**Covert Wireless Communication in IoT Network: From AWGN Channel to THz Band**

* Need for THZ BAND:
* The ever-growing need for smaller devices that can offer **higher speed wireless communication** anywhere and any time can only increase the required wireless data rate, which is expected to approach Terabit-per-second (Tbps) range within the next five to ten years. THz band refers to the spectral band that spans the frequencies between 0.1 THz and 10 THz.
* As the demand for smaller devices that can offer higher speed wireless communication any time and anywhere is growing relentlessly, the need for higher frequency bands with wide unregulated bandwidth that can support multi-Gigabits/s data rates have become essential. The opening up of carrier frequencies in the THz-range, such as D-band (i.e., 110 GHz–170 GHz) and around 300 GHz, is the most promising approach to provide sufficient bandwidth required for ultra-fast and ultra-broadband data transmission. This large bandwidth paired with higher speed wireless links can open the door to a large number of novel applications such as ultra-high-speed pico-cell cellular links, Terabits/s (Tbps) WLAN and WPAN, secure wireless communication for military and defense applications, and on-body communication for health monitoring systems.. Covert communication means exchanging information using a covert (or hidden) channel.Covert channels are used for the secret transfer of information. Encryption only protects communication from being decoded by unauthorised parties, whereas covert channels aim to hide the very existence of the communication
* Two kinds of wireless channel are there AWGN channel and THZ CHANNEL;
* In AWGN CHANNEL each device is equipped with omni directional antenna and the energy radiated is wasted ,whereas THz Band signals are often assumed to be more secure than lower frequency signals due to the more directional transmission and the more narrow beams. and the antenna radiation pattern is the cone model, i.e., a single cone-shaped beam. However this makes covert communication more difficult. In THz Band, Willie can simply place a receiver in the LOS (Line-of-Sight) path between Tx and Rx to find or block their communications. Hence Alice and Bob need resorting to the aggregate interference and the NLOS (Non-Line-ofSight) communication to improve the security and hiding. In a THz Band IoT network, although the LOS communications can be detected easily by Willie, we found that the communication based on reflection or diffuse scattering is a feasible information hiding method. A wave, which is incident on a rough surface under an angle θ1, is scattered into the direction given by the angles θ2 and θ3. Kirchhoff scattering model [24] gives the expression of the scattering path gain, G(f, σh, lc, θ1, θ2, θ3), describing the scattered with respect to the incident power.
* Assessment Metric: To quantify the detection ability .of Willie, we assess a normalized secrecy capacity.
* The quantity c¯s is a metric which can be used to assess the likelihood of a successful covert communication.
* The quantum relative entropy is an information measure representing the uncertainty of a state with respect to another state
* The scattering signals Willie eavesdropping are masked by the background noise and the aggregate interference in a dense IoT network
* Specular reflection, or regular reflection, is the mirror-like reflection of waves, such as light, from a surface
* Diffuse scattering refers to signals that are scattered in many directions, including the usual specular direction. These signals are generated because of gaps and sharp changes in the walls of a building that destroy its flat layer (e.g., windows, balconies, brick or stone decorations, beams). Last but not least, the type of material matters, creating an effective roughness parameter [4] for each wall that can be used with ray-based propagation tools.
* Kirchhoff model is yet another model used for the general scattering geometry in which a wave is incident on a rough surface under angle θ with the normal to that surface, and is scattered to a direction given by elevation and azimuth angles. According to, this model provides good results if the surface does not contain sharp edges, spikes or other sharp irregularities, which is totally impossible to eliminate in many real use-case scenarios. THz signal path loss is the major constraints for the realization of the terahertz wireless communications [9]. However, as the distance increases, the pathlossfor the terahertz link increases at a faster rate than for the mmWave one, Materials characterization in terahertz frequency band is becoming progressively more important due to a vast variety of applications [12]. Due to absorption attenuation of oxygen molecules and water vapors in the air, THz signal experience harsh path losses that restrict the wireless communication to few meters. Wireless communication in THz band has very high molecular absorptions as well as molecular noise generated by water vapors in response to attenuation of electromagnetic radiation. Besides molecular absorption THz signals may suffer reflection and scattering losses in multipath propagation.
* Molecular absorption is a process in which light energy with certain wavelength is absorbed by a molecule during the interaction with light, promoting the molecule from ground state to higher energy excited states,different molecules absorb different wavelengths of light.
* The molecular absorption loss is a function of the carrier frequency and the communication distance and is mainly due to water vapor molecules [11], [16], [17]. The high attenuation absorption peaks due to excited molecule vibrations at specific THz resonant frequencies result in multiple transmission windows [54], each having a bandwidth that shrinks with communication distance. Moreover, higher gas mixing ratios and densities result in stronger and wider spectral peaks. Molecular absorption thus results in frequencyselectivity even in LoS scenarios.