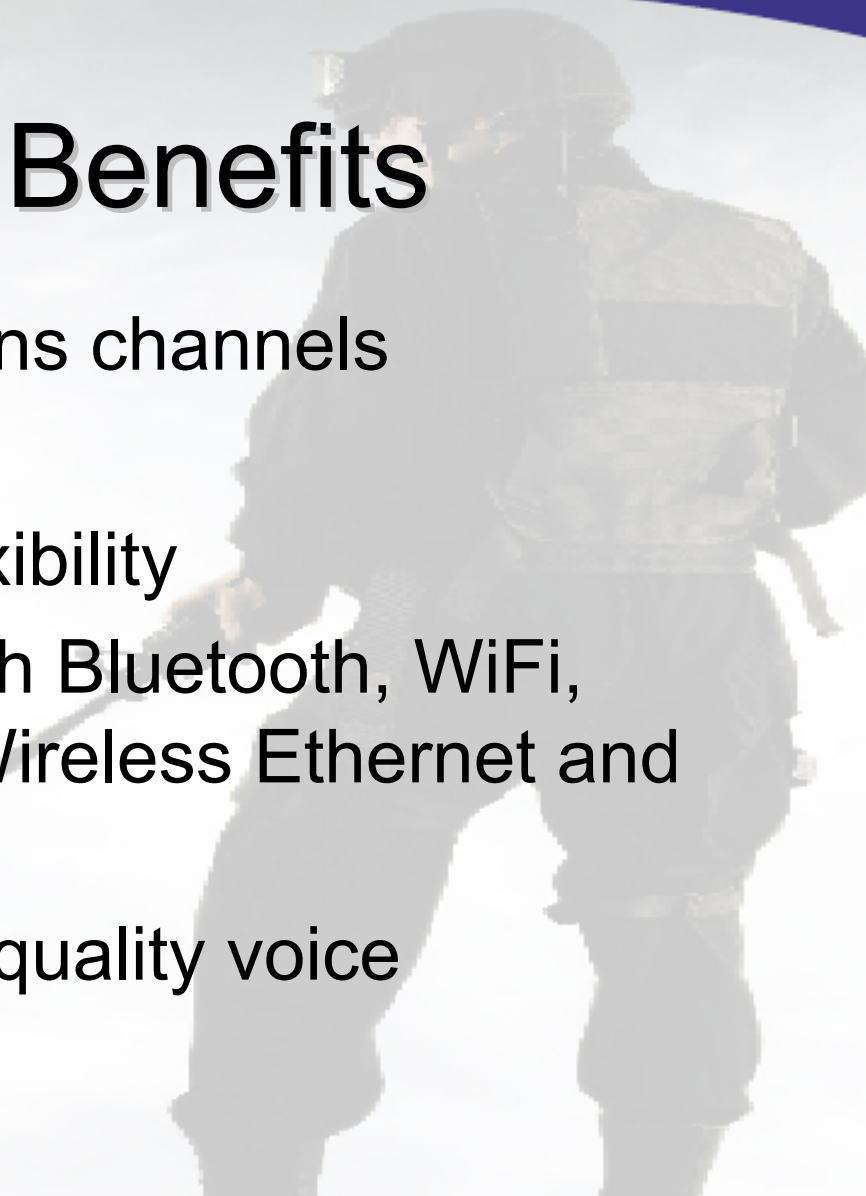
- US-based technology emerged in 2000
- Alternative to Bluetooth for 2-way radios
- FCC approval and field proven by 2005
- Commercially available worldwide
- Now making an impact in the US Military, Police and Public safety sectors
- Pioneered by ***FreeLinc***

NFMC vs Bluetooth (cont)

- NFMC operates in a closed “bubble”
- Inherent security governed by laws of physics
- More energy-efficient and better use of spectrum
- Allows co-location of multiple users
- Full immunity from interference



Additional Benefits

- Dedicated communications channels
 - No bandwidth sharing
 - Worldwide regulatory flexibility
 - Reliable co-existence with Bluetooth, WiFi, CDMA, TDMA & GSM, Wireless Ethernet and other NFMC devices
 - Sufficient bit rates for Hi-quality voice
- 

Typical User Groups

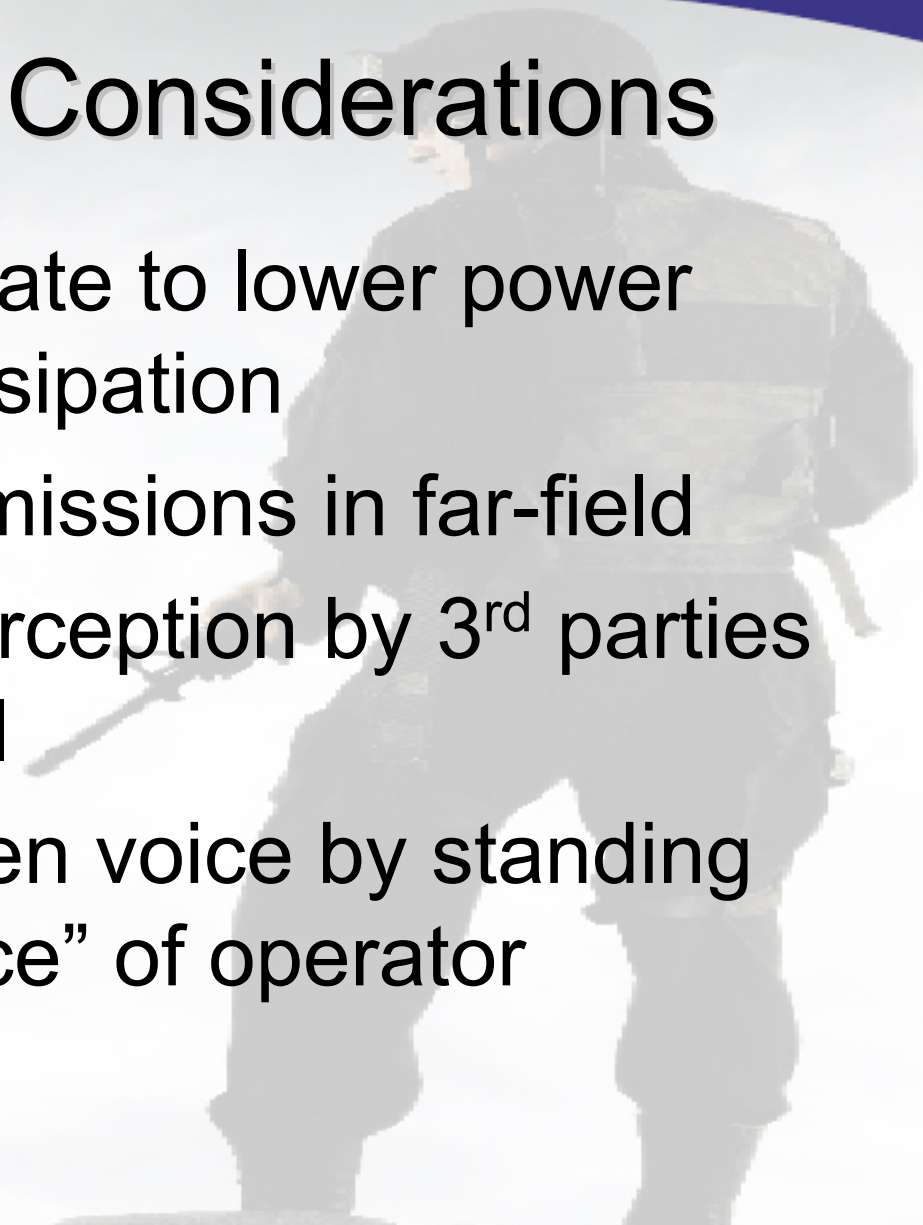
- Front-line Police officers
- Emergency Services
- First Responders
- Military personnel
- Specific industry sectors



Inherent Security

- Inverse sixth-power roll-off ($1/r^6$)
- Far-field strength only $10\text{dB}\mu\text{V}/\text{m}$ at 10m
- Far-field power density only $-97\text{dBm}/\text{m}^2$
- Bluetooth is at around -40 to -50 dBm
- Bluetooth power density typically 50,000 to 500,000 times greater than NFMC

Low Frequency Considerations

- Low frequencies equate to lower power consumption and dissipation
 - Reduced spurious emissions in far-field
 - Standoff DF and Interception by 3rd parties inherently impractical
 - Need to record spoken voice by standing inside “personal space” of operator
- 
- A faint, grey silhouette of a soldier in full combat gear, including a helmet, vest, and rifle, is visible in the background on the right side of the slide.

Typical DF Antennas for 16 MHz



Authentication Security

- NFMC audio accessory is paired with its adapter
- Generates 16-bit security ID code
- ID code is exchanged with adapter and stored in NVM
- ID code constantly exchanged and verified during use





Encryption



- NFMC technology lends itself to add-on encryption techniques
- Encryption modules could be commercial or military grade
- Future Dev path incorporates government encryption requirements



FreeLinc Headsets in use



FreeLinc Speaker-Mics in use



FreeLinc Speaker-Mics in use



Observations & Predictions

- Widespread use amongst all levels of US government agencies
 - Growing use within the military, not just for 2-way radios
 - Amateur radio and FRS sector take-up
 - Eventual widespread consumer demand
- 