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# SDS: Scrumptious Dataflow Strategy for IoT Devices in Heterogeneous Network Environment

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**Abstract:** Communication technologies have drastically increased the number of wireless networks. Heterogeneous networks have now become an indispensable fact while designing the new networks and the way the data packet moves from device to device opens new challenges for transmitting the packet speedily, with maximum throughput and by consuming only confined energy. Therefore, the present study intends to provide a shrewd communication link among all IoT devices that becomes part of numerous heterogeneous networks. The scrumptious dataflow strategy (SDS) for IoT devices in the heterogeneous network environment is proposed and it would deal with all link selection and dataflow challenges. The SDS would accomplish the targeted output in five steps: Step 1 determines the utility rate of each heterogeneous link. Step 2 develops a link selection attribute (LSA) that gauges the loads of network features used for the link selection process. Step 3 calculates the scores of all heterogeneous networks. Step 4 takes the LSA table and computes the network preference for different scenarios, such as round trip time (RTTP), network throughput, and energy consumption. Step 5 sets the priority of heterogeneous networks based on the scores of network attributes. Performance of the proposed SDS mechanism with state of the art network protocols, such as high-speed packet access (HSPA), content-centric networking (CCN), and dynamic source routing (DSR), was determined by conducting a simulation with NS2 and, consequently, the SDS exhibited its shrewd performance. During comparative analysis, in terms of round trip time, the SDS proved that it utilized only 16.4 milliseconds to reach IoT device 50 and was first among all other protocols. Similarly, for network throughput, at IoT device 50, the throughputs of the SDS are recorded at 40% while the rest of other protocols were dead. Finally, while computing the energy consumption used to reach IoT device 50, the SDS was functional and possessed more than half of its energy compared to the other protocols. The SDS only utilized 302 joules while the rest of the protocols were about to die as they had consumed all of their energy.

**Keywords:** wireless communication; scrumptious; heterogeneous network; IoT device; routing

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## 1. Introduction

The deployment process of traditional wireless cellular networks is inherited from past scenarios and requires time-to-time upgradation. The state of the art cellular systems are basically encompassed in base stations and user terminals adopting the same standards as followed by the cellular system in other regions. Currently, wireless networks are keystones, with several diverse application fields, such as wireless sensor networks, cloud facilities, cyber physical systems [1], infrastructures protection, and command control, with several other likely examples. The wireless workstation networking has taken the place of former customary technologies to provide better services with configurability, flexibility, and interoperability [2].

Contemporary network technologies are comprised of software and hardware components. The accessibility of faster and reliable hardware is altering the equilibrium between software and hardware with generating changes in the network of structured devices. Currently, several software-built nodes based on the Python language coexist with hardware-built nodes with the provision of many analogous functions in conjunction with different computing tools [3].

Heterogeneous networks [4] contain numerous existing radio access network (RAN) technologies, such as WiMAX, Wi-Fi, EUTRAN, etc., and have various architectures, different transmission mechanisms, and base stations with a volatile performance range. Configuration networks are used to improve the user experience and reduce RAN and core network (CN) bottlenecks. HetNet [5] can also help to route and manage intelligent IP traffic, and implement efficient load balancing and resource allocation. This is the aggregation of heterogeneous network radio resources and the traffic between selective or packet-switched or circuit-switched HetNet. 3GWLAN has been considered beyond other inter-technology options. Heterogeneous networks include interconnected nodes and different types of links. Such interconnected structures contain a wealth of information that can be used to mutually strengthen nodes and links and transfer knowledge from one type to another.

The heterogeneous wireless sensor network demands an abundant network resource. It attempts to deploy a replication connectivity mechanism in a fast mobile architecture. The real measurement output exhibits that the replication connection mechanism drastically reduces network uncertainty, controls the packet loss ratio, and proactively improves the network throughput. A small network fidelity significantly influences the outcomes of assessments when the network complexity is not inconsequential, so the obtainability of integrated simulation-centered tools to maintain the whole network course is an actual need to evade the underestimation and equivocation of network glitches [6].

Modular simulation is very useful in building an articulate network model with varying levels of applications. The accessibility of modular, programmable, extensible, open-source, community-driven, and community-supported simulation frameworks produces simulation events with desirable outcomes even in a heterogeneous network system using varying simulated nodes [7].

### *1.1. Smart Homes*

Smart homes are getting popular due to two factors. First, sensing and actuation techniques as well as wireless sensor networks, have dramatically advanced. Second, nowadays, individuals rely on technology to answer their worries about their quality of life and home security. Intelligent and automated services are provided via a range of IoT-based sensors in smart homes, which help individuals who forget to automate daily duties and maintain routines and can save energy by automatically shutting off lights and electrical gadgets. Motion sensors are employed for this purpose and security can also be achieved. Sensors collect data from the environment by conserving energy (light, temperature, humidity, gas, fire events).

The data from the heterogeneous sensor is given to the context aggregator, which then transmits it to the context recognition service engine. This engine chooses services depending on their context. When the humidity rises, for example, an application can automatically switch on the air conditioner. If there is a gas leak, you can also switch off all of the lights. Smart home applications are highly beneficial to the elderly and the disabled. Health can be monitored and professionals can be notified immediately in the event of an emergency. The floor is outfitted with pressure sensors, which aid in tracking a person's activity in a smart home and detecting falls. CCTV cameras may be used in smart homes to record interesting occurrences. There are countless challenges and questions about smart home applications [8]. Security and privacy are of paramount importance, as all data about what is happening at home is recorded [9]. An intruder can attack the system and cause it to behave maliciously if its security and dependability are not ensured. When such abnormalities are noticed, smart home systems are meant to warn the owner.

In continuation to smart homes, there are IoT-based applications that govern with smart homes. The role of the most relevant applications to the proposed systems are discussed as follows.

#### 1.1.1. IoT-Based Transport

Sensors and cognitive information processing systems can be used by IoT-based transportation apps to govern everyday traffic in the city. The primary aims of intelligent traffic systems are to reduce traffic congestion, make parking easier and stress-free, appropriately route traffic, and eliminate accidents by identifying intoxicated drivers. GPS sensors for position information, accelerometers for speed, gyroscopes for direction, RFID for vehicle identification, and infrared for counting passengers and cars are examples of IoT devices with sensor technologies for these sorts of applications, as well as sensors and cameras for documenting traffic and vehicle movements.

#### 1.1.2. IoT-Based Water Systems

The current level of water shortages in most regions of the world urges critics to effectively manage the water supplies. As a result, most cities are opting for smart solutions that include the installation of a large number of meters on water supply pipes and storm drains. Smart water meters come in a variety of styles. These meters may be used to determine the amount of water entry and outflow as well as potential leaks. Water metering systems based on IoT are also employed in combination with data from meteorological satellites and river water sensors. They can also assist us in forecasting flooding.

#### 1.1.3. IoT-Based Social Meetings

"Opportunistic IoT" [10] refers to information exchange between opportunistic devices (devices that seek communication with other devices) depending on mobility and availability of contacts in the neighborhood. Personal gadgets with sensing and short-range communication capabilities include tablets, wearables, and mobile phones. When there is a shared goal, people may find and interact with one another.

#### 1.1.4. IoT-Based Supply Chain Management

IoT seeks to simplify the actual processes of business and information systems [11]. One can easily trace items in a supply chain from the point of manufacturing to the point of final distribution by using sensor technologies, such as RFID and NFC. Real-time data is recorded and processed for future reference. RFID tags connected to cargo can also record information regarding product quality and ease of use.

The proposed mechanism (SDS) achieves the required goals in five steps:

- Step 1: The service is separated into patterns and the attributes of each pattern are examined before using the utility function to determine the utility value for each network feature.
- Step 2: Network attribute weights are calculated using the link selection attribute (LSA). Based on this, signal inference is completed.
- Step 3: The network attribute score is calculated using the network attribute utility and weights.
- Step 4: Network settings for different scenarios are calculated using the LSA.
- Step 5: Based on the evaluation of network attributes, unpleasant networks are prioritized. This allows the user to select the network with the highest score.

The key contributions of this work are as follows:

- The link selection attribute (LSA) specifies the network selection criteria that match the predefined values from the data corpus. This selection strategy ensures that only the best network is selected. This mechanism has been explained in Section 3.2 with the help of Figure 3.
- The performance of IoT devices in a heterogeneous network was analyzed by calculating results in terms of round trip time, network throughput, and energy consumption.

- The results were obtained by simulation with the NS2 simulator.
- The proposed strategy allows users to choose the most appropriate network, improve interoperability between devices, and reduce unnecessary handovers between different networks.
- Finally, the results are compared to state of the art protocols, such as high-speed packet access (HSPA), content-centric networking (CCN), and dynamic source routing (DSR).

The rest of this paper is divided into further sections. The current literature on heterogeneous networks is placed in Section 2. Section 3 contains a description of the proposed model, which accomplishes the target output in five steps. Performance analysis is described in Section 4. The conclusions and future research directions are given in Section 5.

## 2. Literature Review

Traditional network resource selection approach usually chooses the network that is the best performer among all available networks. However, with diverse services, each service demands rigid features. Furthermore, various users have diverse preferences. As a result, the goal of the study introduced in this white paper was to create an access selection algorithm that takes network, service, and user demographics into consideration.

Considering the low-speed moving environment, Fung po et al. [12] investigated the performance of high-speed packet access (HSPA). Not only static scenarios were taken into account, but many mobile scenarios, including subways, trains, and city buses were also considered. However, limiting the deployment of commercial networks, it analyzed only 3G networks, and all measurements primarily looked at network and transport layer parameters. Therefore, the network access layer has great priority but SNR was fully ignored during the entire transmission.

Similarly, another work from Mahfuzur [13] developed a content-centric networking (CCN) mechanism in the 4G/5G network, where various heterogeneous networks are converged. They also offered a unique mobility management method to enable content and network variety by using the mobile network's rich computing resources. Rather than establishing a communication link to the information source, they promised to enable more efficient, quicker, and secure content delivery. Furthermore, they examined existing mobility options and assessed the efficacy of a seamless content delivery mechanism in terms of content transfer time, throughput, and the data transmission success ratio. Their suggested solution uses name-based routing rather than content or device addresses. For content transfer, this system primarily employs two basic messages: the Interest packet and the Data packet. The Interest packet provides a request for a requested material, which includes information such as content name, content type, and content version. The Data packet comprises the original data as well as the content name, security information, and numerous additional properties, such as hop distance and content source description. However, they disregarded some of the issues, such as excessive energy usage and data packet delay rationing, which significantly reduce network longevity.

Qin et al. [14] proposed the reactive DSR source routing protocol for cognitive radio ad hoc networks to send IoT data from the IoT gateway to non-constrained networks inside the cognitive radio ad hoc networks. DSR, in particular, falls to the reactive routing protocol group since it may find routes from source to destination only when requested and needed. DSR is a source-routing system that allows for on-demand routing. DSR broadcasts routes to its neighbors but does not overload them with data. It only follows routes by calculating total distance or counting the number of nodes between the source and destination nodes. Nodes in the DSR mechanism keep route cache information that contains the path sequence from the source. Route maintenance and route discovery are the two processes used in DSR.

The authors [15] claimed to improve end-to-end throughput while minimizing the latency. The gateway distributed routers also act as IoT gateway nodes, gathering and encapsulating the data into the distributed cognitive radio ad hoc network. For the IoT network to be simulated in the Cooja simulator, an assumption was made to get IoT data from the LLN node to the LNN gateway node (LBR), which also functions as a cognitive source node. When a packet reaches the CR source node, it is wrapped in IP-in-IP and delivered via the cognitive radio network simulator. Channel route identification and restoration delays via local or global channel route recovery approaches have an impact on the end-to-end cumulative network throughput inside CRAHNs. As a result, the chance of PU spectrum handoff is higher than in the absence of active PU transmitters. As a consequence, the performance of source routing with various PU transmitter nodes was being assessed in order to compute the aggregate network throughput of IoT data inside the ad hoc network. The performance of the cognitive source routing protocol was compared to the existing hybrid cognitive AODV routing protocols, licensed control channel-based AODV routing protocols, unlicensed AODV-based routing protocols, and traditional IEEE 802.11 DCF-based routing techniques. Overall, this method is only suitable for sparse networks and is impractical for dense networks; no alternate measure for dense settings was provided.

Z. Yang et al. [16] employed a directional antenna to enhance the amount of concurrent noninterfering broadcasts within the cognitive radio network. This raises the possible end-to-end throughput in multihop communication while simultaneously lowering node power consumption. In other words, by minimizing interference with directional antennas, directional cognitive control and IoT application transmission would help in obtaining greater end-to-end throughput. The authors omitted to compute power consumption, which seems to be a major flaw in this work.

Ashraf et al. [17] suggested a lower power listening (LPL) technique to monitor malfunctioning nodes and energy waste in a wireless network using ContikiMAC Cooja. In both the centralized and distributed models, energy usage is lowered. By presenting a stochastic model for wireless sensor networks, the author calculated energy consumption with end-to-end latency. The suggested model, however, incorporates cylindrical propagation but lacks common spherical propagation.

### *2.1. Advantage of Heterogeneous Network*

It has been noted that network performance is poor in high-speed mobile scenarios, unable to fulfil user requests for network resource access. The elements influencing user network performance are examined layer by layer, and the benefits of heterogeneous networks are analyzed.

#### 2.1.1. Transport Layer

Each user is familiar with the shifting patterns of TCP throughput at various speeds. In every case, the performance of TCP throughput [18] appears to be the weakest, even the average of TCP throughput is the lowest, and the volatility of TCP throughput is the most dramatic. Given the statistics from the cumulative distribution function (CDF) [19], it is challenging to meet user demand for network resource access over a single wireless network. Taking use of diverse networks may be able to meet the user's need for network access.

#### 2.1.2. Network Layer

It was determined from the data travelling throughout the transport layer that the network performance of a single wireless network is poor. However, with heterogeneous networks, the overall network performance has a lot of opportunity for improvement. The benefits of heterogeneous networks with a network layer have been studied because when speed of the movement grows, the packets take longer to transport and are even lost. This might mean trouble for applications that are extremely sensitive to packet delays, such as real-time gaming. Using diverse networks may help to decrease transmission delays [20].

## 3. Proposed SDS Model

The propagation of wireless heterogeneous networks is a challenge that researchers have related to networking, to develop unique methodologies and techniques that can attain affordable, reproducible, and credible results for the experimentation and development of many network designs, and for the smooth flow of data in heterogeneous networks.

The proposed model developed a trust engine for the smooth data flow in heterogeneous networks for the provision of flexible and creative research experimentation by using an advanced simulation technique.

The proposed SDS layout is illustrated in Figure 1, with four heterogenous network environments and access points. The main router has been fixed while other dedicated routers are associated with each heterogeneous network and each is linked with a radio link.

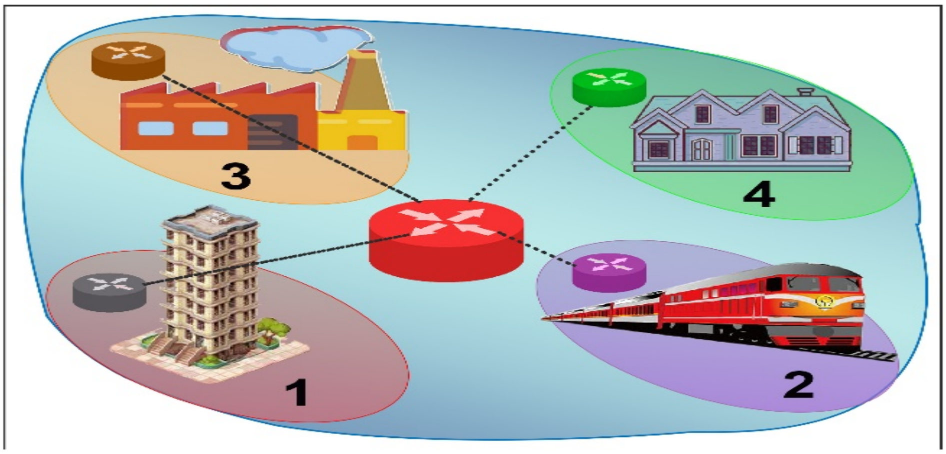


**Figure 1.** SDS heterogeneous network with router configuration.

Each heterogeneous network, such as Network 1, covers the dense residential population where a number of IoT devices are interconnected. Similarly, Networks 2, 3, and 4 represent the railway transport, industrial environment, and sparse residential area, respectively. Each heterogeneous network has different dynamics and challenges.

### *3.1. Selection of Prudent Network*

The interconnectivity and relative performance of IoT-enabled devices have been examined using network simulator (NS2). The volatile nature of wireless network scan easily be analyzed when discrete data are feed. It possesses extensive libraries and a variety of communication protocols. The results are a hallmark for future investigation.

Initially, three hosts and two routers (one main router and another related to a particular heterogeneous network) were configured after creating the devices and linking routers and hosts in the network to perform basic tests. Four networks (10.0.100.0/24, 10.0.200.0/24, 10.300.0/24) and (10.0.1.0/24) were configured with dynamic OSPF routing protocol [1] running for the network, linking two routers to transfer network information from one router to a subsequent one.

As the execution begins, the IoT-enabled wireless devices initiate the packet broadcast mechanism illustrated in Figure 2, where a number of IoT devices broadcast the data packets in the heterogeneous environment.

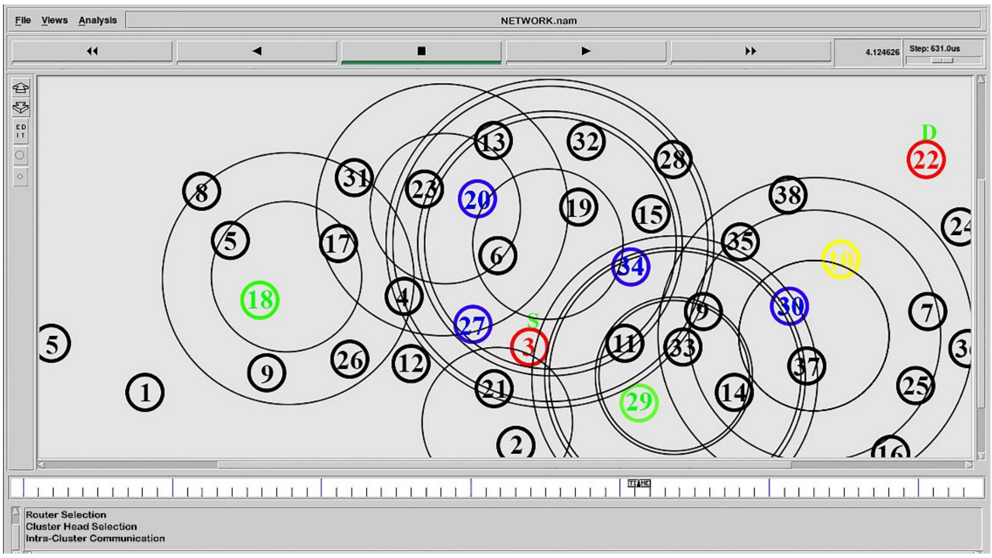


**Figure 2.** SDS heterogeneous network simulation in process.

The proposed scenario is designed to appropriately represent the deviating values of response metrics from their corresponding performance metric bounds in order to conserve network capacity and increase transmission ability. The values of the performance metrics are entered into the system to maximize and decrease the performance measure. Furthermore, the deviating value represents the balance of the trade-off between device demand and routing efficiency; both values are critical in balancing the weight of communication expenses. Using communication potential, the suggested SDS approach computes the optimal fitness value. The communication potential is associated with each device, which affects the behavior of particles to find the overall dataflow output value of a single parameter at a time. These values represent the new parameters upon which the performance of each heterogeneous network is analyzed in terms of round trip time (RTTP), network throughput, and energy consumption.

### *3.2. IoT Device to Device Link Selection Mechanism*

The routing path between the IoT devices are represented by $d\Delta$, which, in fact, foretells the best quality path but not a legitimate scrumptious link. Therefore, a predefined link selection attribute ($LSA$) is considered and all records are maintained in a data table corpus. Equation (1) shows the entire process of the link selection mechanism, where four varieties of links are determined. Sometimes, it happens that the best quality link is achieved but it does not belong to a targeted destination; therefore, such links are not considered as legitimate links.

$$LSA = \begin{cases} Scrumptious\ link, \\ Average\ link, \\ Fair\ link, \\ Uncouth\ link, \end{cases} \qquad LSA_{scrumptious} < d\Delta \tag{1}$$

Consider $pt$ as an absolute data packet sent from the source device and $ps$ to be the destination device's successfully accepted packet. The $pti$ represents the data packet sent from device node $i$, and would determine the connection quality through calculating the total $LSA$ and signal-to-noise ratio ($SNR$) of $pti$ in relation to the accessible networks. Equation (2) may be used to compute the link factor estimator ($LFE$) parameter.

$$lfe = D(i_{pt},\ S) - D(j_{pt}, S) \tag{2}$$

The $D(i_{pt}, S)$ and $D(j_{pt}, S)$ are taken from the Euclidean distance formula, i.e., from source device $i$ to the destination device $j$. $S$ represents the source region where nodes are found as $i = (i1, i2, i3, \ldots, in)$. The packet transmission from the $i$ sensor node moves toward the destination region denoted by $D$ and, therefore, respected packets are *pt_i*1, *pt_i*2, *pt_i*3.

The *LFE* parameters are calculated between the nodes ($i$) belonging to the source ($S$) region and the nodes ($j$) located at the destination ($D$) region, as illustrated in Figure 3.

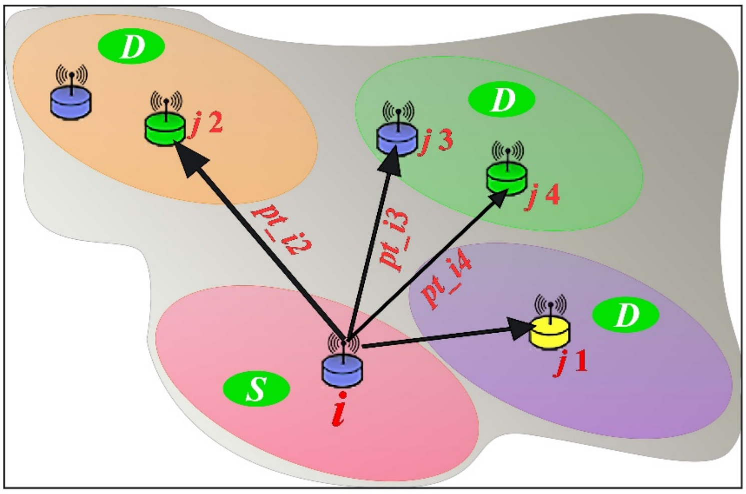


**Figure 3.** IoT-enabled device-to-device communication link selection mechanism.

The *pti* packet is created by the source device $i$, while *pt_i*2, *pt_i*3, and *pt_i*4 represent the packet formed from source device $i$ towards destination devices as a result of the displacement impact of nearby network overlapping. When the link quality reaches an acceptable level, the fixed device factor and link threshold parameter are verified according to the criteria given in Table 1.

**Table 1.** LSA link corpus.

| Metric Type | SNR | *LFE* | Scalability |
|---|---|---|---|
| Scrumptious link | >32 | >110 | >150 |
| Average link | 18–32 | 100–110 | 90–150 |
| Fair link | 10–18 | 50–100 | 30–90 |
| Uncouth link | 0–10 | 0–50 | 0–30 |

The *SNR* computes the signal-to-noise ratio by combining the loudness of the received signal and the background noise. Obtaining the *LFE* mean, the *SNR* strongly suggests that higher *LFE* and *SNR* threshold parameters result in a delicious connection. The selection of a delectable link between the source device and the next device was tested by executing a thorough test paradigm and, therefore, Algorithm 1 ratifies the subject finding's conclusion.

Description of Algorithm 1.

The packet (packetp*t*) created by the source device (device*i*) is distributed over the full transmission zone I via the first communication connection (*pt_i*1), which then expands towards the remainder of the next device inside the transmission zone as (*pt_i*2) and (*pt_i*3) and continues as seen in Figure 3. Furthermore, the link factor estimator determines delectable links by employing an extensive link testing technique and yielding astute outcomes (line 5–23). It considers when the value of the link factor estimator of the transmitted packet from sensor node device $i$ becomes greater or equal to the entire displaced route between source node $i$ and the destination node $j$. This entire segment remains shorter to the link factor estimator of the transmitted packet by sensor node device $i$ having the same parameters as that of the scrumptious link, where SNR and LFE is calculated between 32 to 100 and the overall condition is given as ( $LFE.\ tc_{pti} \geq d\Delta$ and $<$ $(LFE.\ tc_{pti} =$ Scrumptious link)). Then, this link is considered to be an "Average link" stated as ( $LFE.\ tc_{pti} =$ average link) on line #12. After establishing a strong link between the source and the next device, it advances to the next device, which requires a steady communication link with constant transmission power. Using an absolute transmitted packet (*pt*) and an acknowledgement packet (*ps*), the link factor estimator (*LFE*) and signal-to-noise ratio (*SNR*) are calculated (line 28–35). As a result, the link selection attribute corpus table is updated with the devices' current condition.

**Algorithm 1** Link consistency estimation and packet forwarding mechanism

1: **Procedure** LinkFactorEstimator {(*LFE.tc*), device***i***, packet***pt***}//Link consistency estimation
2: ***F*(*i*) = {*pt_i1*, *pt_i2* . . . . . . . .. *Pt_i*$_n$}**
3: ***Device i*** transmits packet ***pt*** over distance $d\Delta$
4: **Switch** $LFE.\ tc \leftarrow$ Types
5: **Case** 1: *Scrumptious_Link*
6: **if** $LFE.\ tc_{pti} < d\Delta$ **then**
7: $LFE.\ tc_{pti} =$ scrumptious link
8: **endif**
9: **EndCase**
10: **Case 2**: *Average_Link*
11: **if** $LFE.\ tc_{pti} \geq d\Delta$ & $<$ $(LFE.\ tc_{pti} =$ Scrumptious link) **then**
12: $LFE.\ tc_{pti} =$ average link
13: **endif**
14: **EndCase**
15: **Case 3**: *Fair_Link*
16: **if** $LFE.\ tc_{pti} \geq d\Delta$ & $<$ $(ALQ.\ tc_{pti} =$ average link) **then**
17: $LFE.\ tc_{pti} =$ fair link
18: **endif**
19: **EndCase**
20: **Case 4**: *Uncouth_Link*
21: **if** $d\Delta <$ $LFE.\ tc_{pti}$ **then**
22: $LFE.\ tc_{pti} =$ uncouth link
23: **endif**
24: **EndCase**
25: **end Procedure**
26:
27: **Procedure PacketTransmission**(device***i***, packet***pt***, $d_{irj}$, *lfe*, *snr*, *(TransmittingDevicei2,i3)*, *lct*}//Devices transmit the packets
28: ***pt*** ←absolute transmitted packet
29: ***ps*** ←packet received and acknowledge by destination
30: **if** LinkFactorEstimator(*lfe*) = $LFE.\ tc_{pti}$ **then**
31: **goto** line 2
32: Debuts: *F(i)* = $\varphi$
33: for ($i_{2,3}$) = 1: Max
34: Max = $T_{ip}$ //transmission impulses
35: **if** Signal-to-NoiseRatio (*snr*) = $LFE.\ tc_{pti}$ **then**
36: **goto** line 2
37: **endif**
38: **End**for
39: **Endif**
40: Compute $N\left(d_{irj}, f\right) \geq D_0$
41: update LFETable//Link Corpus Table
42: *F (i)* = *F (i)* +{$pt_{2,3}$}
43: **end Procedure**

### 3.3. Packet Transmission between IoT Devices

Usually, various applications are used to avail the IoT devices for packet movement. In fact, it builds a device-level heterogenous environment. The device $i$ receives numerous data packets from other devices, such as $i1$ to $i2$. The colored lines between all devices illustrate the various applications. This scenario shows that even at the device level, the applications also communicate in a heterogenous environment.

## 4. Performance Analysis

After the completion of the simulation process, the output results were collected according to the given scenario, and simulation setting parameters are shown in Table 2. These parameters maintain the stability of the execution process, and the fixed values, for instance, number of networks, the specified area distance among the devices, transmission communication range, number of devices for each network, and the transmission rounds, etc., are indeed in real-time perception. The execution process directly depends on these parameters, which might change the output of the results. For instance, transmission starting energy has been fixed to 7 Joules for the entire round. If at some stage this energy level changes, it would definitely affect the results and could cause dysfunction. The NS2 simulator is the best approach for wireless communication when the real-time data transmission would be required in an efficient manager. The proposed SDS model was compared to three state of the art protocols: high-speed packet access (HSPA), content-centric networking (CCN), and dynamic source routing (DSR). The output performance is analyzed on the basis of round trip time (RTTP), network throughput, and energy consumption.

**Table 2.** Simulation setting values.

| Parameter | Value |
|---|---|
| Number of networks | 4 |
| Area | $500 \times 500$ m$^3$ |
| Distance devices | 10 m |
| Number of devices in each network | [10–30] |
| Communication range | 500 m |
| Type of protocol | OSPF |
| Start energy | 100 J |
| Medium | Wireless |
| Bandwidth capacity | 100 Kbps |
| Packet generation rate | 0.03 pkts/min |
| Energy consumption | 2 W; 1.75 W; 8 mW |
| Data packet volume | 64 bytes |
| Data packet interval (Hello) | 99 s |
| Packet creation time | 15 s |
| No. of runs | 50 |

### 4.1. Computing Round Trip Time

The RTTP represents the amount of time it takes for a source device to send a request to the destination device and to receive acknowledgment. Usually, this technique is used to determine the health of a network connection. Analyzing the results shown in Figure 4, the overall response time of HSPA, CCN, DSR, and the proposed SDS protocols can be observed more scrumptiously. It can be seen that the network devices are responding quickly and remain active. If these devices take longer, in contrast to the standard time, it means that there are some anomalies that hinder the packet movement as well as the network lifespan.

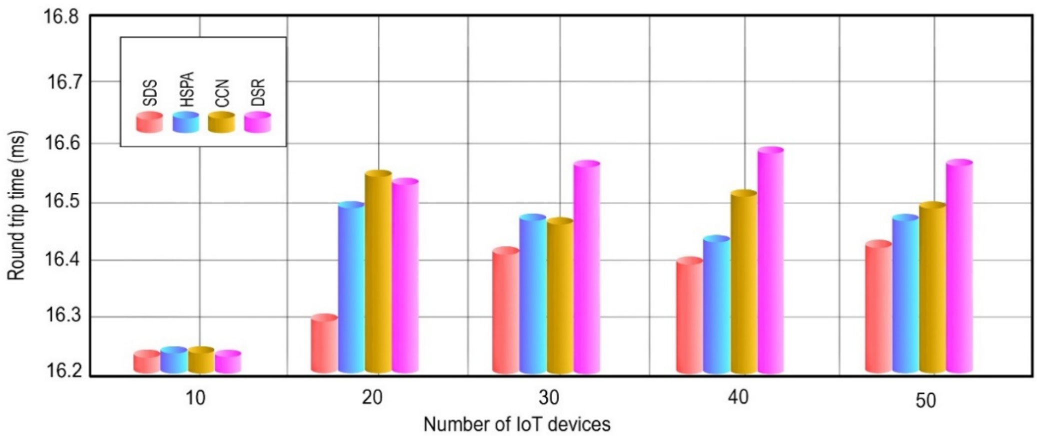


**Figure 4.** Round trip time computation.

When compared to the rest of the protocols, the SDS takes substantially less time. In reality, our suggested technique uses LSA to identify the best link between the source and the following device. The chosen communication link carried the most energy, but the identical devices coupled with other protocols carried far less energy and were judged inoperable. It produces tangle-free routing and seamless network functioning.

It can be observed that as the number of devices increased, i.e., to 20, the RTTP for CCN somehow became greater, but when approaching device 30, it decreased. This happened due to some unavoidable changes in the routing port, which sometimes blocks the traffic but soon releases. Although HSPA worked better than the other protocols in certain ways, since devices with modest distances were picked more frequently, the data reveal a fast delay when reaching device 50. For DSR, transmission appeared to be more crucial, reducing network lifetime and requiring additional resources to alter response time. It is worth noting that device responsiveness appears to be lower in CCN than in others. The source device continues to deliver data packets until the energy level falls below a certain threshold, putting a heavy pressure on the server. The SDS, on the other hand, changes the momentum during packet transmission and responds quickly. From device 10 to 50, the RTTP time remained less than all other protocols.

### *4.2. Network Throughput*

Throughput is the rate at which a packet or information is successfully transmitted over a network and recognized by the destination device. Network throughput and the packet dissemination ratio both assess network strength, and throughput is directly proportional to the packet dissemination ratio in general. When the network became denser and the number of devices increased, the extravagant communication load immediately impacted the SDS's performance metrics. In this case, the LSA's judicious link selection considerably influences the throughput ratio. The result shown in Figure 5 vouches for the tremendous achievement made by the proposed SDS as compared to the HSPA, CCN, and DSR. At IoT device 10, the throughput of the SDS reached more than 75%, followed closely by HSPA. When SDS reaches device 50, the amazing results can be illustrated by its throughput maintaining high energy levels while the rest of the protocols are about to lose energy.

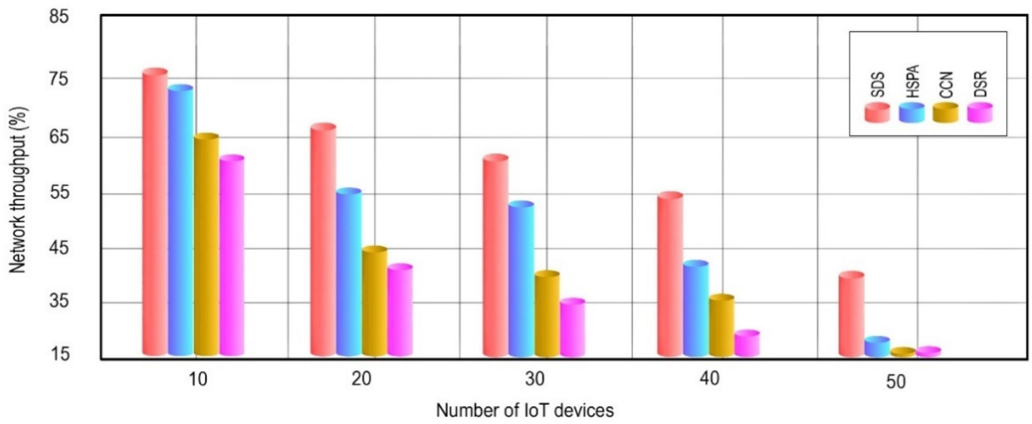


**Figure 5.** Proposed SDS network throughput.

### *4.3. Energy Consumption*

The overall energy consumption by all IoT devices during packet transmission is known as system energy consumption. As the SDS establishes the communication link by considering the predefined values available in the LSA corpus table, only the prudent links are chosen, and the rest of the links are ignored, consequently, it prevents energy wastage and energy is only utilized for the prudent link. In Figure 6, it can be seen that the SDS has only utilized a confined energy level when the link was selected by the IoT device 10 whereas HSPA, CCN, and DSR utilized exorbitant energy. Similarly, at IoT device 50, the SDS still has a substantial energy level while the rest of the protocols' energy is almost empty. Considering the above discussion, it can be concluded that the proposed SDS mechanism has extraordinary performance as compared to the rest the protocols (HSPA, CCN, and DSR). This only became possible due to adopting a prudent LSA technique.

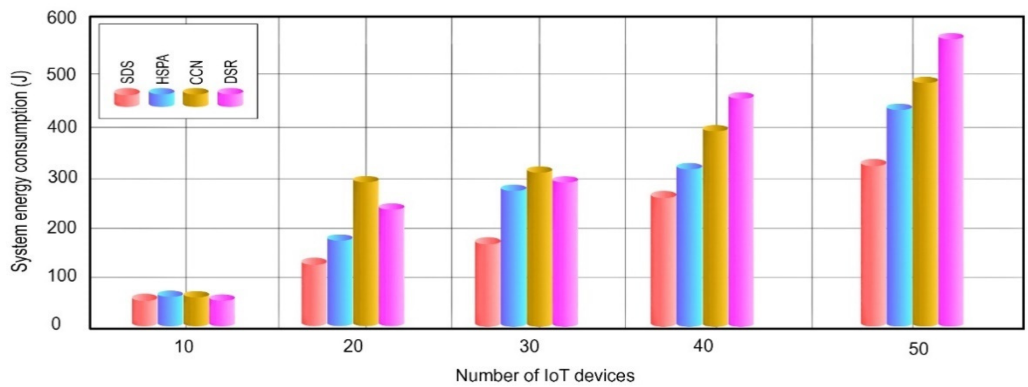


**Figure 6.** Overall system energy consumption.

## 5. Conclusions

This study was focused on streamlining the better dataflow mechanism by establishing the prudent communication link among IoT devices for a community based wireless network. The proposed scrumptious dataflow strategy (SDS) has achieved this by developing an LSA data corpus that possessed the pre-defined link parameters. The results were obtained through an NS2 simulator. The output performance of this system has vouched for the statement that was made in the methodology section about the performance. The results were obtained on the basis of a round trip time (RTTP), network throughput, and system energy consumption, and were compared with the results of HSPA, CCN, and DSR protocols. The comparison proved that the SDS performed much better than the rest of the protocols. To compute round trip time, the SDS utilized only 16.4 milliseconds to reach IoT device 50, and was first to do so. Similarly, for network throughput, at IoT device 50, the throughputs are recorded at 40% while the rest of the other protocols died. Finally, when the energy consumption used to reach IoT device 50 was computed, the proposed SDS was functional and possessed more than half of its energy compared to other protocols. The SDS only utilized 302 joules while the rest of the protocols were about to die as they had consumed all of their energy.

**Author Contributions:** S.A. implemented the idea and designed images and tables. Z.R. solved the topology design problem and wrote the algorithm; N.A.I. accepted the entire module. Comprehensive proofreading has been performed by P.K.B. and E.H.S. All authors have read and agreed to the published version of the manuscript.

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