



## TFI Wireless Forecast

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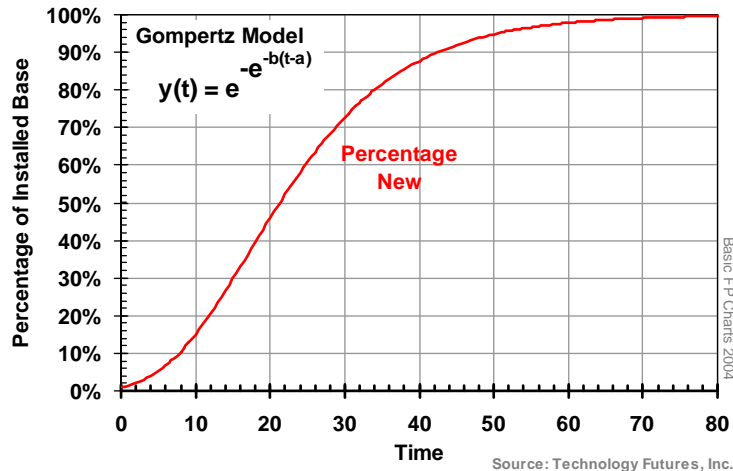
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## The Gompertz Model



$y(t)$  = Fraction of market taken over by new technology at time “t”  
“a” is 37% time; “b” determines rate of substitution

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## Wireless Universe?

- Wireline – Places
- Wireless Voice – People
- Wireless Data – Devices
- Wireless Potential – All things fixed or mobile, man or machine (Now referred to as the Internet of Things)
- 2015 forecast breaks out M2M connections

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## The Internet of Things has the Potential of Becoming Much Larger

- As an example of the potential, one forecast calls for the Internet of Things to grow to 26 billion units by 2020 compared to smartphones, tablets, and PCs reaching only about 7.3 billion units at that time.

Source: CTIA - Facts and Infographics

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## Could be 50 Billion

- Cisco has been enthusiastically predicting that 50 billion “things” could be connected to communications networks within six years, up from around 10 billion phones and PCs today

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## The list of things include many items that won't likely be connected to cellular network

- The items can be grouped by those that will have tags and those that will have connections (M2M)
- The GSMA estimates 20% of M2M will connect to the cellular network

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## What type Things may get connected to the cellular network?

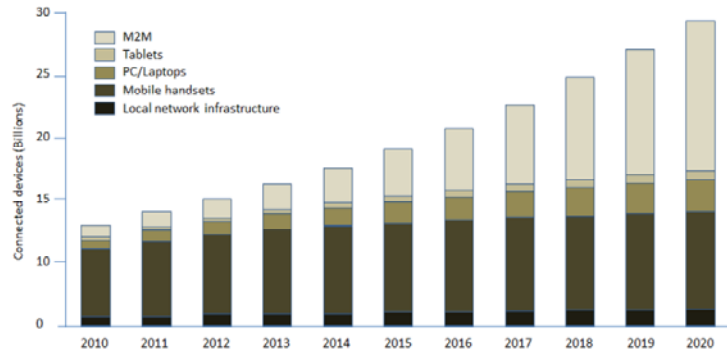
Number of items, billion	2010	2011	2012	2013	2014	2015	2016	2017	2020	CAGR (%)
<b>RFID tags</b>										
Passive tags	0.06	0.08	0.10	0.13	0.17	0.22	0.28	0.37	0.80	29.57
Active tags	2.30	3.43	5.11	7.61	11.33	16.89	25.16	37.49	124.00	48.99
Tags, total	2.40	3.56	5.29	7.86	11.67	17.32	25.72	38.19	125.00	48.48
<b>Connected devices</b>										
Connected M2M devices	1.64	2.00	2.44	2.98	3.63	4.43	5.41	6.60	12.00	22.03
Connected devices, total	8.04	8.99	10.05	11.23	12.55	14.02	15.67	17.52	24.45	11.76
<b>Total tags and connected devices</b>	10.44	12.55	15.34	19.08	24.21	31.34	41.39	55.70	149.45	31.68

- Source: GSMA 2011

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## Expected growth in the number of connected devices



- Source: GSMA 2011

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## U.S. leads mobile M2M market connections

- US had 35 million mobile M2M connections, or 19 percent of all global (184.2M) at the end of 2013.
- M2M represented one out of every 10 mobile connections in the U.S (YE 2013)
- M2M mobile connections projected to be 41 million in the U.S. YE 2014 (estimated Sept. 2014)
- Mobile M2M global projected to be 2 billion by 2020

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Source: GSMA 2014

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## US carriers are actively pursuing M2M

- AT&T had 17 Million M2M mobile connections as of July 2014.
- Sprint has a 36% growth rate for M2M.
- Verizon and most others have organizations to pursue M2M development.

• Source: Company 10Qs 3Q 1014

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## The US Market

- The US has 115 million households each with many Things. Most will not have individual mobile connections. New homes and smart homes are of most interest.
- There are 250 million autos. Most that get connected will be to the cellular network. About 15 million new cars per year.
- Many commercial locations with wide assortment of Things.
- Outdoor locations such as oil fields, mines, environmental sensors, etc.
- The GSMA estimates 2B mobile M2M connections worldwide in 2020. This implies roughly 200M for the US. We assume the potential market to be at least twice that or 400M.

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- M2M represented one out of every 10 mobile connections in the U.S (YE 2013)
- M2M mobile connections projected to be 41 million in the U.S. YE 2014 (estimated Sept. 2014)

Source: GSMA 2014

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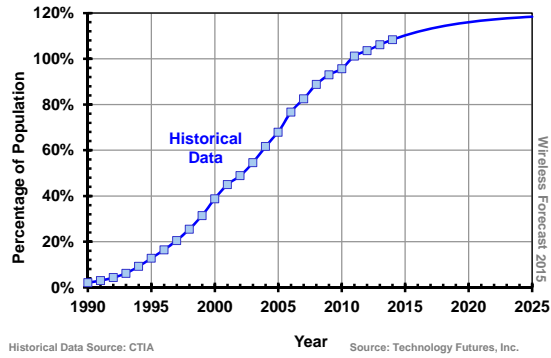
## Bottom Line – The Market is Expanding

- Most of the growth in connections will be M2M.
- Most of the data growth will be from upgraded devices and new applications.

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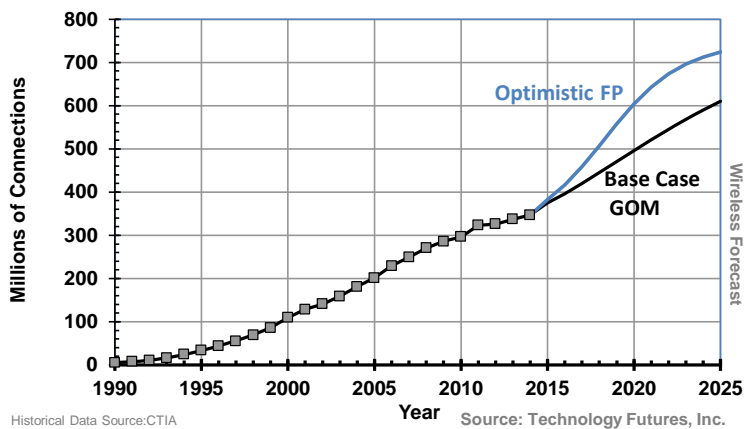
## 2015 TFI Wireless Penetration Forecast Previous Method (120% pop limit)



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## 2015 TFI Wireless Connection Forecast



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## 2015 TFI Wireless Connections Base Case Forecast

U.S. Wireless Connections Tabulated  
Base Case GOM

Year	US M2M Potential	M2M %Connecti	M2M Connections millions	Population millions	All Other %Connecti	All Other Connections millions	Total Connections millions
2011	400.0	2.7%	11.0	312.3	97.0%	302.9	313.9
2012	400.0	5.2%	20.7	315.0	97.0%	305.5	326.2
2013	400.0	8.8%	35.0	317.6	97.0%	308.1	343.1
2014	400.0	10.3%	41.0	320.3	97.0%	310.7	351.7
2015	400.0	15.3%	61.3	323.0	97.0%	313.3	374.6 Forecast
2016	400.0	20.1%	80.5	325.7	97.0%	315.9	396.4
2017	400.0	25.4%	101.5	328.4	97.0%	318.5	420.0
2018	400.0	31.0%	123.8	331.1	97.0%	321.1	444.9
2019	400.0	36.7%	146.7	333.8	97.0%	323.7	470.5
2020	400.0	42.4%	169.7	336.5	97.0%	326.4	496.0
2021	400.0	48.0%	192.1	339.2	97.0%	329.0	521.1
2022	400.0	53.4%	213.6	341.9	97.0%	331.7	545.3
2023	400.0	58.5%	234.0	344.7	97.0%	334.3	568.3
2024	400.0	63.2%	252.9	347.5	97.0%	337.0	589.9
2025	400.0	67.6%	270.2	350.3	97.0%	339.8	610.0

Source: Technology Futures, Inc.

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## 2015 TFI Wireless Connections Optimistic Forecast

U.S. Wireless Connections Tabulated  
Optimistic FP

Year	US M2M Potential	M2M %Connecti	M2M Connections millions	Populat millions	All Other %Connecti	All Other Connections millions	Total Connections millions
2011	400.0	2.7%	11.0	312.3	97.0%	302.9	313.9
2012	400.0	5.2%	20.7	315.0	97.0%	305.5	326.2
2013	400.0	8.8%	35.0	317.6	97.0%	308.1	343.1
2014	400.0	10.3%	41.0	320.3	97.0%	310.7	351.7
2015	400.0	17.4%	69.5	323.0	97.0%	313.3	382.8 Forecast
2016	400.0	25.3%	101.2	325.7	97.0%	315.9	417.1
2017	400.0	35.3%	141.1	328.4	97.0%	318.5	459.6
2018	400.0	46.7%	186.9	331.1	97.0%	321.1	508.0
2019	400.0	58.5%	234.1	333.8	97.0%	323.7	557.8
2020	400.0	69.4%	277.7	336.5	97.0%	326.4	604.1
2021	400.0	78.5%	314.1	339.2	97.0%	329.0	643.1
2022	400.0	85.5%	341.9	341.9	97.0%	331.7	673.5
2023	400.0	90.4%	361.8	344.7	97.0%	334.3	696.1
2024	400.0	93.8%	375.4	347.5	97.0%	337.0	712.4
2025	400.0	96.1%	384.3	350.3	97.0%	339.8	724.1

Source: Technology Futures, Inc.

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## 2015 TFI Wireless Penetration/Connections Forecast Tabulated (Base Case)

U.S. Wireless Connections Tabulated (Base Case)

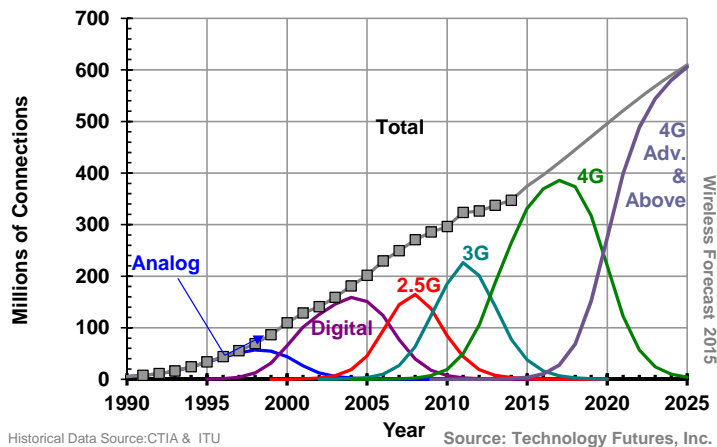
Year	Population millions	Total %Connections	Total Connections millions
1990	250.8	2.1%	5.3 Historical
1991	253.6	3.0%	7.6
1992	256.4	4.3%	11.0
1993	259.1	6.2%	16.0
1994	261.9	9.2%	24.1
1995	264.7	12.8%	33.8
1996	267.3	16.5%	44.0
1997	269.0	20.6%	55.3
1998	271.2	25.5%	69.2
1999	273.4	31.5%	86.0
2000	282.2	38.8%	109.5
2001	285.1	45.0%	128.4
2002	288.0	48.9%	140.8
2003	290.9	54.6%	158.7
2004	293.7	61.7%	181.1
2005	296.4	67.9%	201.4
2006	299.1	77.9%	233.0
2007	301.7	84.6%	255.4
2008	304.4	88.8%	270.3
2009	307.0	93.0%	285.6
2010	309.7	95.7%	296.3
2011	312.3	103.5%	323.3
2012	315.0	103.8%	326.2
2013	317.6	106.2%	337.2
2014	320.3	108.4%	347.1
2015	323.0	116.0%	374.6 Forecast
2016	325.7	121.7%	396.4
2017	328.4	127.9%	420.0
2018	331.1	134.4%	444.9
2019	333.8	141.0%	470.5
2020	336.5	147.4%	496.0
2021	339.2	153.6%	521.1
2022	341.9	159.5%	545.3
2023	344.7	164.9%	568.3
2024	347.5	169.8%	589.9
2025	350.3	174.1%	610.0

Source: Technology Futures, Inc.

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## 2015 TFI Wireless Generations Forecast (Base Case)



Historical Data Source: CTIA & ITU

Source: Technology Futures, Inc.

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## 2015 TFI Wireless Generations Forecast, Percentages (Tabular Data)

Year	Analog		Digital		G2.5	G3	G4	G4 Adv
	T0	T1	T1	T2	T2	T3	T4	T5
1990	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1991	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1992	99.9%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1993	99.8%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1994	99.5%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1995	98.8%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1996	96.8%	3.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1997	92.3%	7.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1998	82.1%	17.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1999	63.7%	36.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
2000	40.1%	59.6%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
2001	20.4%	78.9%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%
2002	8.9%	89.3%	1.7%	0.1%	0.0%	0.0%	0.0%	0.0%
2003	3.6%	91.9%	4.2%	0.3%	0.0%	0.0%	0.0%	0.0%
2004	1.4%	87.6%	10.3%	0.7%	0.0%	0.0%	0.0%	0.0%
2005	0.6%	75.0%	22.7%	1.7%	0.1%	0.0%	0.0%	0.0%
2006	0.2%	53.9%	41.4%	4.4%	0.1%	0.0%	0.0%	0.0%
2007	0.1%	31.0%	58.0%	10.6%	0.4%	0.0%	0.0%	0.0%
2008	0.0%	14.6%	60.9%	23.5%	1.0%	0.0%	0.0%	0.0%
2009	0.0%	6.1%	48.0%	43.3%	2.6%	0.0%	0.0%	0.0%
2010	0.0%	2.4%	28.6%	62.5%	6.5%	0.0%	0.0%	0.0%
2011	0.0%	0.9%	13.7%	70.0%	15.4%	0.0%	0.0%	0.0%
2012	0.0%	0.4%	5.8%	61.6%	32.2%	0.1%	0.0%	0.0%
2013	0.0%	0.1%	2.3%	42.1%	55.3%	0.1%	0.0%	0.0%
2014	0.0%	0.1%	0.9%	22.5%	76.2%	0.4%	0.0%	0.0%
2015	0.0%	0.0%	0.3%	10.1%	88.5%	1.0%	0.0%	0.0%
2016	0.0%	0.0%	0.1%	4.1%	93.2%	2.6%	0.0%	0.0%
2017	0.0%	0.0%	0.1%	1.6%	91.8%	6.5%	0.0%	0.0%
2018	0.0%	0.0%	0.0%	0.6%	84.0%	15.4%	0.0%	0.0%
2019	0.0%	0.0%	0.0%	0.2%	67.5%	32.2%	0.0%	0.0%
2020	0.0%	0.0%	0.0%	0.1%	44.4%	55.3%	0.0%	0.0%
2020	0.0%	0.0%	0.0%	0.0%	23.4%	76.6%	0.0%	0.0%
2020	0.0%	0.0%	0.0%	0.0%	10.4%	89.5%	0.0%	0.0%
2020	0.0%	0.0%	0.0%	0.0%	4.3%	95.7%	0.0%	0.0%
2020	0.0%	0.0%	0.0%	0.0%	1.7%	98.3%	0.0%	0.0%
2020	0.0%	0.0%	0.0%	0.0%	0.6%	99.4%	0.0%	0.0%

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## 2015 TFI Wireless Generations Forecast, Connections (Tabular Data)

Year	UNITS (millions)							
	Total	Analog		Digital		G2.5	G3	G4
	T0	T1	T1	T2	T2	T3	T4	T5
1990	5.3	5.3						
1991	7.6	7.6						
1992	11.0	11.0						
1993	16.0	16.0						
1994	24.1	24.0						
1995	33.8	33.4	0.4					
1996	44.0	42.7	1.4					
1997	55.3	51.1	4.3					
1998	69.2	56.8	12.4					
1999	86.0	54.8	31.2	0.1				
2000	109.5	43.9	65.3	0.3				
2001	128.4	28.2	101.3	0.8				
2002	140.8	12.5	125.7	2.3	0.1			
2003	158.7	5.7	145.8	6.7	0.4			
2004	181.1	2.6	158.6	18.7	1.2	0.0		
2005	201.4	1.1	151.0	45.7	3.4	0.1		
2006	229.5	0.5	123.7	85.0	10.0	0.3		
2007	249.1	0.2	77.1	144.4	26.4	1.0		
2008	270.3	0.1	39.5	164.6	63.4	2.7		
2009	285.6	0.0	17.5	137.0	123.7	7.4		
2010	296.3	0.0	7.2	84.7	185.1	19.2		
2011	323.3	0.0	3.1	44.3	228.2	49.6	0.1	
2012	326.2	0.0	1.2	18.9	200.3	105.0	0.2	
2013	337.2	0.0	0.5	7.8	141.8	186.6	0.5	
2014	347.1	0.0	0.2	3.1	78.1	264.4	1.3	
2015	374.6	0.0	0.1	1.3	37.8	331.7	3.7	
2016	384.4	0.0	0.0	0.5	16.4	369.2	10.2	
2017	420.0	0.0	0.0	0.2	6.8	385.8	27.2	
2018	444.9	0.0	0.0	0.1	2.8	373.7	68.4	
2019	470.5	0.0	0.0	0.0	1.1	317.6	151.7	
2020	496.0	0.0	0.0	0.0	0.5	220.3	275.3	
2020	521.1	0.0	0.0	0.0	0.2	121.9	399.0	
2020	545.3	0.0	0.0	0.0	0.1	57.0	488.3	
2020	568.3	0.0	0.0	0.0	0.0	24.2	544.0	
2020	589.9	0.0	0.0	0.0	0.0	9.9	580.0	
2020	610.0	0.0	0.0	0.0	0.0	3.9	606.1	

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## Two Key Drivers for New Generations

- Mobile data traffic is growing much more rapidly than connections
- Greatly improving cost/performance of newer technology

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