Deregistration Identifier Analysis

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Re: IEEE 802.16-10/0043, “IEEE 802.16 Working Group Sponsor Ballot”, on P802.16m/D7

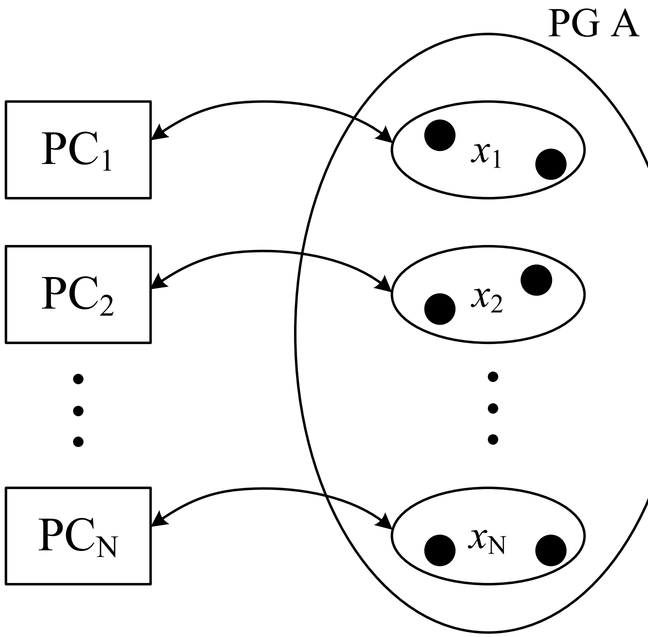
Base Contribution: This is base contribution.

Purpose:

To be discussed and adopted by TGm for 802.16m SB.

Analysis Model – DID collision

- N: the number of PCs associated with PG A.
  - PC_n has x_n AMSs under control in PG A.
- B: total number of IDs in the ID pool.
  - E.g. $B = 2^{24}$ for MAC address hash, $B = 2^{21}$ for DID(12)+paging_offset(9)
- Assumptions
  - 1: Each PC records which IDs it has already assigned to AMSs.
  - 2. Each PC randomly assigns ID to AMSs from the set of IDs that are not in use.
  - 3. Each PC assigns an ID at a time.
  - 4. Idle mode entry to PC_1 to PC_N are uniformly distributed.



- Conditional probability
  - Knowing that there are x_n AMSs in PG A controlled by PC_n, n=1, 2, …, N, and no ID collision occurs.
  - Now an AMS is joining PG A, and its corresponding paging controller, PC_i wants to assign an ID to the AMS in the PG, then

$$\Pr\{\text{No collision of newly assigned ID} \mid \text{No ID collision among } (\textstyle\sum_{n=1}^{N} x_n) \text{ ID assignments in the PG}\}$$

$$= (B - \textstyle\sum_{n=1}^{N} x_n) / (B - x_i).$$

Collision Probability Results

1- P_r (collision prob.)	Number of AMSs in PG A (N=5)				
	2000	4000	6000	8000	10000
MAC address hash (24 bits)	$9.537*10^{-5}$	$1.907*10^{-4}$	$2.861*10^{-4}$	$3.815*10^{-4}$	$4.769*10^{-4}$
DID (12 bits) + P. offset (12 bits)	$9.537*10^{-5}$	$1.907*10^{-4}$	$2.861*10^{-4}$	$3.815*10^{-4}$	$4.769*10^{-4}$
DID (12 bits) + P. offset (9 bits) (P. cycle = 512)	$7.631*10^{-4}$	$1.526*10^{-3}$	$2.290*10^{-3}$	$3.054*10^{-3}$	$3.818*10^{-3}$
DID (12 bits) + P. offset (8 bits) (P. cycle = 256)	$1.526*10^{-3}$	$3.054*10^{-3}$	$4.582*10^{-3}$	$6.113*10^{-3}$	$7.644*10^{-3}$
DID (12 bits) + P. offset (7 bits) (P. cycle = 128)	$3.054*10^{-3}$	$6.113*10^{-3}$	$9.176*10^{-3}$	$1.224*10^{-2}$	$1.532*10^{-2}$
DID (12 bits) + P. offset (6 bits) (P. cycle = 64)	$6.112*10^{-3}$	$1.224*10^{-2}$	$1.839*10^{-2}$	$2.456*10^{-2}$	$3.075*10^{-2}$

Paging overhead saving by applying current DID design

- In AAI_PAG-ADV
  - DID(12)+ p.cycle(4) = 16 bits
  - MAC address hash = 24 bits
  - 24-16 = 8 bits saving
- In AAI_RNG-REQ (Network re-entry)
  - DID(12)+p.cycle(4)+p.offset(12)+PGID(16) = 44 bits
  - MAC address = 48 bits
  - 48-4 = 4 bits saving
- Totally we can save 12 bits for each paged AMS.

12 bits was agreed in July's meeting

Damages caused by false-alert paging (DID design)

- Assume that the “Idle Mode Retain Information element” parameter is configured by 0b1110 during the idle mode negotiation.
  - AAI_SBC-REQ/RSP can be omitted (network reentry)
  - AAI_PKM-REQ/RSP can be omitted (network reentry)
  - AAI_REG-REQ/RSP can be omitted (network reentry)
- Damages are mainly caused by unnecessary AAI_RNG-REQ/RSP message exchanges for network re-entry
  - AAI_RNG-REQ requires 220 bits (including AGMH)
  - AAI_RNG-RSP requires 82 bits (including AGMH)

Pure overhead saving by applying current DID design

Call arrival rate (per minunte)	Paging cycle	Avg. call numbers coming to an MS during the paging cycle	Poisson prob. (one call arrives during the paging cycle)	Number of AMSs in PG A	Number of AMSs being paged	Overhead saving (bits) per paged AMS	Total overhead saving (bits) per paging cycle	DID collision probability	Number of false-alert paged AMSs	Damage due to false-alert paging (per AMS, in bits)	Total damage due to false-alert paging	Pure overhead saving (bits)
1	512	0.170666667	0.143890243	2000	287.780486	12	3453.365831	0.0007631	0.21960529	302	66.32079722	3387.045034
1	512	0.170666667	0.143890243	4000	575.560972	12	6906.731663	0.001526	0.87830604	302	265.248425	6641.483238
1	512	0.170666667	0.143890243	6000	863.341458	12	10360.09749	0.00229	1.97705194	302	597.0696854	9763.027809
1	512	0.170666667	0.143890243	8000	1151.12194	12	13813.46333	0.003054	3.51552642	302	1061.688978	12751.77435
1	512	0.170666667	0.143890243	10000	1438.90243	12	17266.82916	0.003818	5.49372948	302	1659.106302	15607.72285
1	256	0.085333333	0.078353794	2000	156.707588	12	1880.491056	0.001526	0.23913578	302	72.21900534	1808.272051
1	256	0.085333333	0.078353794	4000	313.415176	12	3760.982112	0.003054	0.95716995	302	289.0653241	3471.916788
1	256	0.085333333	0.078353794	6000	470.122764	12	5641.473168	0.004582	2.1541025	302	650.5389564	4990.934211
1	256	0.085333333	0.078353794	8000	626.830352	12	7521.964224	0.006113	3.83181394	302	1157.20781	6364.756413
1	256	0.085333333	0.078353794	10000	783.53794	12	9402.455279	0.007644	5.98936401	302	1808.787932	7593.667347
1	128	0.042666667	0.040884564	2000	81.7691288	12	981.2295453	0.003054	0.24972292	302	75.41632162	905.8132237
1	128	0.042666667	0.040884564	4000	163.538258	12	1962.459091	0.006113	0.99970937	302	301.9122293	1660.546861
1	128	0.042666667	0.040884564	6000	245.307386	12	2943.688636	0.009176	2.25094058	302	679.7840542	2263.904582
1	128	0.042666667	0.040884564	8000	327.076515	12	3924.918181	0.01224	4.00341654	302	1209.031797	2715.886385
1	128	0.042666667	0.040884564	10000	408.845644	12	4906.147727	0.01532	6.26351526	302	1891.58161	3014.566117
1	64	0.021333333	0.020883056	2000	41.7661116	12	501.1933395	0.006112	0.25527447	302	77.09289123	424.1004483
1	64	0.021333333	0.020883056	4000	83.5322233	12	1002.386679	0.01224	1.02243441	302	308.7751926	693.6114865
1	64	0.021333333	0.020883056	6000	125.298335	12	1503.580019	0.01839	2.30423638	302	695.8793863	807.7006323
1	64	0.021333333	0.020883056	8000	167.064447	12	2004.773358	0.02456	4.10310281	302	1239.137048	765.6363106
1	64	0.021333333	0.020883056	10000	208.830558	12	2505.966698	0.03075	6.42153966	302	1939.304978	566.6617195