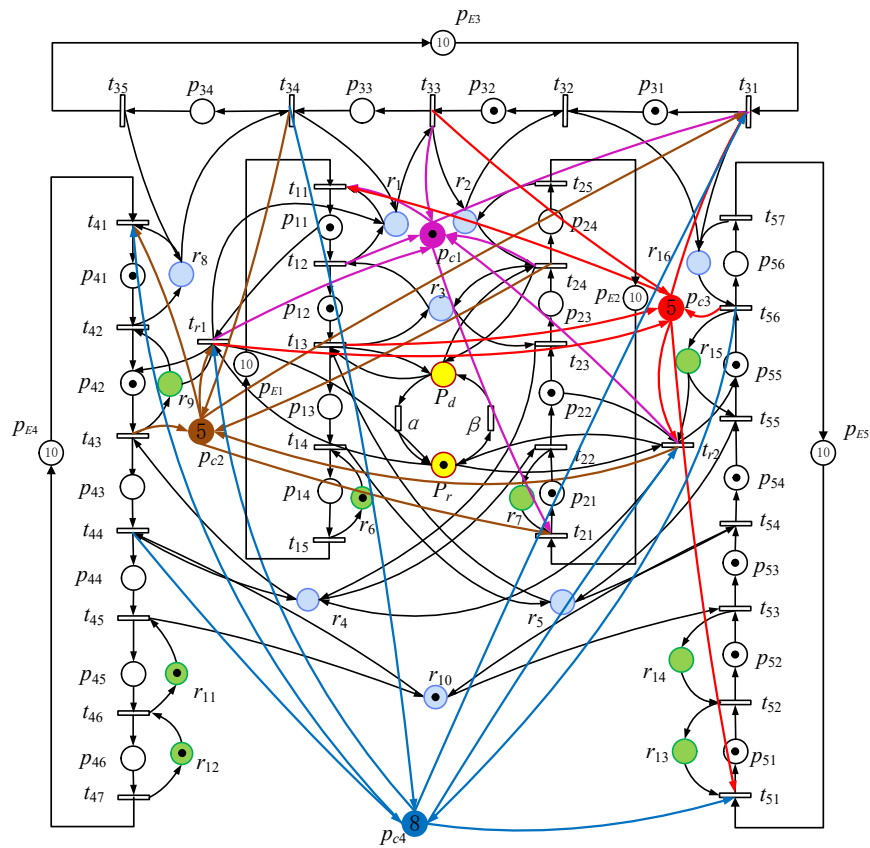**Fig. s1.** The partially controlled autonomous intersection N_{u1}
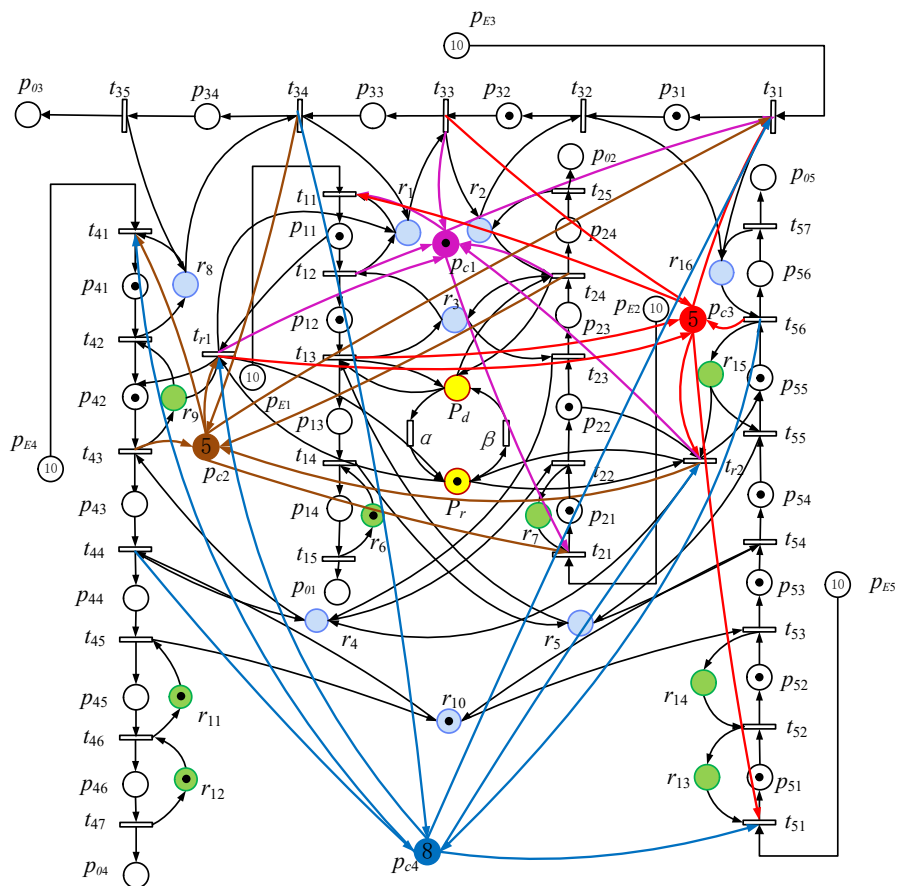

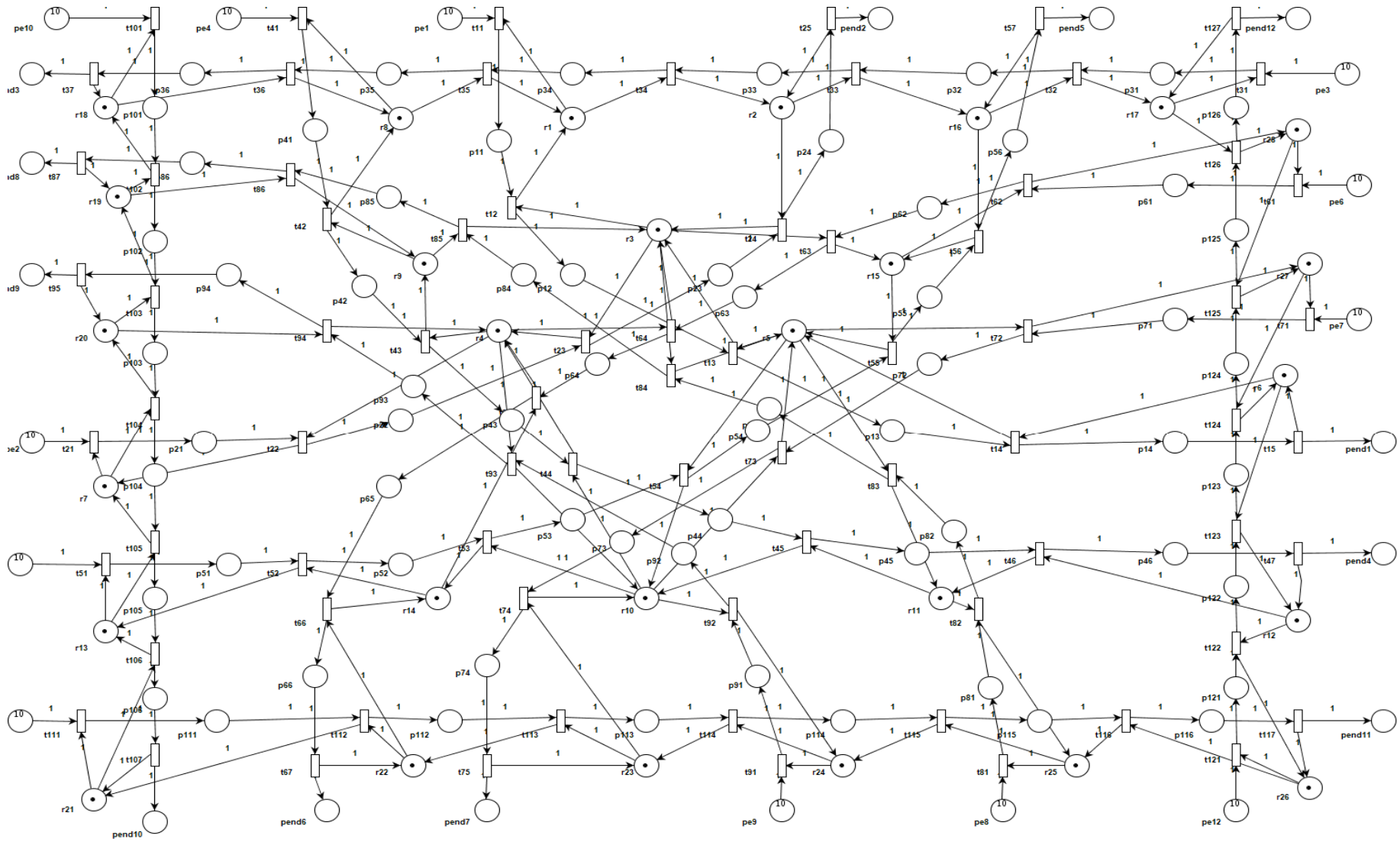**Fig. s2.** The controlled autonomous intersection N_{u2}

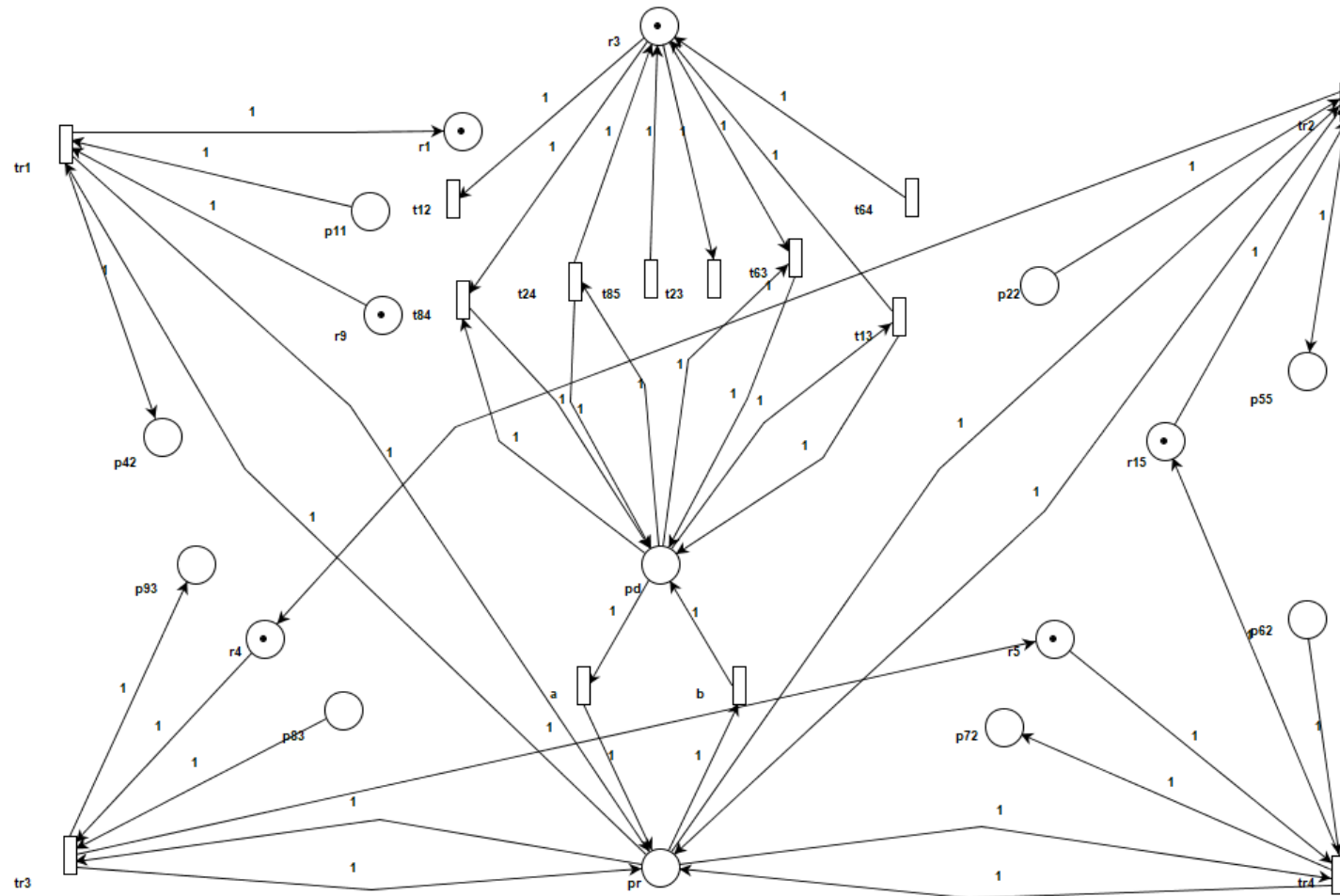**Fig. s3.** The complete RRPN model for a bidirectional four-lane autonomous intersection

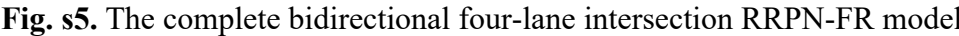**Fig. s4.** The complete failure-recovery structure for ROW r_3

Fig. s5. The complete bidirectional four-lane intersection RRPN-FR model

Table.s1. All the controllers added to the complete intersection RRPN-FR

p_{ci}	$^\bullet p_{ci}$	$p_{ci}^\bullet$	$M_\Gamma(p_c)$
p_{c1}	$t_{12}, t_{24}, t_{34}, t_{r1}, t_{r2}, t_{r3}, t_{r4}$	t_{11}, t_{21}, t_{31}	1
p_{c2}	$t_{22}, t_{94}, t_{104}, t_{r2}, t_{r4}$	$t_{21}, t_{91}, t_{101}, t_{r1}, t_{r3}$	2
p_{c3}	t_{74}, t_{92}, t_{114}	$t_{71}, t_{91}, t_{111}, t_{r1}, t_{r2}, t_{r3}, t_{r4}$	2
p_{c4}	$t_{14}, t_{72}, t_{124}, t_{r1}, t_{r3}$	$t_{11}, t_{71}, t_{121}, t_{r2}, t_{r4}$	2
p_{c5}	$t_{13}, t_{55}, t_{63}, t_{r1}, t_{r3}$	t_{11}, t_{51}, t_{61}	2
p_{c6}	t_{45}, t_{73}, t_{83}	$t_{41}, t_{71}, t_{81}, t_{r2}, t_{r4}$	2
p_{c7}	t_{53}, t_{65}, t_{93}	$t_{51}, t_{61}, t_{91}, t_{r1}, t_{r3}$	2
p_{c8}	$t_{23}, t_{43}, t_{85}, t_{r2}, t_{r4}$	t_{21}, t_{41}, t_{81}	2
p_{c9}	$t_{13}, t_{84}, t_{r1}, t_{r3}$	t_{11}, t_{81}	1
p_{c10}	t_{54}, t_{73}	$t_{51}, t_{71}, t_{r2}, t_{r4}$	1
p_{c11}	t_{44}, t_{93}	$t_{41}, t_{91}, t_{r1}, t_{r3}$	1
p_{c12}	$t_{23}, t_{64}, t_{r2}, t_{r4}$	t_{21}, t_{61}	1
p_{c13}	$t_{14}, t_{63}, t_{125}, t_{r1}, t_{r3}$	t_{11}, t_{61}, t_{121}	5
p_{c14}	$t_{13}, t_{34}, t_{56}, t_{r1}, t_{r3}$	t_{11}, t_{31}, t_{51}	5
p_{c15}	$t_{24}, t_{35}, t_{43}, t_{r2}, t_{r4}$	t_{21}, t_{31}, t_{41}	5
p_{c16}	$t_{23}, t_{86}, t_{104}, t_{r2}, t_{r4}$	t_{21}, t_{81}, t_{101}	5
p_{c17}	t_{66}, t_{93}, t_{114}	$t_{61}, t_{91}, t_{111}, t_{r1}, t_{r3}$	5
p_{c18}	t_{74}, t_{83}, t_{115}	$t_{71}, t_{81}, t_{111}, t_{r2}, t_{r4}$	5
p_{c19}	t_{46}, t_{73}, t_{124}	$t_{41}, t_{71}, t_{121}, t_{r2}, t_{r4}$	5
p_{c20}	t_{53}, t_{94}, t_{105}	$t_{51}, t_{91}, t_{101}, t_{r1}, t_{r3}$	5
p_{c21}	$t_{36}, t_{106}, t_{116}, t_{126}$	$t_{31}, t_{101}, t_{111}, t_{121}$	19