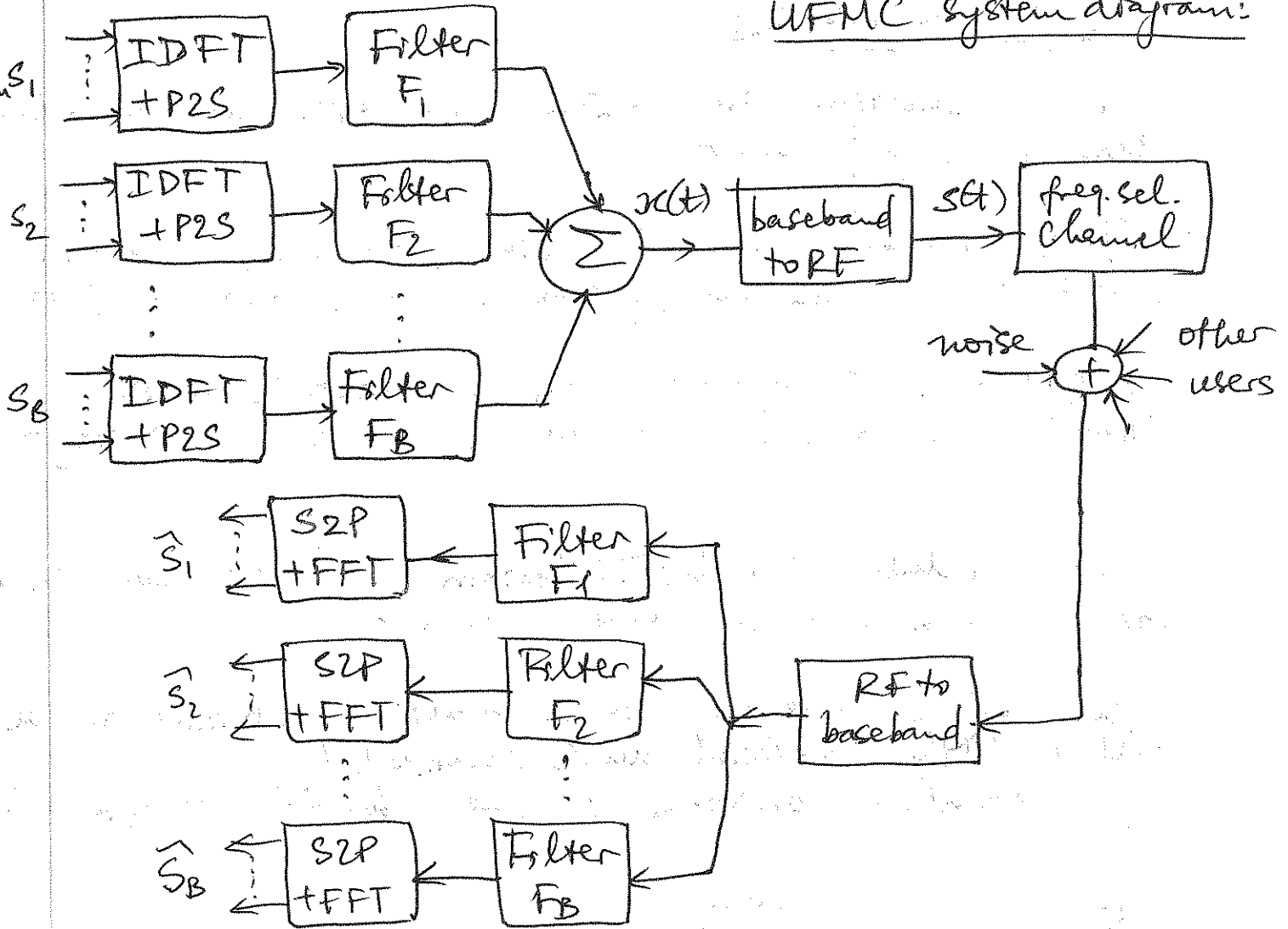


UFMC system diagram:



At this point it is not clear which multicarrier modulation technique will be used for 5G systems.

The specific filter design will also matter.

# Multuser Systems

◦ In a multiple user system, resources will need to be divided among users.

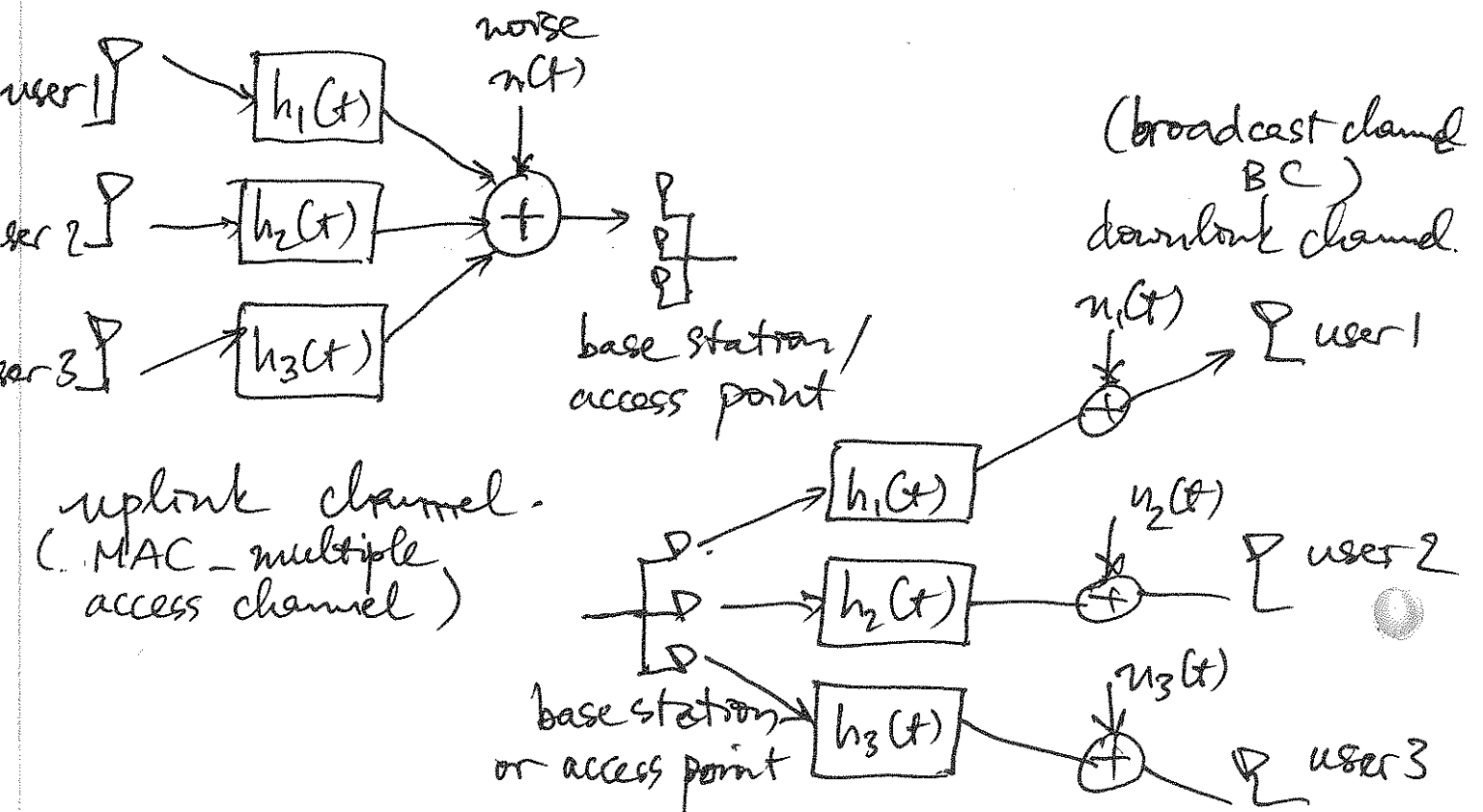
These resources include: time, frequency and antennas (or spatial) dimensions, also transmit power and rate.

Allocating these resources among multiple users is called "multiple access". This allocation need not be orthogonal.

◦ In a cellular (or WiFi) system, there are two different type of access: uplink and downlink.

The uplink corresponds to a multuser channel model called the "multiple access channel".

The downlink corresponds to the "broadcast channel" model.



• The capacity of the MAC and BC are known (under Gaussian noise).

For a multiuser channel, the capacity becomes a multidimensional region where each point is a rate tuple for all users.

We will look at the capacity regions for the MAC and BC and also study practical multiple access (resource allocation) techniques and compare their performance to the capacity.

• The current wireless devices can only either transmit or receive at a time. This constraint is called half-duplexing.

For half-duplex systems, the uplink and downlink must be separated in time or frequency.

- TDD: Time-division duplexing systems where both uplink and downlink communications occur in the same frequency band but are separated in time.

- FDD: Frequency-division duplexing systems where both uplink and downlink can occur at the same time over different frequency bands.

Current cellular systems (3G, 4G) mostly operate on FDD. This mode however requires closed loop control and synchronization or for obtaining CSIT (i.e. via feedback) and has high overhead for advanced techniques (OFDMA, MIMO, beamforming...)

Thus TDD is being considered for future systems including 5G.