In the modern day, there is a serious spectrum crunch in the legacy radio frequency (RF) band, for which visible light communication (VLC) can be a promising option. VLC is a short-range wireless communication variant which uses the visible light spectrum. In this paper, we are using a VLC-based architecture for providing scalable communications to Internet-of-Things (IoT) devices where a multi-element hemispherical bulb is used that can transmit data streams from multiple light emitting diode (LED) boards. The essence of this architecture is that it uses a Line-of-Sight (LoS) alignment protocol that handles the hand-off issue created by the movement of receivers inside a room. We start by proposing an optimization problem aiming to minimize the total consumed energy emitted by each LED taking into consideration the LEDs’ power budget, users’ quality-of-service, LED-user associations, and illumination uniformity constraints. Then, because of the non-convexity of the problem, we propose to solve it in two stages: (1) We design an efficient algorithm for LED-user association for fixed LED powers, (2) using the LED-user association, we find approximate solution based on Taylor series to optimize the LEDs’ power. We devise two heuristic solutions based on this approach along with a near optimal solution. Finally, we illustrate and compare the performance of our methods via simulations.