[Traffic models comments on IEEE 802.16j-06/013]

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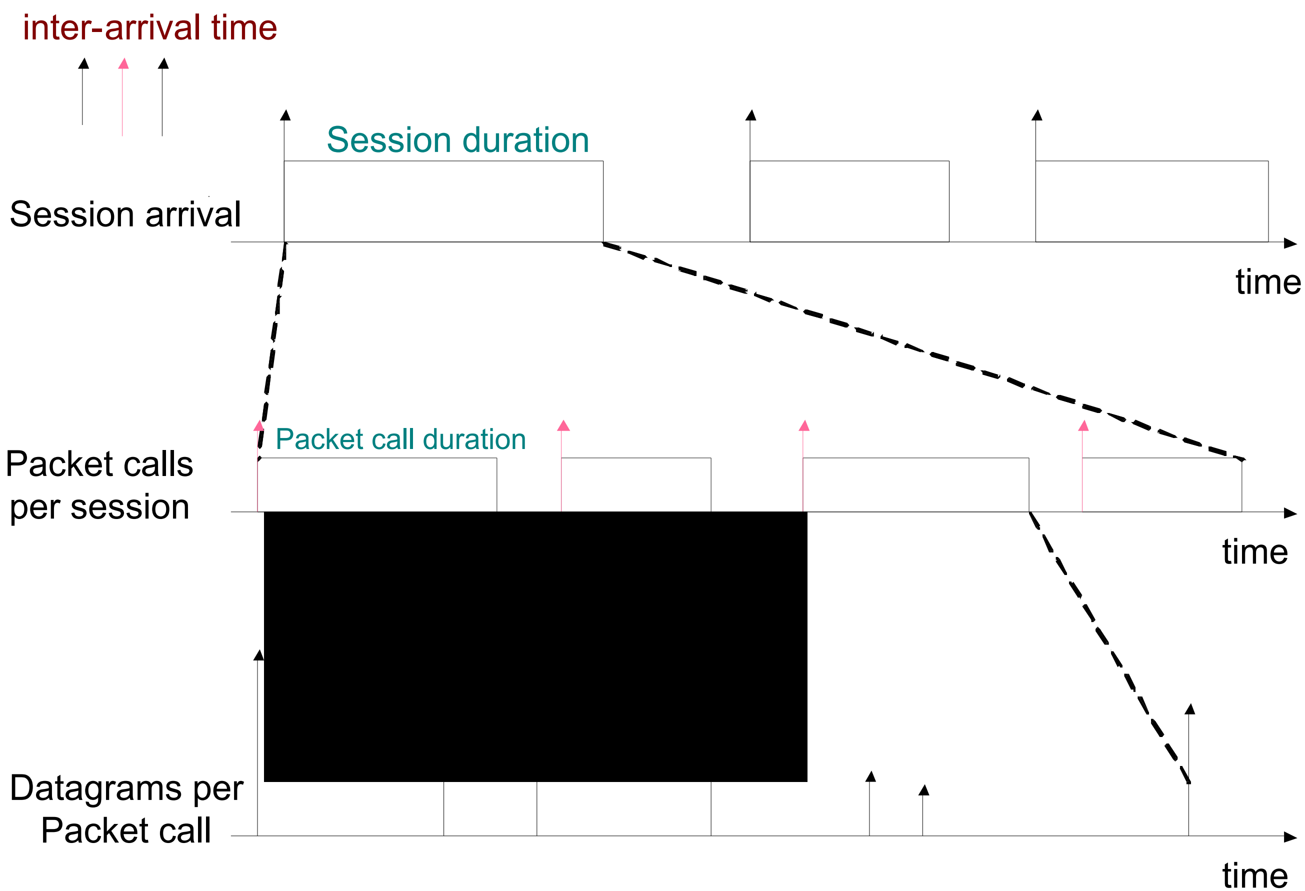
Summary of contribution

- We propose to replace the traffic models in Section 3 and Appendix C of IEEE 802.16j-06/013 with our traffic models in IEEE 802.16j-06/093.
- Based on 3GPP2 traffic models (3GPP2/TSG-C.R1002, “1xEV-DV Evaluation Methodology (V14)”), we re-organized models and added missing gaming model to the original traffic modes in IEEE 802.16j-06/013.
- The following traffic models will be included
  - HTTP [1][2][7]
  - FTP [1][2]
  - NRT video streaming [1][2]
  - VoIP [1][3][4][5]
  - Gaming [1][6]

Bursty traffic generation model

- All traffic model can be generated using a bursty traffic generation model.

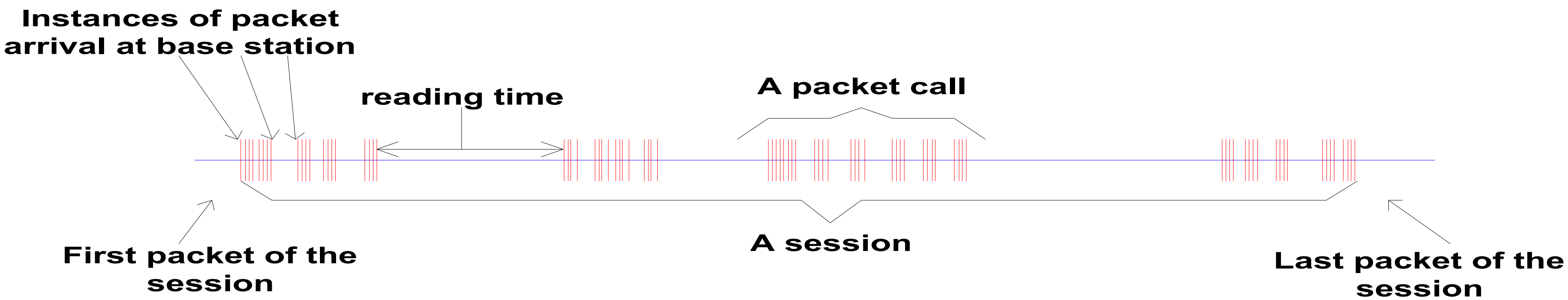


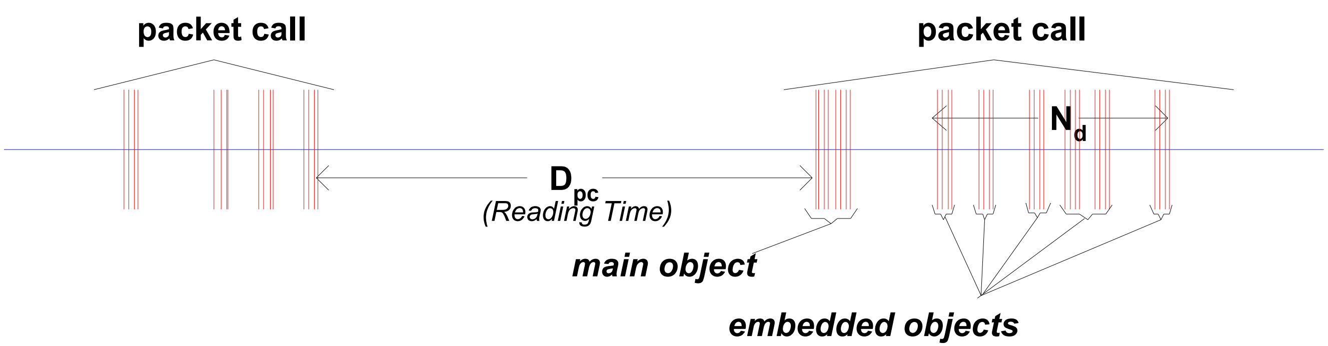
Bursty traffic generation model-2

- Parameter of interests are:
  - Session inter-arrival time and session duration
  - Packet call inter-arrival time and duration
  - Datagram inter-arrival time and datagram size

Traffic models - HTTP

- Interactive and self-similar





Traffic models – HTTP parameter description

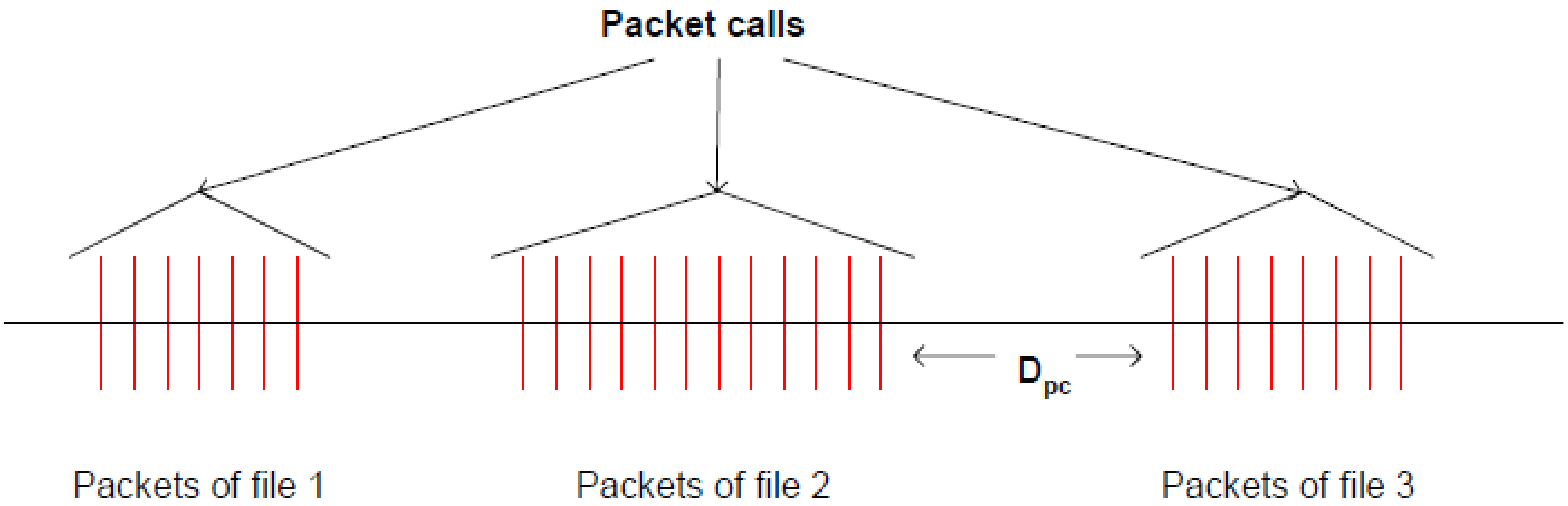
- Session arrival is poisson with rate
- Session duration distribution is indirectly determined by other parameters, i.e., # of pages/session, size of objects, and reading time
- Within a packet call, the following parameters are important:
  - S_M: size of the main object in a packet call
  - S_E: size of an embedded object in a packet call
  - N_d: number of embedded objects in a packet call
  - D_{pc}: reading time
  - T_p: parsing time for main page

Traffic models – HTTP parameters

Component	Distribution	DL Parameters	UL Parameters	PDF
No. of Pages/ Session	Lognormal	Mean = 17, Std. Dev = 22	Mean = 17, Std. Dev = 22	$f_x = \frac{1}{\sqrt{2\pi}\sigma x}\exp\left[-\frac{(\ln x - \mu)^2}{2\sigma^2}\right],$ $x \geq 0$
Main object size (S_M)	Truncated Lognormal	Mean = 10710 bytes Std. dev. = 25032 bytes Minimum = 100 bytes Maximum = 2 Mbytes = 1.37, =8.35	Mean = 9055 bytes Std. dev. = 13265 bytes Minimum = 100 bytes Maximum = 100 Kbytes = 1.37, =8.35	
Embedded object size (S_E)	Truncated Lognormal	Mean = 7758 bytes Std. dev. = 126168 bytes Minimum = 50 bytes Maximum = 2 Mbytes = 2.36, =6.17	Mean = 5958 bytes Std. dev. = 11376 bytes Minimum = 50 bytes Maximum = 100 Kbytes = 1.69, =7.53	
Number of Embedded objects per page (N_d)	Truncated Pareto	Mean = 5.64 Max. = 53	Mean = 4.229 Max. = 53	$f_x = \frac{\alpha k^{\alpha}}{x^{\alpha+1}}, k \leq x < m$ $f_x = \left(\frac{k}{m}\right)^{\alpha}, x = m$ $\alpha = 1.1, k = 2, m = 55$ Note: Subtract k from the generated random value to obtain N_d
Reading time (D_{pc})	Exponential	Mean = 30 sec	Mean = 30 sec	[redacted]
Parsing time (T_p)	Exponential	Mean = 0.13 sec	Mean = 0.13 sec	

Traffic models – FTP

- DL FTP user session



- For UL FTP traffic, each packet call refers to the transfer of one file only.

Traffic models – FTP parameter description

- For DL FTP session
  - Session arrival has Poisson with rate .
  - Session duration distribution is TBD (It can be modeled indirectly by # files transferred per session, file size, and reading time)
  - Packet calls are made up of file transfer with parameter of interests:
    - S: size of file to be transferred
    - D_{pc}: reading time
- For UL FTP session
  - FTP users arrive according to Poisson again.
  - Parameter of interest is upload file size.

Traffic models – FTP parameters

- DL FTP model

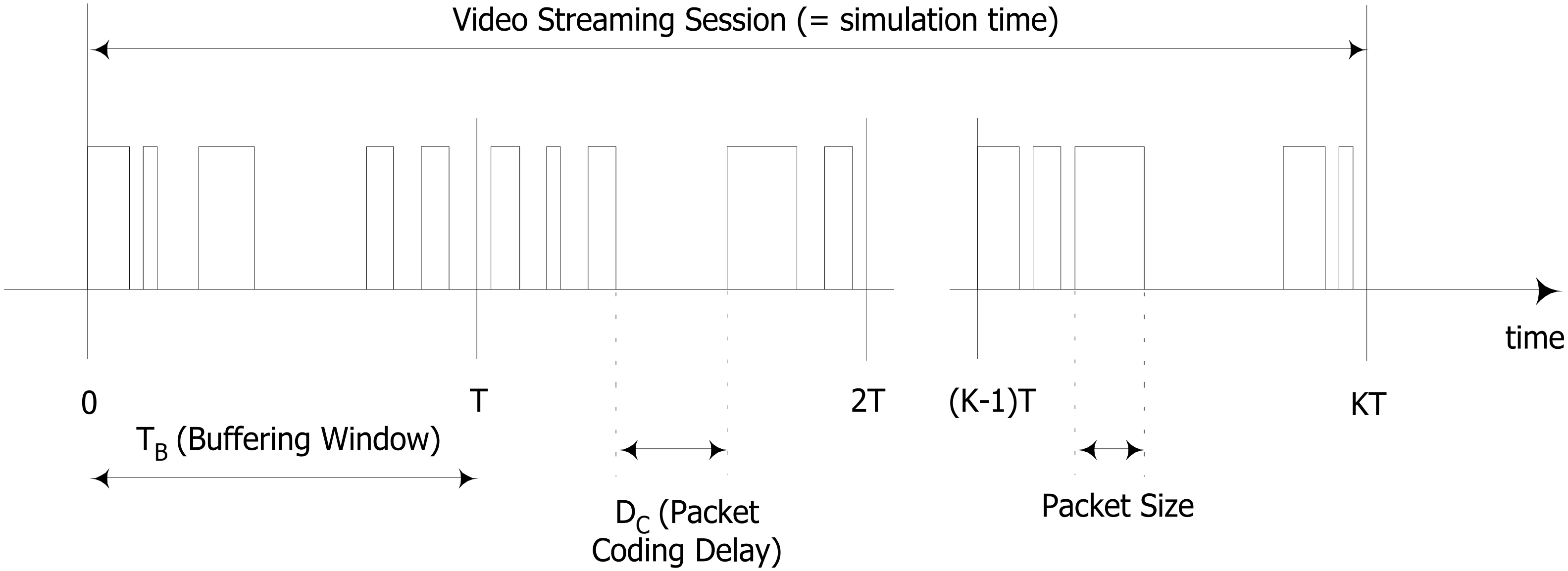
Component	Distribution	Parameters	PDF
File size (S)	Truncated Lognormal	Mean = 2Mbytes Std. Dev. = 0.722 Mbytes Minimum = TBD Maximum = 5 Mbytes	$f_x = \frac{1}{\sqrt{2\pi}\sigma x} \exp\left[\frac{-(\ln x - \mu)^2}{2\sigma^2}\right], x \ge 0$ $\sigma = 0.35, \mu = 14.45$
Reading time (D_{pc})	Exponential	Mean = 180 sec.	$f_x = \lambda e^{-\lambda x}, x \ge 0$ $\lambda = 0.006$

- UL FTP model

Component	Distribution	Parameters	PDF
File size (S)	Truncated Lognormal	Mean =19.5kbytes Std. Dev. = 46.7kbytes Minimum = 0.5kbytes Maximum = 500 kbytes	$f_x = \frac{1}{\sqrt{2\pi}\sigma x} \exp\left[\frac{-(\ln x - \mu)^2}{2\sigma^2}\right], x \ge 0$ $\sigma = 2.0899, \quad \mu = 0.9385$

Traffic models – Near real time video streaming for DL

- Video session is assumed to last the whole simulation.
- Packet call arrives regularly every frame. There is zero OFF period in a video session.

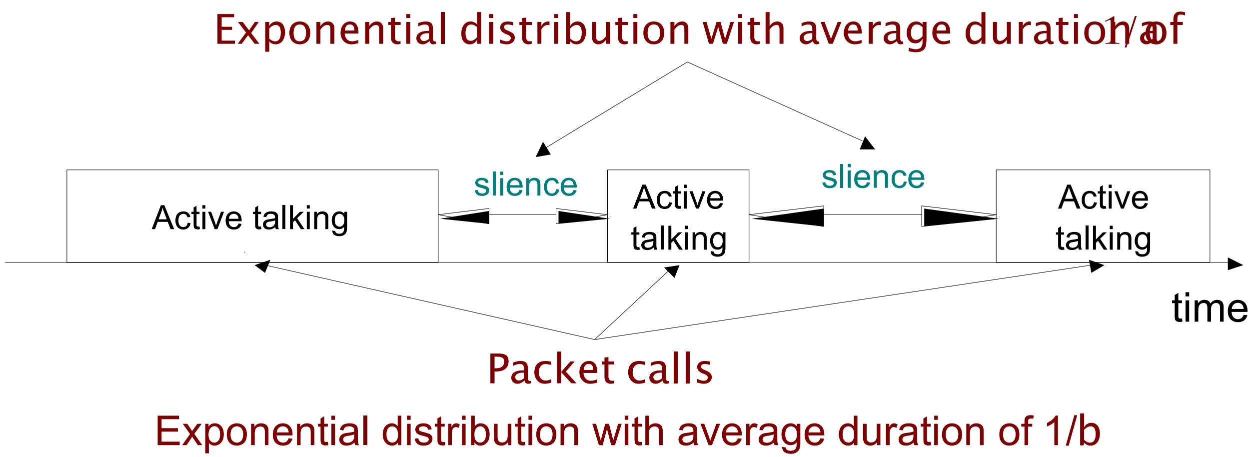


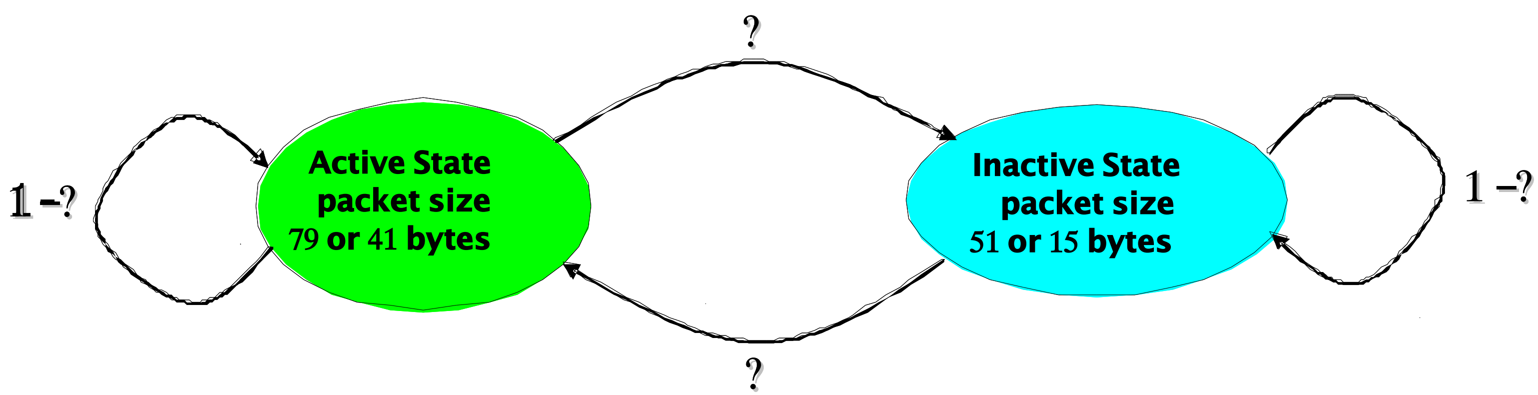
Traffic models – Near real time video streaming for DL parameter

- Each video frame arrives at a regular interval T
- Each frame is a packet call
- Within each frame (packet call), datagrams arrive randomly with randomly distributed packet sizes.

Information types	**Inter-arrival time between the beginning of each frame**	**Number of packets (slices) in a frame**	**Packet (slice) size**	**Inter-arrival time between packets (slices) in a frame**
Distribution	**Deterministic (Based on 10fps)**	**Deterministic**	**Truncated Pareto (Mean= 50bytes, Max= 125bytes)**	**Truncated Pareto (Mean= 6ms, Max= 12.5ms)**
Distribution parameters	**100ms**	**8**	**K=20bytes = 1.2**	**K=2.5ms = 1.2**

Traffic model - VoIP





Traffic model – VoIP parameters

- VoIP users arrives with Poisson distribution with rate .
- Session duration is TBD distribution.
- Use simplified AMR model with active state and inactive state generating packets of different constant size depending on with or without header compression and using IPv4 or IPv6
  – Active state: 33bytes of AMR payload for every 20msec
  – Inactive state: 7 bytes of AMR payload for every 160msec

VoIP Packet Size Calculation

Description	AMR without Header Compression IPV4(IPv6)	AMR with Header Compression IPV4(IPv6)	G.729 without Header Compression IPV4(IPv6)	G.729 with Header Compression IPV4(IPv6)
Voice Payload	7bytes (inactive) * 33 bytes (active)	7bytes (inactive) 33 bytes (active)	0 bytes (inactive) 20 bytes (active)	0 bytes (inactive) 20 bytes (active)
Protocol Headers	40 bytes (60 bytes)	2 bytes(4 bytes)	40 bytes (60 bytes)	2 bytes(4 bytes)
RTP	12 bytes		12 bytes	
UDP	8 bytes		8 bytes	
IPv4 (IPv6)	20 bytes (40 bytes)		20 bytes (40 bytes)	
802.16e GMH	6 bytes	6 bytes	6 bytes	6 bytes
CRC	4 bytes	4 bytes	4 bytes	4 bytes
Total VoIP packet size	57 bytes/ 77 bytes (inactive) 83 bytes / 103 bytes (active)	19 bytes/ 21 bytes (inactive) 45 bytes/ 47 bytes (active)	0 bytes (inactive) 70 bytes / 90 bytes (active)	0 bytes (inactive) 32 bytes/ 34 bytes (active)

Traffic models – VoIP parameters

Component	Distribution	Parameters	PDF
Active state duration	Exponential	Mean = 1 second	$f_X = \lambda e^{-\lambda x}, x \ge 0$ $\lambda = 1/Mean$
Inactive state duration	Exponential	Mean = 1.5 second.	$f_X = \lambda e^{-\lambda x}, x \ge 0$ $\lambda = 1/Mean$
Probability of transition from active to inactive state	N/A	(=0.6)	
Probability of transition from inactive to active state	N/A	(=0.4)	

Traffic models – Gaming

- Gaming user session arrival with Poisson distribution with arrival rate .
- Gaming user session duration has TBD distribution.

Component	Distribution		Parameters		PDF
	DL	UL	DL	UL	
Initial packet arrival	Uniform	Uniform	a=0, b=40ms	a=0, b=40ms	$f(x) = \frac{1}{b-a}, a \quad x \quad b$
Packet arrival time	Extreme	Extreme	a=48ms, b=4.5ms	a=40ms, b=6ms	$f(x) = \frac{1}{b} e^{-\frac{x-a}{b}} e^{-e^{-\frac{x-a}{b}}}, b > 0$ $X = a - b\ln(-\ln Y), Y \quad U(0,1)$
Packet size	Extreme	Extreme	a=330bytes, b=82	a=45bytes, b=5.7	$f(x) = \frac{1}{b} e^{-\frac{x-a}{b}} e^{-e^{-\frac{x-a}{b}}}, b > 0$ $X = a - b\ln(-\ln Y) + 2, Y \quad U(0,1)$

Traffic mix proposal

	VoIP	FTP	HTTP	n.r.t. video	Gaming
Voice Capacity	100% #users = Nv	0%	0%	0%	0%
Data Capacity	0%	100%	0%	0%	0%
Traffic Mix 1	0.5 Nv	Remaining Data Users 100% 0% 0% 0%			
Traffic Mix 2	0.5 Nv	Remaining Data Users 30% 30% 30% 10%			
Traffic Mix 3	0.75 Nv	Remaining Data Users 30% 30% 30% 10%			

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