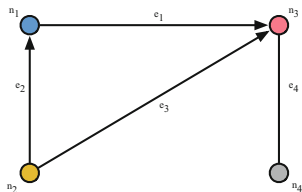
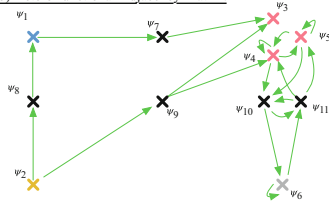


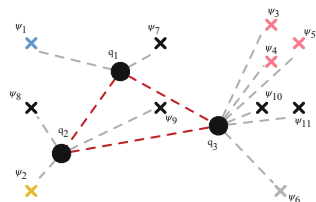
(a) Original Network Topography:



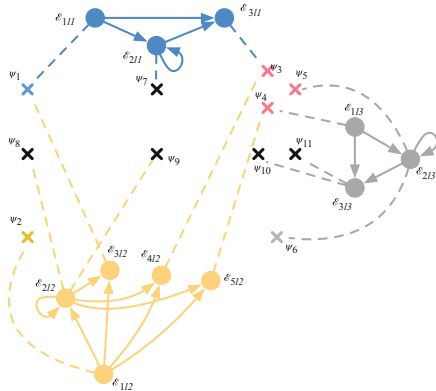
(b) Hetero-functional Adjacency Matrix:



(c) Controller Adjacency Matrix with Controller Agency Matrix:



(d) Service Graphs with Service Feasibility Matrix:

**Legend:**Nodes:

n_1 : Water Treatment Facility
 n_2 : Solar PV
 n_3 : House
 n_4 : Work Location

Edges:

c_1 : Water Pipeline
 c_2 : Power Line 1
 c_3 : Power Line 2
 c_4 : Road

Cyber-resources:

q_1 : Water Utility
 q_2 : Electric Utility
 q_3 : End User

Degrees of Freedom:

w_1 : treat water at water treatment facility
 w_2 : generate electricity at solar PV
 w_3 : consume water at house
 w_4 : charge EV at house
 w_5 : park EV at house
 w_6 : park EV at work location
 w_7 : transport water from water treatment facility to house with water pipeline
 w_8 : transport power from solar PV to water treatment facility with power line 1
 w_9 : transport power from solar PV to house with power line 2
 w_{10} : discharge EV from house to work location with road
 w_{11} : discharge EV from work location to house with road

Service Activities:

e_{111} treat water	e_{412} consume water
e_{211} continuing water	e_{512} charge EV
e_{311} consume water	e_{113} charge EV
e_{112} generate electricity	e_{213} continuing EV
e_{212} continuing electricity	e_{313} discharge EV
e_{312} treat water	