

# Network Analyzers

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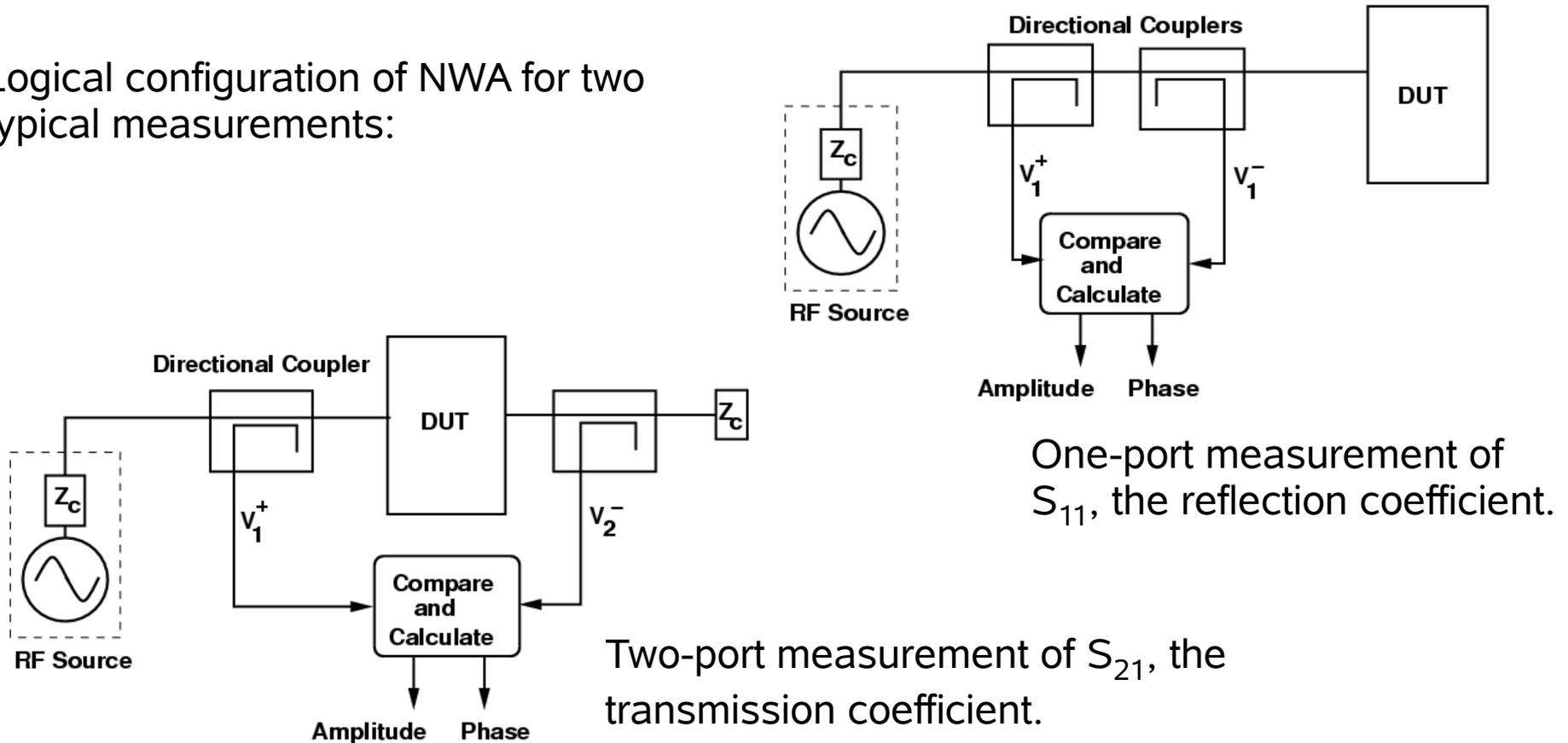
October 2007

## Logical Configuration

A **network analyzer** (NWA) measures the S-parameters of a 1 or 2-port network and calculates all the other parameters, such as impedance, phase, transmission over a range of frequencies.

The NWA has two 50-ohm ports that are connected to the input and output of the **device under test** (DUT). Note that the DUT itself is terminated in  $Z_c$ , the 50-ohm normalizing impedance of the NWA and cables.

Logical configuration of NWA for two typical measurements:



## Network Analyzer Setup

Actual NWAs use a set of coaxial relays, directional couplers, power splitters and 50-ohm terminations to set up the various operational modes for the S-parameter test set.

Setup parameters for the NWA

Frequency range -- start, stop, or center, span, along with the units

Measurement -- S11, S21, S12, S22

Display type -- Smith Chart, (Log) Magnitude, Phase

Scale factor of display

Number of points -- discrete frequencies to scan

Auxiliary setup parameters

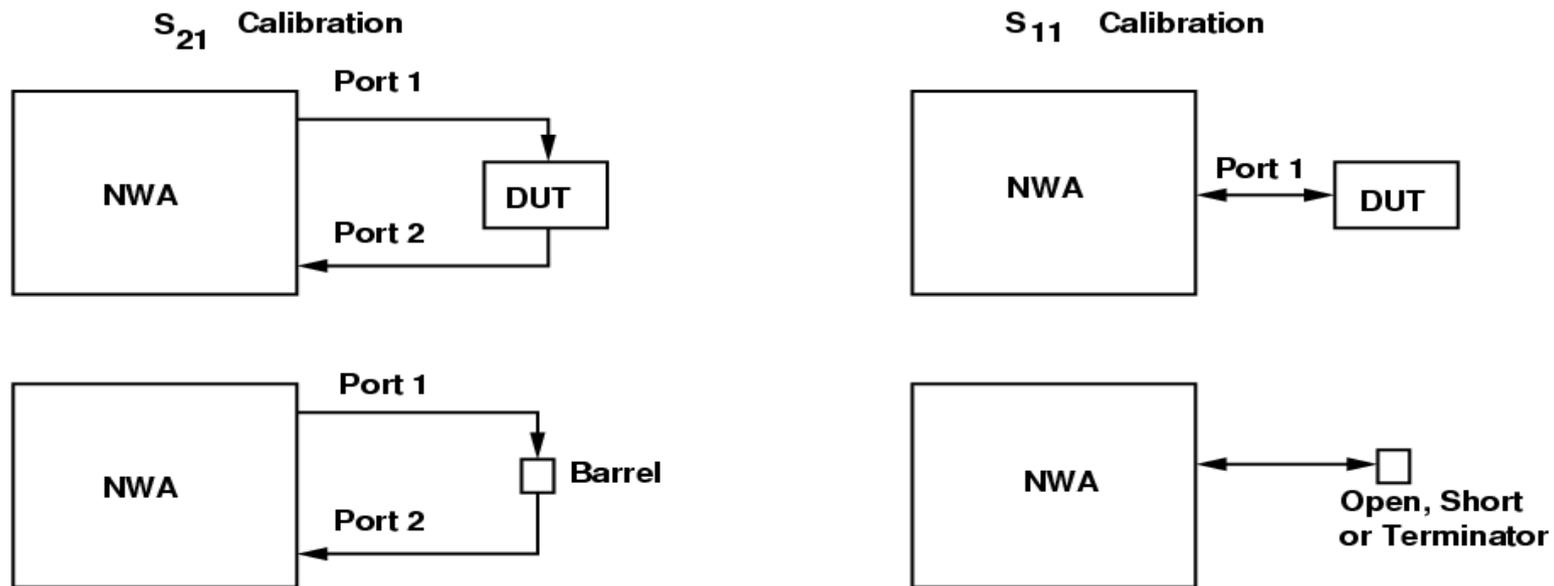
Averaging, smoothing of the display

Power delivered to the DUT

## Network Analyzer Calibration

The NWA operates over a wide frequency range. To compensate for uncontrolled losses in the components and test cables, a calibration procedure is carried out before measuring the characteristics of the DUT.

After the test cables are selected and attached, the DUT is removed and replaced by standard open and short circuits, a standard 50 ohm load, or bypassed by a barrel connector.



The calibration procedure replaces the DUT with a known impedance (open, short, 50 ohms). The NWA measures the known impedance and then subtracts out the systematic errors in the measurements of the DUT.



