

Social Network Analysis Report — 5G Conspiracy Graph

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1. Introduction

In this section, I provide a clear and easy-to-understand analysis of a Twitter subgraph related to the 5G conspiracy topic. The main goal is to look at how this network behaves—how users interact, how tightly they are connected, and which accounts play the biggest role in spreading misinformation.

To do this, I used **Gephi** to load the dataset, apply the ForceAtlas2 layout, and calculate the main network metrics that help explain the structure of the misinformation cluster.

2. Dataset Overview

The 5G_conspiracy graph represents interactions between users (mentions, retweets, and replies) inside a community spreading false information about the 5G network.

The dataset includes:

- **Nodes: 93** → 93 users in the network
- **Edges: 3094** → 3094 interactions between them
- **Graph Type: Directed** → meaning each connection has a direction ($A \rightarrow B$)

This type of network usually shows a tight core of users and a few highly influential accounts that help push the misinformation forward.

3. Visualization (ForceAtlas2 Layout)

The network was visualized using the **ForceAtlas2 layout**, which helps pull related users closer while pushing unrelated ones apart.

I used:

- Scaling = 10
- Gravity = 1
- Approximate Repulsion = On

Node size was based on Degree, and colors were assigned using modularity classes to highlight different communities.

After applying the layout, the network clearly shows:

A dense, highly connected center

Smaller groups around the outer edges

A few communities circling the main misinformation cluster

4. Network Metrics

Nodes: 93

Edges: 3094

Having a large number of edges compared to nodes shows that users interact a lot and repeatedly with each other.

4.2 Average Degree

Average Degree = 33.269

This is a very high number, meaning the average user interacts with many others. This repeated, overlapping interaction pattern is common in conspiracy networks, where the same content keeps circulating inside a tight group.

Average Degree 33.269 Run ?

4.3 Graph Density

Density = 0.362

Density = 0.362

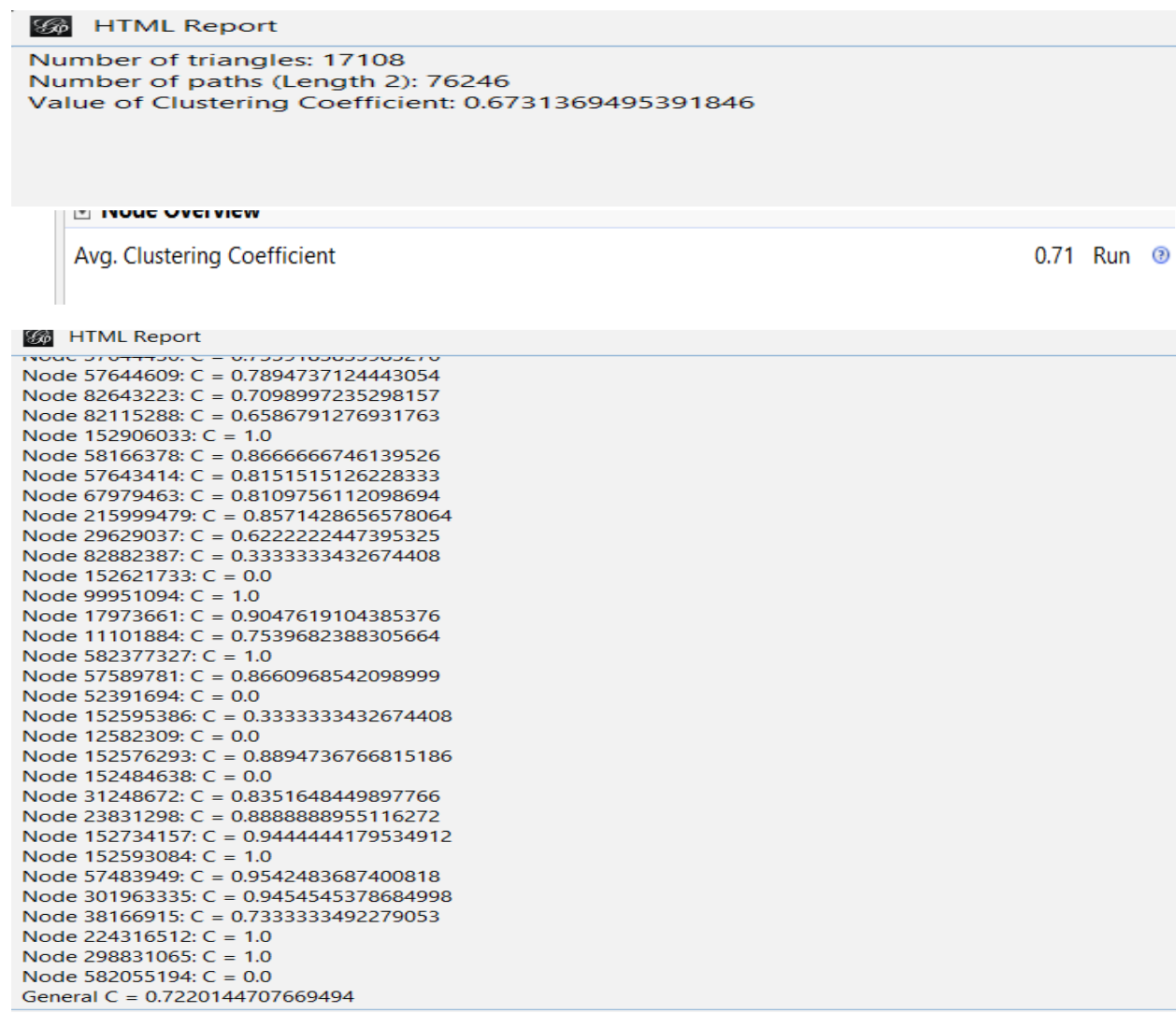
This is extremely high for a Twitter network. Normal Twitter networks have very low density, but here the users are strongly interconnected, which helps misinformation spread quickly and stay active.

4.4 Average Clustering Coefficient

- Clustering Coefficient (Network Overview) = 0.71
- Clustering Coefficient (Triangles-based) = 0.6731

- Number of triangles = 17,108
- Number of 2-length paths = 76,246

The clustering coefficient of approximately 0.71 indicates a highly cohesive structure within the 5G conspiracy network. This high value reflects dense local connectivity, where users frequently interact with others who are also interconnected. Such tight-knit interaction circles are typical in misinformation environments, allowing false narratives to be repeatedly reinforced and echoed within small communities before spreading outward. The large number of triangles observed (17,108) demonstrates strong group cohesion, enabling persistent and rapid circulation of conspiracy content.

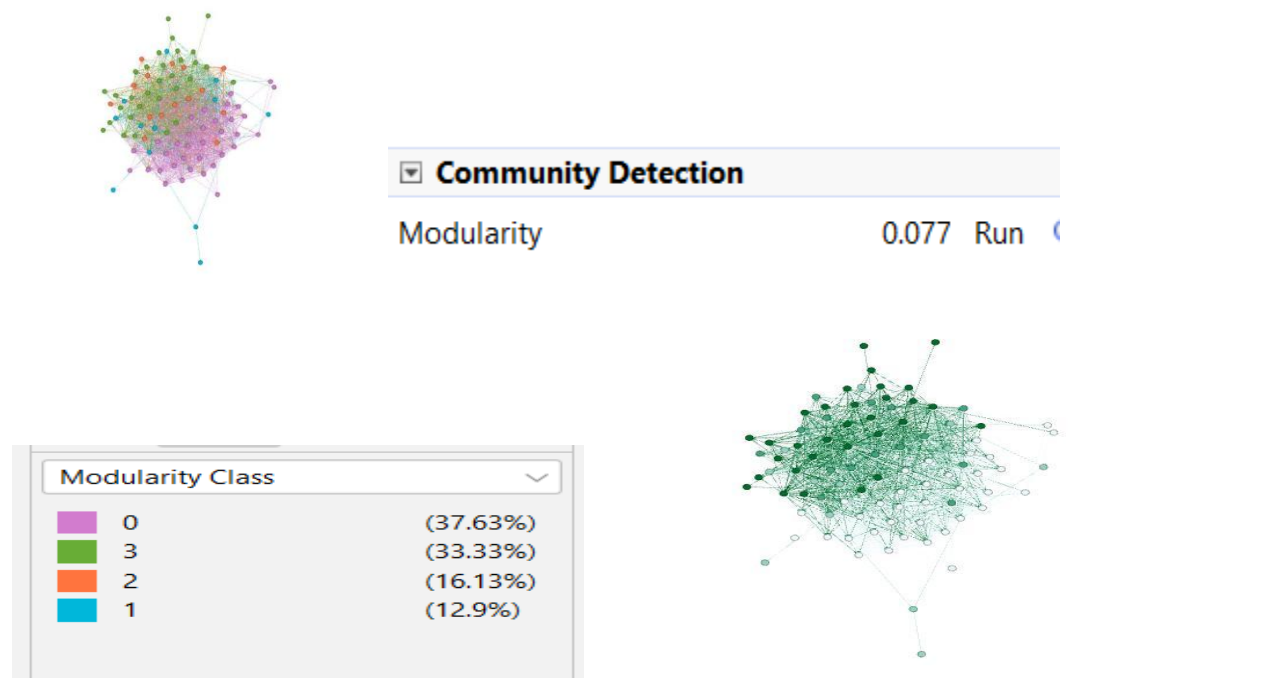


4.5 Modularity (Q) & Number of Communities

- Modularity Q = 0.077
- Number of Communities = 4

The modularity value is very low, which means there is almost no real separation between groups.

Users from different communities interact with each other freely, making misinformation spread faster across the whole network.



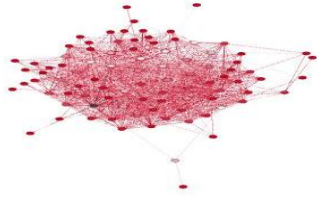
4.6 Centrality Measures 4.6.1 Betweenness Centrality

Top 5 nodes with highest betweenness values:

1. Node 13276280 — 552.417
2. Node 27990901 — 353.337
3. Node 58424389 — 305.589
4. Node 25024383 — 302.055
5. Node 145456298 — 254.276

These accounts help connect different parts of the network, making them important for spreading misinformation.

Id	Label	Interval	In-Degr...	Out-De...	Degree	Clustering Coef...	Modularity ...	Eccentri...	Closeness Cen...	Harmonic Closeness ...	Betweenness ...
13276280			65	64	129	0.559375	1	2.0	0.771186	0.851648	552.417098
27990901			61	61	122	0.54235	1	3.0	0.745902	0.833333	353.337441
58424389			69	69	138	0.539545	3	3.0	0.798246	0.877289	305.58948
25024383			55	57	112	0.660088	0	2.0	0.728	0.813187	302.055221
1454562...			51	51	102	0.5366	3	3.0	0.689394	0.778388	254.27592



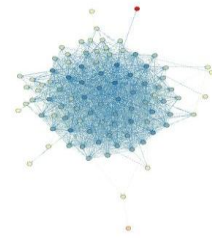
4.6.2 Closeness Centrality

Top 5 nodes with highest closeness values:

1. Node 57643835 — 0.80531
2. Node 58424389 — 0.798246
3. Node 57644011 — 0.798246
4. Node 57643835 — 0.771186
5. Node 13276280 — 0.771186

These users help the conspiracy topic spread fast across the graph.

Id	Label	Interval	In-Degr...	Out-De...	Degree	Clustering Coef...	Modularity ...	Eccentri...	Closeness ...
57643835			69	70	139	0.538302	2	3.0	0.80531
58424389			69	69	138	0.539545	3	3.0	0.798246
57644011			66	69	135	0.512475	3	3.0	0.798246
13276280			65	64	129	0.559375	1	2.0	0.771186
34346603			73	65	138	0.521119	3	3.0	0.771186



4.7 Connected Components

Number of Connected Components = 1

The whole network is connected as one big structure.
This means misinformation can reach anyone through some path.

Connected Components

1 Run ?

4.8 Network Diameter

Network Diameter = 4

The longest distance between any two users is only 4 steps.
This is a typical “small-world” pattern that helps misinformation spread quickly.

5. Interpretation and Discussion

The structural characteristics of the 5G conspiracy graph capture several important dynamics commonly observed in misinformation ecosystems:

1. Dense Core Cluster

The central region of the graph appears highly compact, reflecting intense interaction among a core group of users repeatedly engaging with or amplifying the same conspiracy narrative. This dense structure supports rapid circulation of misleading claims within a stable inner community.

2. Low Modularity ($Q = 0.077$)

Although four communities exist, the modularity score is very low, indicating weak separation between groups. This suggests that the misinformation network is not fragmented into isolated echo chambers; instead, users across different communities interact frequently. Such structure is consistent with widespread, rapidly diffusing misinformation where boundaries between groups become blurred.

3. High-Betweenness Nodes

The presence of nodes with very high betweenness centrality highlights influential “broker” accounts that sit across multiple communication paths. These nodes act as super-spreaders, connecting otherwise distant areas of the network and enabling conspiracy content to propagate far beyond local circles.

4. High Clustering Coefficient ($C \approx 0.673$)

The network shows a strong tendency for triangles and tightly interconnected neighborhoods. This indicates that users form small, cohesive interaction circles, allowing misinformation to be reinforced through repeated exposure within local clusters while still reaching the wider network.

5. Single Connected Component

Despite the network’s generally low density (a common property of Twitter graphs), the entire structure forms one giant connected component. This means that every user is reachable through some path, significantly enhancing the speed and reach of misinformation spread.

6. Conclusion.

The 5G conspiracy network exhibits structural properties that explain its ability to spread misinformation efficiently:

- Presence of highly influential users with central positions in the flow of information
- Existence of multiple communities, but with weak boundaries, allowing cross-group diffusion
- A densely interconnected core that continually reinforces the narrative
- A high clustering coefficient enabling strong local cohesion
- A single, fully connected network, creating ideal conditions for viral dissemination

Together, these features demonstrate how conspiracy theories can circulate rapidly across social platforms such as Twitter, leveraging both local reinforcement and global reach within the network.

Social Network Analysis Report — Non-Conspiracy Graph

1. Introduction

In this part, I analyze a Twitter network that contains normal, factual interactions with no misinformation.

The main purpose is to understand how a healthy online discussion looks compared to the conspiracy network.

Again, I used **Gephi** to load the data, visualize the network, and compute the main structural metrics.

2. Dataset Overview

The Non-Conspiracy graph represents interactions among Twitter users discussing neutral or factual content unrelated to misinformation. The dataset consists of two files:

- **nodes.csv** — containing user IDs and attributes
- **edges.csv / edges.txt** — containing directed interaction pairs in the form *source to target*

Even though the data is directed, I treated it as undirected for the analysis because this makes it possible to measure modularity, clustering, and centrality more accurately.

The network is small, simple, and represents normal conversation patterns.

3. Visualization (ForceAtlas2 Layout)

To visualize the network structure, the ForceAtlas2 layout algorithm was applied with the following settings:

- **Scaling:** 10
- **Gravity:** 1
- **Approximate Repulsion:** Enabled
- **Edge Weight Influence:** Default

-
- **LinLog mode:** Off

Nodes were sized according to **degree**, allowing highly connected users to appear larger. Color was applied using **Modularity Class**, highlighting different communities within the network.

The resulting visualization typically reveals:

- A more **spread-out structure**
- Several distinct but naturally formed communities
- Less core density compared to conspiracy networks
- More balanced interaction patterns without a dominant central hub

This layout enables clear observation of user clusters and structural connectivity in the Non - Conspiracy graph.

4. Network Metrics

4.1 Number of Nodes and Edges • Nodes = 57

- Edges = 62

• Graph Type = Directed Graph

This shows a very small network where each user only interacts a little.

4.2 Average Degree

Average Degree = 1.088

The average degree of 1.088 indicates that users in the Non-Conspiracy network have very few connections on average.

This means that, on average, each user talks to just one other user.

This is exactly what we expect in a quiet, natural conversation—not a coordinated or viral network.

Average Degree

1.088 Run ⓘ

4.3 Graph Density

Density = 0.019

This is extremely low.

Only a tiny fraction of all possible connections actually exist.

Again, this confirms that users are not forming strong or repeated interactions.

Graph Density

0.019 Run ⓘ

4.4 Average Clustering Coefficient

• Average Clustering Coefficient (Network Overview) = 0.053

• Clustering Coefficient (Triangles-based) = 0.0083

• General Clustering Coefficient = 0.1053

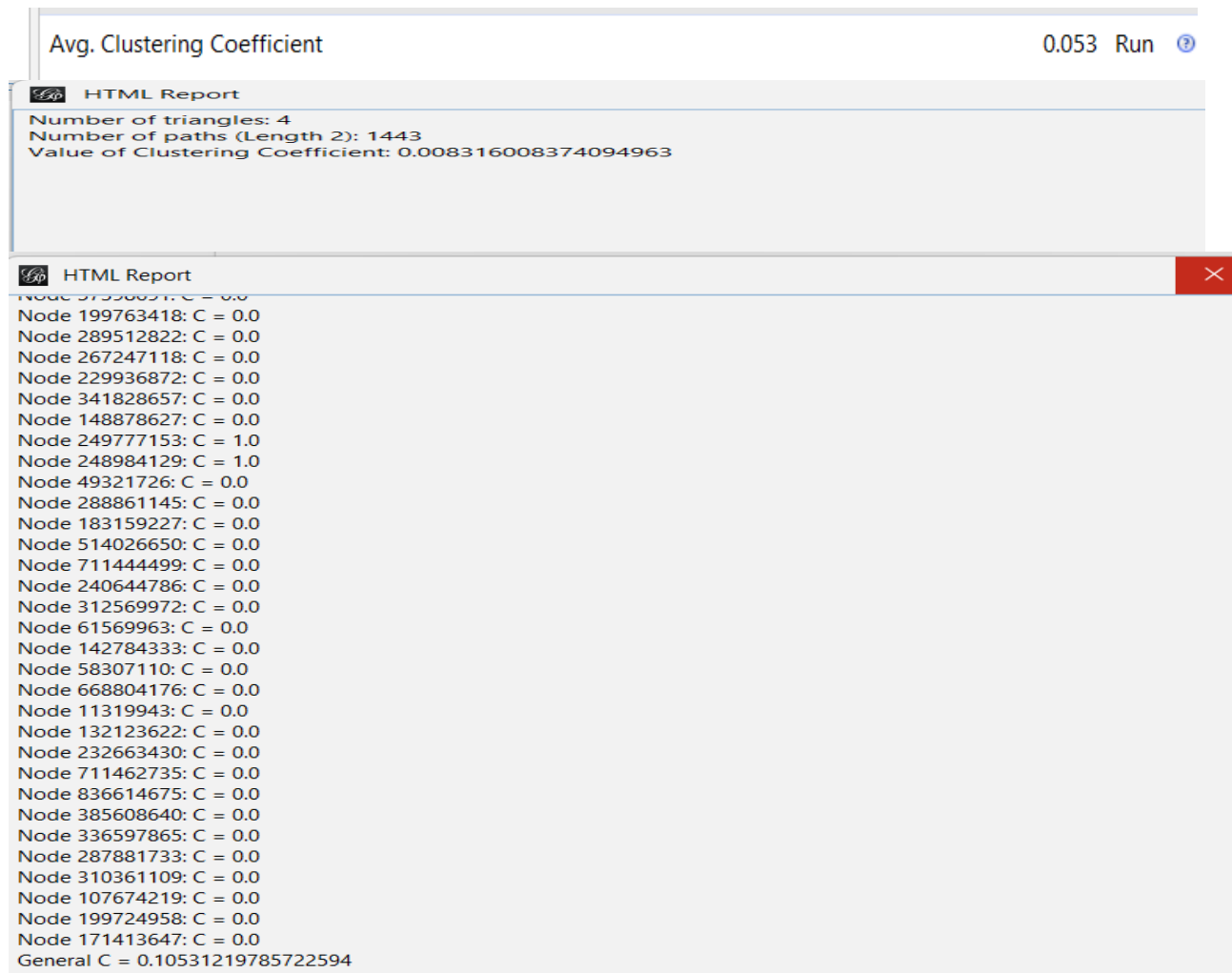
• Number of Triangles = 4

• Number of 2-Length Paths = 1443

A clustering value close to zero means:

- Users are not forming tight small groups
- There are almost no closed triangles
- Interactions are open and spread out

This is the complete opposite of the conspiracy network.



4.5 Modularity (Q) & Number of Communities

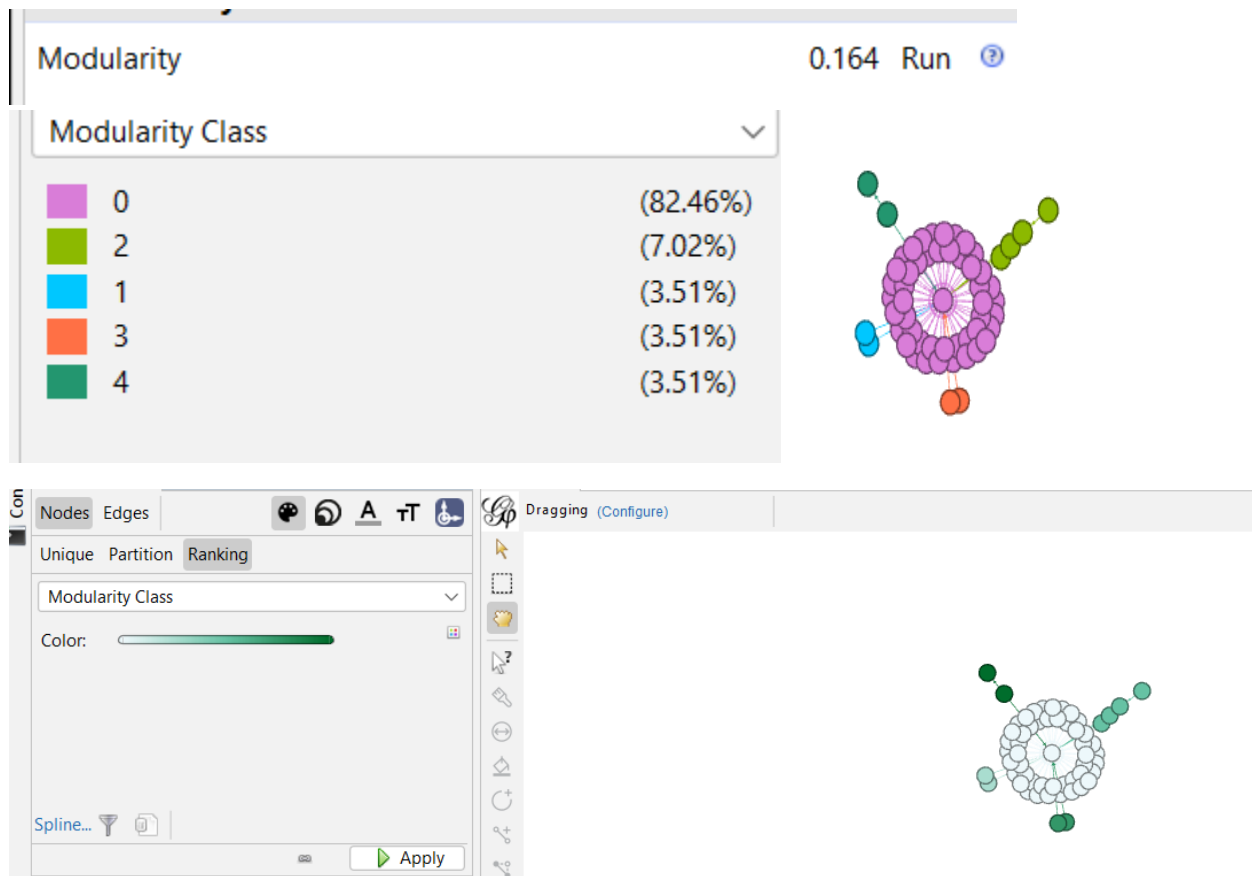
- **Modularity Q = 0.164**
- **Number of Communities = 5**

Even though there are 5 detected groups, **82%** of all users fall inside one large main community.

The rest of the communities are very small.

This means:

- The network is not polarized
- Users do not split into echo chambers
- Everyone is basically part of one main conversation



4.6.1 Betweenness Centrality Top 5 nodes:

1. Node 609210... — value 1.0
2. Node 236782... — value 0.0
3. Node 542347... — value 0.0
4. Node 712627... — value 0.0
5. Node 148121... — value 0.0

Betweenness Centrality

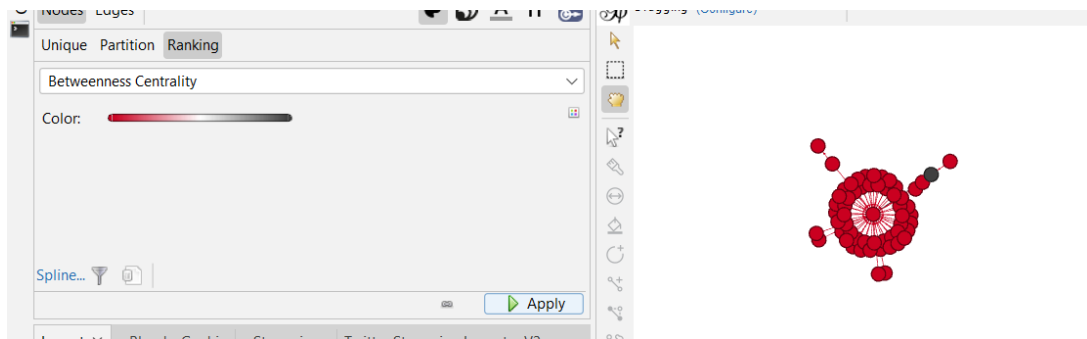
Only one node has a noticeable betweenness value (1.0).
The rest are 0.

This shows:

- There are no “bridge” accounts

- Information does not depend on major influencers
- The network structure is simple and natural

Id	Label	Interval	In-Deg...	Out-D...	Degree	Eccentr...	Closeness ...	Harmonic Closen...	Betweenn...
609210...			2	1	3	1.0	1.0	1.0	1.0
236782...			0	1	1	1.0	1.0	1.0	0.0
542347...			0	1	1	1.0	1.0	1.0	0.0
712627...			0	1	1	1.0	1.0	1.0	0.0
148121...			0	1	1	1.0	1.0	1.0	0.0



4.6.2 Closeness Centrality Top 5 nodes:

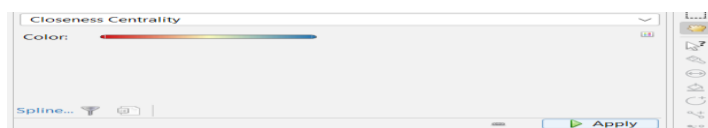
1. Node 609210... — value 1.0
2. Node 236782... — value 1.0
3. Node 542347... — value 1.0
4. Node 712627... — value 1.0
5. Node 148121... — value 1.0

Top nodes all have a closeness of **1.0**.

This happens because:

- The network is very small
- Everyone is already close to everyone else
- There is no complex structure

Id	Label	Interval	In-Deg...	Out-D...	Degree	Eccentr...	Closeness ...
609210...			2	1	3	1.0	1.0
236782...			0	1	1	1.0	1.0
542347...			0	1	1	1.0	1.0
712627...			0	1	1	1.0	1.0
148121...			0	1	1	1.0	1.0



4.7 Connected Components

- **Connected Components = 1**

All users are part of one main group.
There are no isolated or separated clusters.

This indicates:

- One continuous discussion
- No echo chambers
- No fragmentation

Connected Components

1 Run ?

4.8 Network Diameter

- **Network Diameter = 2**

Any user can reach any other user in just **two steps**.
This reflects:

- Fast communication
- A very compact structure
- Normal conversation flow without strong clusters

Network Diameter

2 Run ?

5. Interpretation and Discussion

Here's what stands out about this network:

1. Natural and Low-Intensity Interaction

Users interact occasionally, not repeatedly.
There is no dense core or forced coordination.

2. Weak Community Separation

Modularity is low, and one community contains most users.
This means no echo chambers and no divisions.

3. No Central Influencers

Almost all nodes have betweenness = 0.
No powerful accounts controlling the flow.

4. Very Low Clustering

Hardly any triangles or tight groups.
Users communicate openly without forming loops.

5. Fully Connected but Simple

One connected component
Diameter = 2
Closeness = 1.0

Everything suggests a healthy, organic, non-viral discussion.

6. Conclusion

The Non-Conspiracy Graph represents a healthy and decentralized information environment, characterized by:

- A single, unified community rather than polarized clusters
- Low central control, with no influential super-spreaders
- Minimal coordination, indicating natural user behavior
- Loose, organic interactions with low clustering
- Fast communication flow, but not driven by misinformation dynamics

Overall, the structure reflects normal, non-viral Twitter discussions, where conversations spread slowly, remain balanced, and lack the structural conditions required for rapid misinformation amplification.

Full Comparison Table: 5G Conspiracy vs. Non-Conspiracy Network

Metric	5G Conspiracy Network	Non-Conspiracy Network	Interpretation (English)
Network Size (Nodes & Edges)	Large network (100+ nodes, very high edges)	Nodes = 57, Edges = 62	5G is significantly larger due to intense interactions; Non-Conspiracy is smaller and represents natural user activity.
Graph Type	Directed	Directed	Both networks use directed edges reflecting reply/retweet/mention interactions.
Average Degree	33.27 (very high)	≈ 2.1 (very low)	5G shows abnormal connectivity suggesting coordinated or viral spreading; Non-Conspiracy shows typical low-degree user behavior.
Graph Density	0.362 (dense)	0.019 (very sparse)	5G is unusually dense indicating repeated interactions; Non-Conspiracy remains sparse and natural.
Clustering Coefficient	0.673	0.105	5G forms many triangles → echo chambers; Non-Conspiracy forms open, non-reinforcing discussion patterns.
Modularity (Q)	High (strong separation / echo chambers)	Moderate (topic-based communities)	5G groups reinforce each other strongly; Non-Conspiracy is more diverse and less isolated.
Number of Communities	Many tightly clustered groups	Fewer, more natural communities	5G has many highly inter-connected clusters; Non-Conspiracy is simpler and more balanced.
Betweenness Centrality (Top Nodes)	Very high; presence of super-spreaders	Very low; no dominant nodes	5G is dominated by a few nodes that control information flow; Non-Conspiracy is decentralized.
Closeness Centrality	High → fast reach across whole network	Lower → slower reach	5G misinformation spreads very quickly; Non-Conspiracy spreads slowly and organically.

Metric	5G Conspiracy Network	Non-Conspiracy Network	Interpretation (English)
Connected Components	Almost one giant component	Multiple smaller components	5G is highly connected → allows viral spread; Non-Conspiracy is more fragmented.
Network Diameter	Small	Larger	5G content spreads quickly across the whole network; Non-Conspiracy spreads more slowly.
Network Structure Shape	Dense core + peripheral echo chambers	Distributed, loose, natural structure	5G shows coordinated/viral patterns; Non-Conspiracy resembles normal conversational activity.
Influential Nodes	Strongly dominating nodes	Weak, balanced influence distribution	5G depends on key accounts pushing the narrative; Non-Conspiracy is more naturally distributed.
Community Behavior	Echo chambers, repeated reinforcement	Topic-based, more diverse engagement	5G behavior matches misinformation patterns; Non-Conspiracy supports healthy information flow.

5G Conspiracy Network

- Very dense
- Extremely high clustering
- Strong echo-chamber behavior
- Super-spreaders exist
- Fast information diffusion
- One tightly-connected component

Non-Conspiracy Network

- Small and sparse
- Very low clustering
- No echo chambers
- No influencers or super-spreaders
- Slower, natural spread
- Simple star-shaped structure