**6. IOTA**

The IOTA framework serves as a blockchain-less distributed ledger which can be used to perform transactions and data transfers. An IOTA token is a cryptocurrency designed for the Internet-of-things. The distributed ledger which consists of the transactions in the network is radically different in IOTA where a directed acyclic graph (DAG) termed as ‘Tangle’ thus eliminating the use of blockchains. A DAG is a data structure in the form of a graph where the nodes are connected by means of edges. Further, the nodes in the graph consist of edges which point in a specific direction to the other node. The acyclic component specifies that the edges are not circular and point in a single direction only thereby avoiding cycles. [1]

In Ethereum and Eris, the verification of transactions is decoupled from the users involved. The miners verify the transactions to reach a consensus and they receive incentives for the same. But in IOTA, the verification process is intrinsic since IOTA is self-sustained and miners need not be given incentives for verifying the transactions. This implies that transaction settlements and data transfer can be performed without any additional fees which fosters machine to machine communication and enhances the interoperability between the connected devices. Blockchains typically can be used to establish smart contracts between parties on a large scale but IOTA is the first framework which provides a feasible framework for devices to carry out micro transactions. In micro transactions, small amount of payments for instance 5 cents or 0.1 cents can be transferred between parties thereby making the transactions feasible by eliminated the transaction fee. [2]

**6.1 Tangle**

The directed acyclic graph (DAG) which is referred to as a “Tangle” stores all the transactions serving as the distributed ledger. The remarkable features of tangle include scalability, light- weightiness, tamper-proof, higher protection equivalent to quantum-computing. Given the huge ecosystem of Internet-of-things, a light weight framework is needed to serve at a larger scale and the tangle is designed for this purpose.

When a new transaction initiated by a node enters, it approves two previous transactions. The transactions approved are represented in the form of directed edges which are not looped i.e acyclic. Consider two nodes A and B which do not have a directed edge between them but do have a path where A approves B, B approves C, then A indirectly approves C. A transaction receives more acceptance from the system when it receives higher number of approvals. A transaction which is not approved is known as a tip.

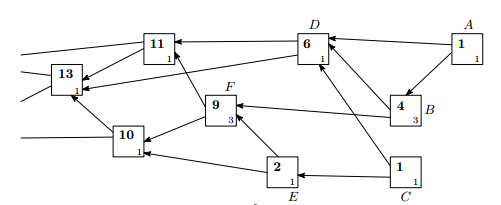


Fig 6.1 Tangle , Directed Acyclic Graph (DAG)

Source: Popov, Serguei. IOTA - Next Generation Blockchain, 3 Apr. 2016, iotatoken.com/IOTA\_Whitepaper.pdf. Accessed 31 Nov. 2016.

Consider the above tangle and the transactions A, B, C, D, E, F which are referred to as ‘sites’. The values mentioned in the bottom of the box are the own weights of the transactions which are proportional to the amount of work a node puts into it. The values are expressed in the form of 3n where n takes the value of a positive integer. Consider the transaction D with its own weight 1. A, B, C are the transactions which approve D. A ‘cumulative weight’ is the sum of the own weights of the approvers (direct and indirect) and the own weight of the transaction. In the case of site D, the own weights of A, B, C, which are 1,3,1 are added to the weight of D which is 1 thus making the cumulative weight 1+3+1+1=6. Thus the value 6 mentioned in transaction D (in the figure) is the cumulative weight. In the above graph, A and C are the tips since their transactions are not approved. [3]

[1] Varshney, Neer. "The Internet of Things, Blockchain-less Token IOTA Launched: Interview with Co-Founder." CoinTelegraph, 20 July 2016, cointelegraph.com/news/the-internet-of-things-blockchain-less-token-iota-launched-interview-with-co-founder. Accessed 1 Dec. 2016.

[2] "IOTA Introduction." IOTA, iota.readme.io/docs/glossary. Accessed 1 Dec. 2016.

[3] Popov, Serguei. IOTA - Next Generation Blockchain, 3 Apr. 2016, iotatoken.com/IOTA\_Whitepaper.pdf. Accessed 31 Nov. 2016.