Principles of Radio - Frequency Communications

Course Number: EE-02-510

PDH: 9

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Module 1: Introduction To Radio-Frequency Communications

Learning Objectives

By the end of this section, you will be able to:

- **Define** electrical telecommunications and identify the primary methods used in naval operations.
- **Analyze** the hierarchical relationship between systems, sets, groups, and parts using standard reference designations.
- **Evaluate** the radio-frequency spectrum to select appropriate frequency bands for strategic and tactical mission requirements.

Executive Summary: Naval telecommunications has evolved from simple 20-mile ship-to-shore transmissions to a sophisticated global infrastructure. Modern operations rely on a highly structured hierarchy of electronic equipment and the strategic application of the radio-frequency spectrum—from ELF for submarine penetration to SHF for satellite links—to ensure reliable, secure, and timely information exchange.

Introduction to Naval Telecommunications

The Navy's use of wireless communication dates back to 1899 with the first official naval radio message traveling 20 miles from ship to shore. Since then, the field has grown tremendously in size and complexity. Key milestones include:

- **1916:** First use of **radiotelephone** between ships.
- **1931:** Introduction of **superheterodyne receivers**, which nearly eliminated signal pick-up problems.
- **1944:** Successful **radio teletypewriter** (rtty) transmissions between ships.
- **1945:** First use of **facsimile** (fax) for transmitting graphic documents, specifically the World War II surrender document.

Telecommunications Defined

Telecommunications refers to communication over a distance and encompasses any transmission, emission, or reception of signs, signals, writings, images, or sounds. This includes intelligence produced by visual, oral, wire, radio, or other electromagnetic systems.

Electrical Transmission Methods

The Navy utilizes two primary electrical methods: **Radio** and **Wire**. Radio uses electromagnetic waves unguided by a physical path, while wire uses conductors to carry these waves.

- **Radiotelegraph (CW):** Known as continuous wave telegraphy, it involves manual or automatic transmission using Morse code (dots and dashes). While slow, its main advantage is **reliability**.
- **Radiotelephone:** Highly useful for its directness and convenience. It is the primary method for short-range tactical communications.
    - ⚠️ **Safety Constraint:** Tactical radiotelephone typically operates on high frequencies with **line-of-sight** characteristics, limiting range to 20–25 miles.
- **Teletypewriter (TTY):** Used for high-speed automatic communications via landline, cable, or radio (rtty).
- **Facsimile (FAX):** Process for electronically transmitting photographs, charts, and graphic information. It is less susceptible to complete loss of intelligence because its high-resolution scanning ensures noise bursts only distort tiny segments of the image.

System Introduction and Subdivision

A communications system consists of two or more equipment sets arranged and interconnected to perform operations a single piece of equipment cannot.

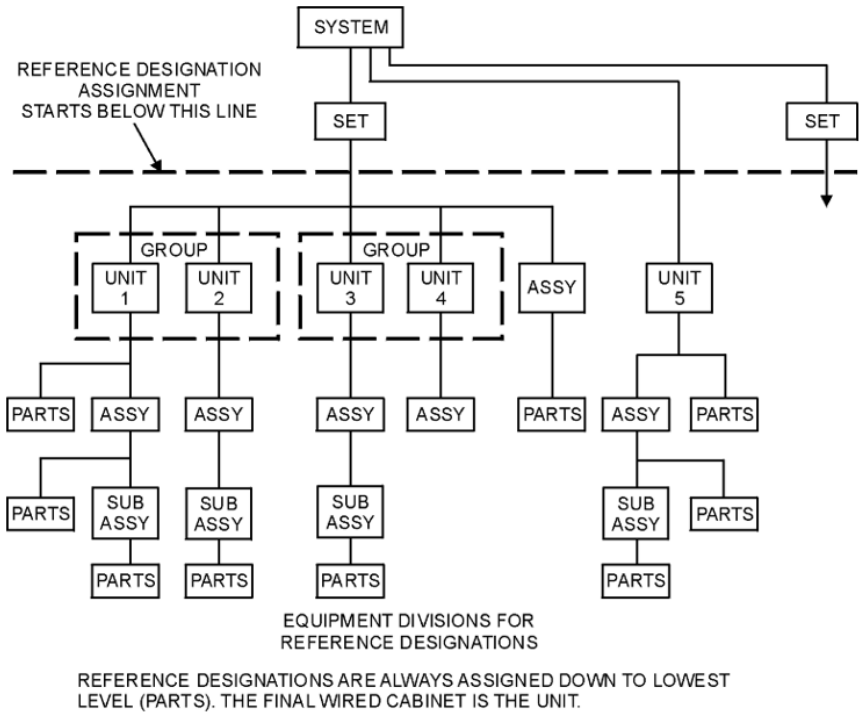

Figure 1-1. System subdivision.

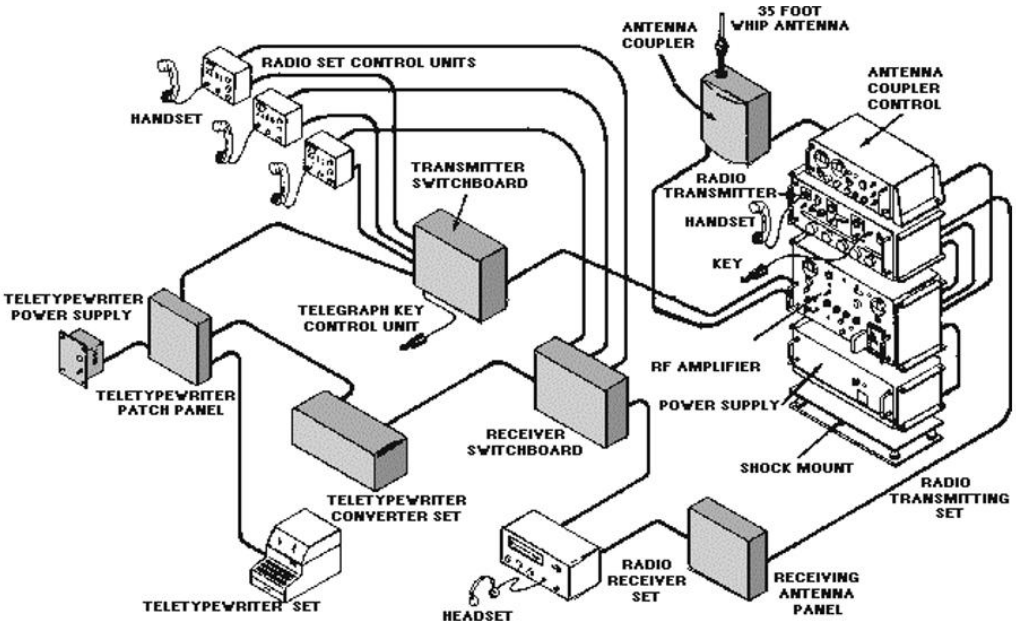

Figure 1-2. Communications system pictorial view.

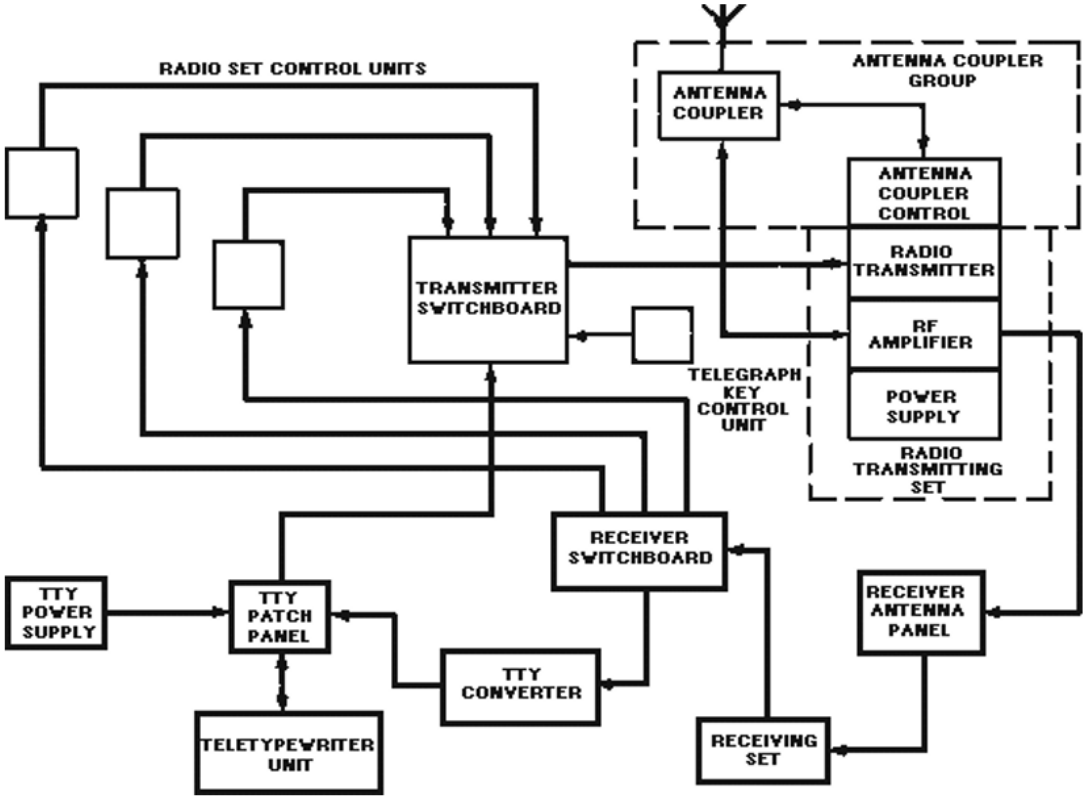

Figure 1-3. Communications system block diagram.

Equipment Hierarchy Definitions

- **System:** A combination of sets, units, and parts joined for a specific operational function.
- **Set:** Units and associated assemblies connected to perform a specific function.

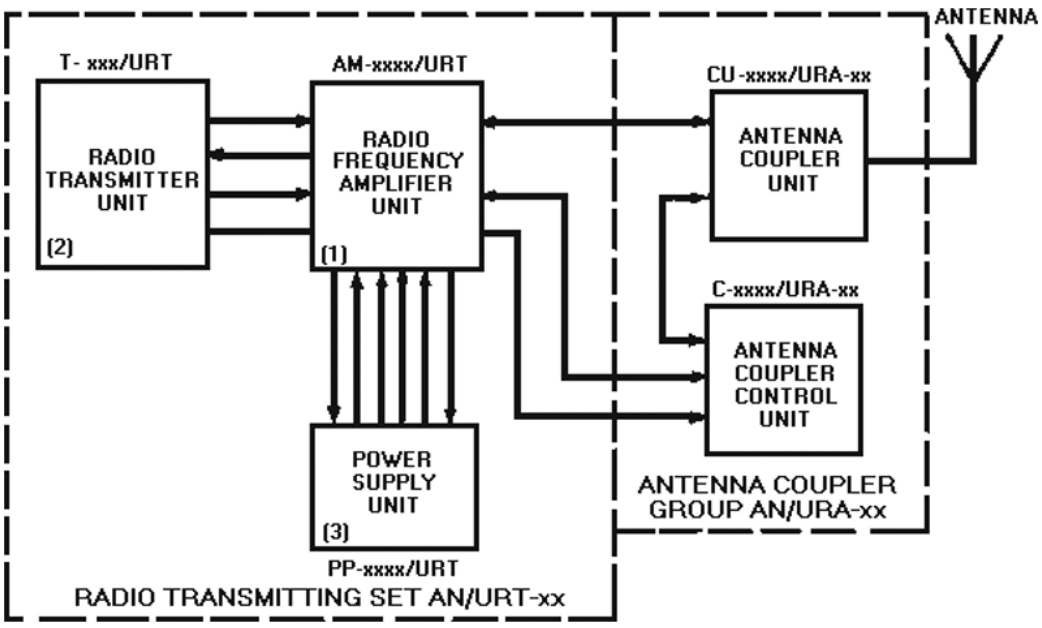

Figure 1-4. Radio transmitting set.

- **Group:** A collection of units that is a subdivision of a set but cannot perform a complete function alone (e.g., an antenna coupler group).
- **Unit:** An assembly of parts capable of independent operation (e.g., a power supply).
- **Assembly:** A number of parts or subassemblies joined together to perform a specific function.

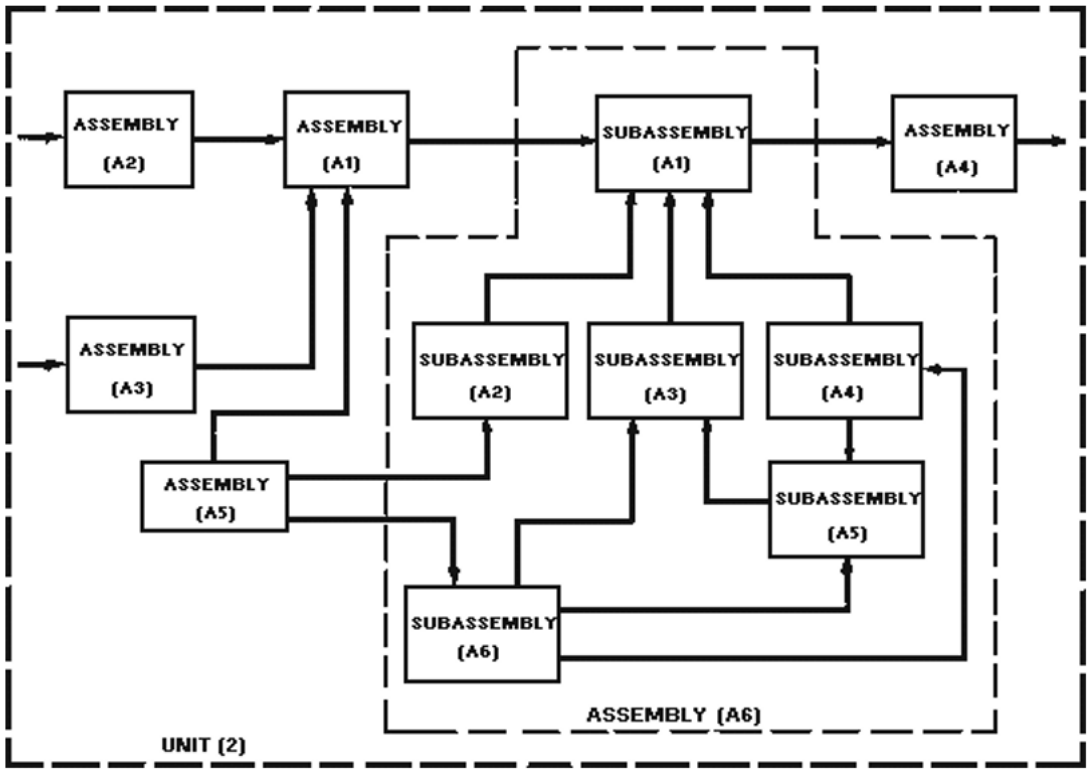

Figure 1-5. Unit and assembly.

- **Subassembly:** Consists of two or more parts forming a portion of an assembly or unit. It is replaceable as a whole.

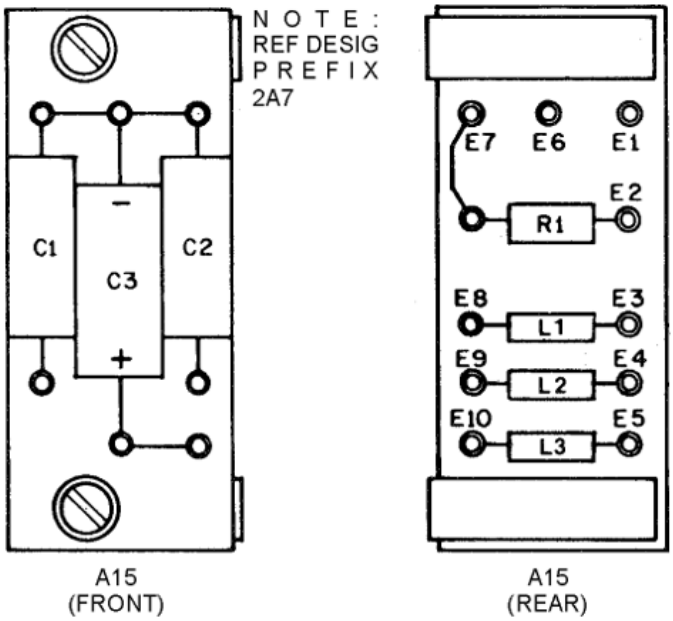

Figure 1-6. Typical subassembly.

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