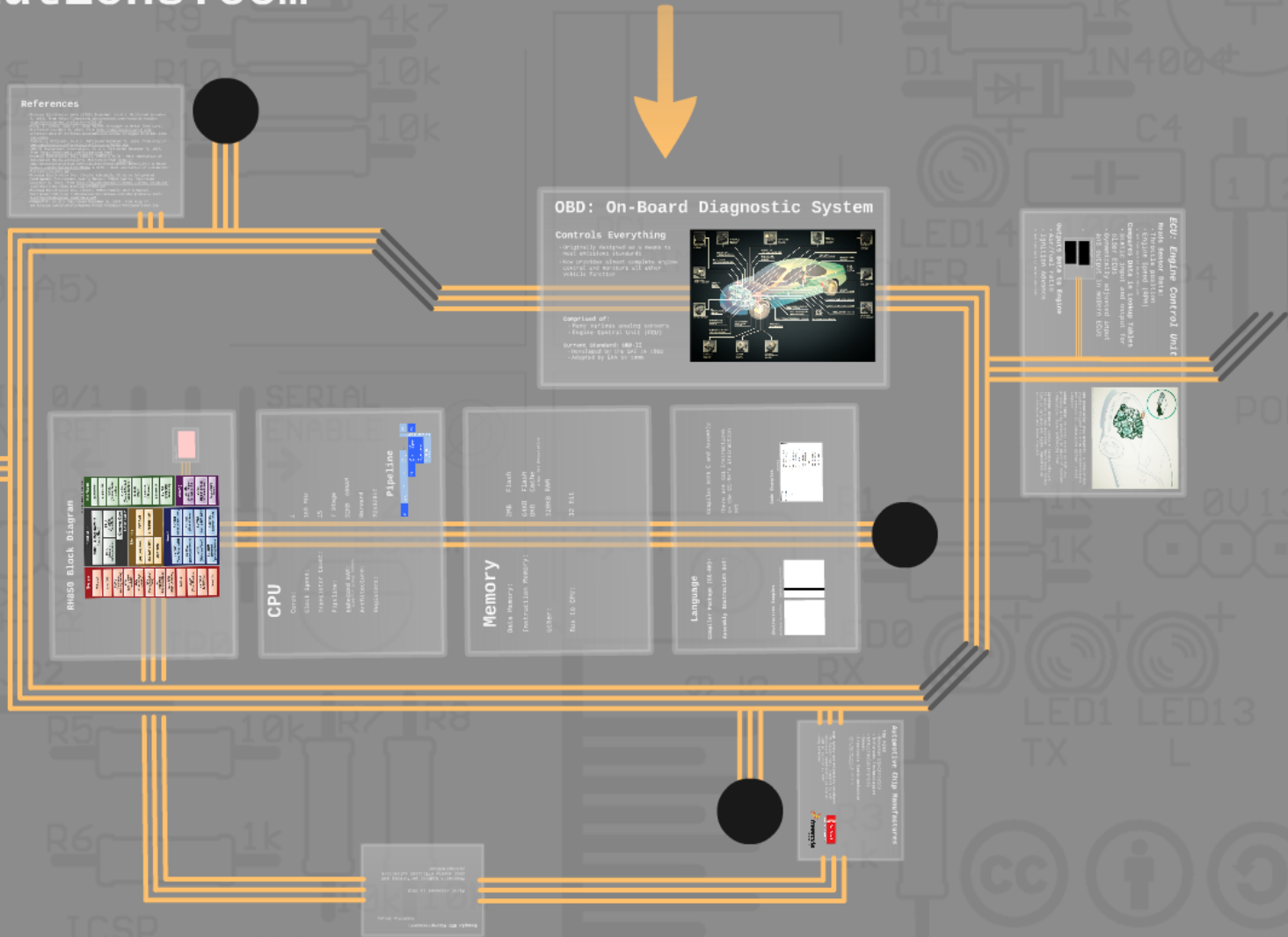


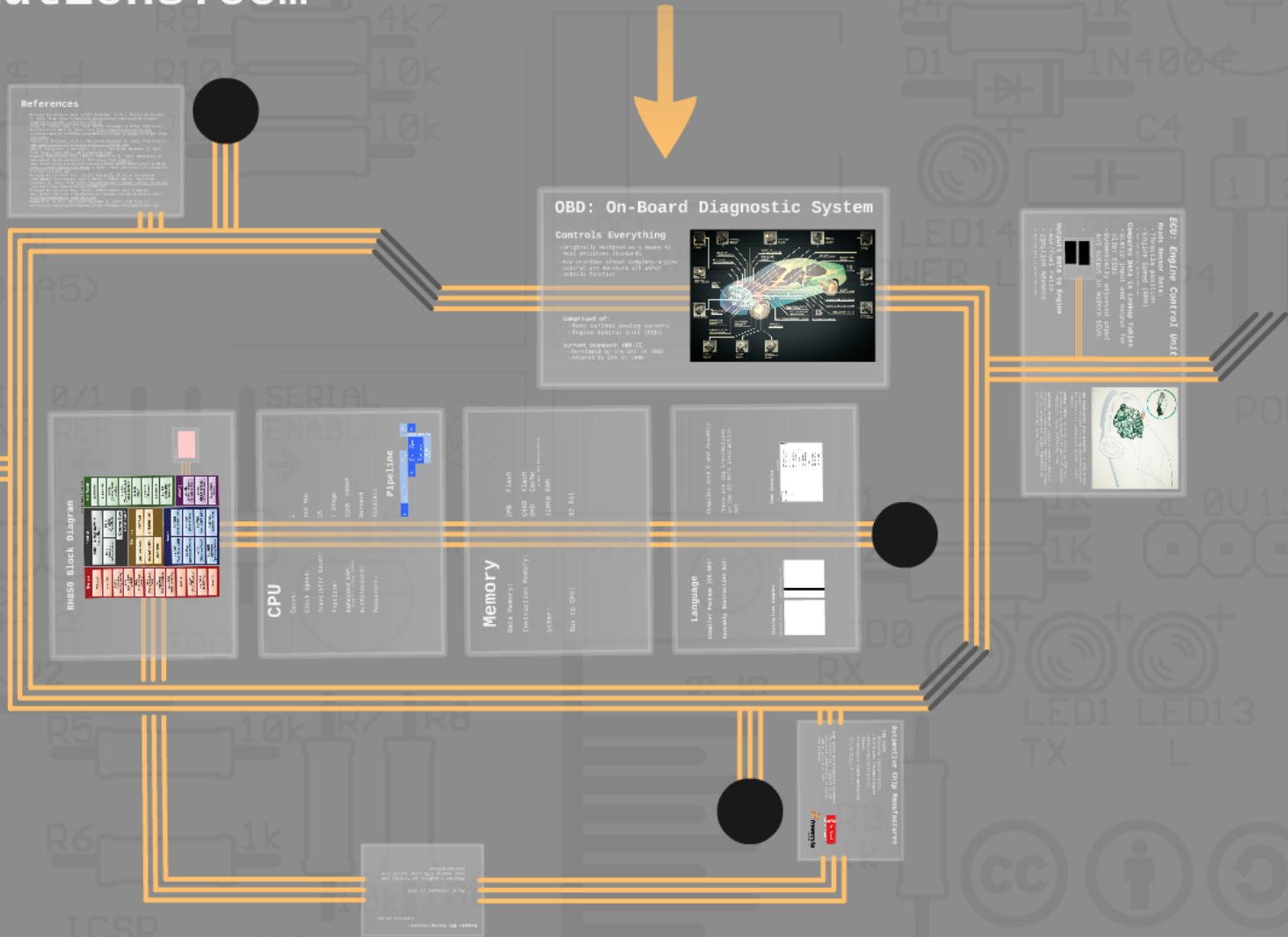
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OBD: On-Board Diagnostic System

Controls Everything

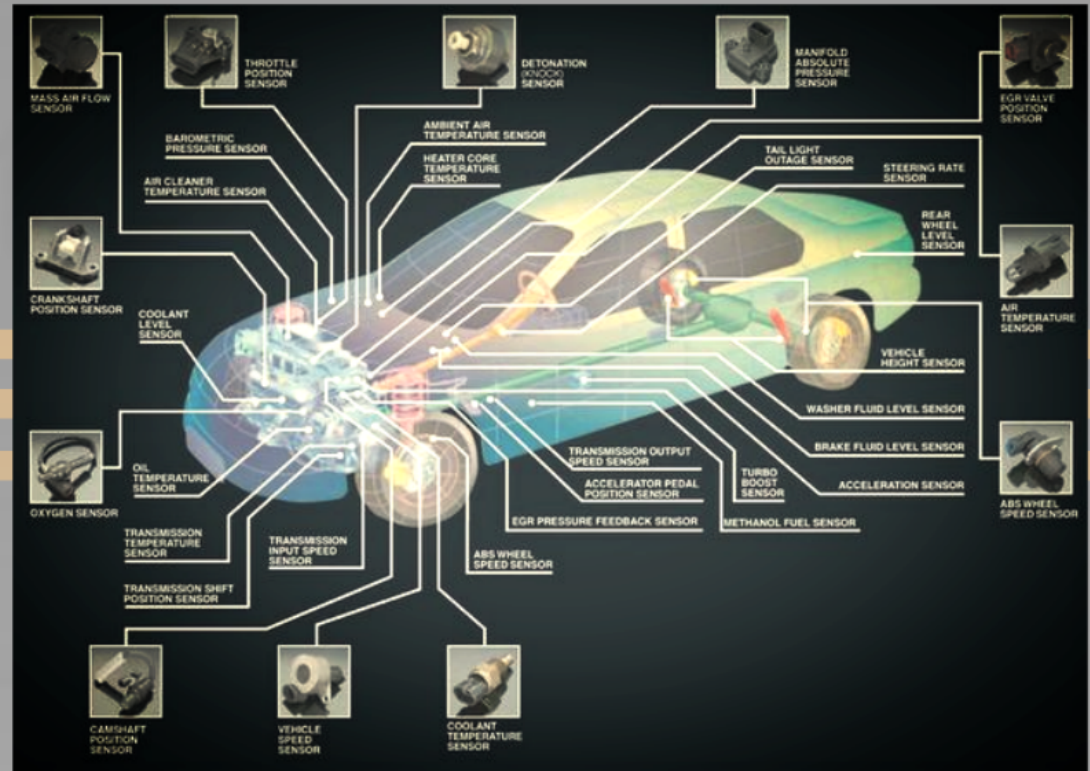
- Originally designed as a means to meet emissions standards
- Now provides almost complete engine control and monitors all other vehicle function

Comprised of:

- Many various analog sensors
- Engine Control Unit (ECU)

Current Standard: OBD-II

- Developed by the SAE in 1988
- Adopted by EPA in 1996



ECU: Engine Control Unit

Reads Sensor Data:

- Throttle position
- Engine Speed (RPM)
- And tons more in modern vehicles

Compares Data in Lookup Tables

- Static input and output for older ECUs
- Dynamically adjusted input and output in modern ECUs

Ignition Advance Lookup Table Examples

Static input/output

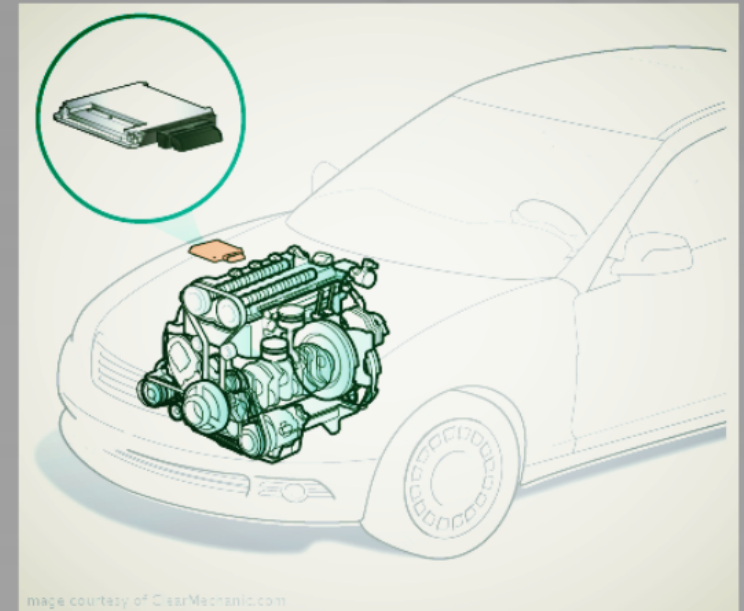
Engine Speed (RPM)	Ignition Advance (Degrees)
1000	10
1200	12
1400	14
1600	16
1800	18
2000	20
2200	22
2400	24
2600	26
2800	28
3000	30

Dynamically Adjusted input/output

Engine Speed (RPM)	Ignition Advance (Degrees)
1000	10
1200	12
1400	14
1600	16
1800	18
2000	20
2200	22
2400	24
2600	26
2800	28
3000	30

Outputs Data to Engine

- Air/fuel ratio
- Ignition Advance
- And tons more in modern vehicles



CAN (Controller Area Network): a vehicle bus standard designed to allow microcontrollers and sensors to communicate without a host computer

Lookup Table: An array stored in ROM that provides array indexing in place of runtime computation. Saves processing time

Ignition Advance: Ignition timing relative to piston stroke position. Spark plug firing time is variable per cycle, depending on acceleration and other factors

Ignition Advance Lookup Table Examples

Static input/output

Boost Tables: WG Duty Cycles

RPM - Read-only															
	500	1000	1500	2000	2250	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25.00	50.00	50.00	50.00	50.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31.25	50.00	50.00	50.00	50.00	50.00	7.22	5.00	6.00	6.57	7.14	7.71	9.14	9.29	9.43	7.29
37.50	50.00	50.00	50.00	50.00	50.00	14.44	10.00	12.00	13.14	14.29	15.43	18.29	18.57	18.86	14.57
43.75	50.00	50.00	50.00	50.00	50.00	21.67	15.00	18.00	19.71	21.43	23.14	27.43	27.86	28.29	21.86
50.00	50.00	50.00	50.00	50.00	50.00	28.89	20.00	24.00	26.29	28.57	30.86	36.57	37.14	37.71	29.14
56.25	50.00	50.00	50.00	50.00	50.00	36.11	25.00	30.00	32.86	35.71	38.57	45.71	46.43	47.14	36.43
62.50	50.00	50.00	50.00	50.00	50.00	43.33	30.00	36.00	39.43	42.86	46.29	54.86	55.71	56.57	43.71
68.75	50.00	50.00	50.00	50.00	50.00	43.33	30.00	42.00	46.00	50.00	54.00	64.00	65.00	66.00	51.00
75.00	50.00	50.00	50.00	50.00	50.00	43.33	30.00	42.00	46.00	50.00	54.00	64.00	65.00	66.00	51.00
81.25	50.00	50.00	50.00	50.00	50.00	43.33	30.00	42.00	46.00	50.00	54.00	64.00	65.00	66.00	51.00
87.50	50.00	50.00	50.00	50.00	50.00	43.33	30.00	42.00	46.00	50.00	54.00	64.00	65.00	66.00	51.00
93.75	50.00	50.00	50.00	50.00	50.00	43.33	30.00	42.00	46.00	50.00	54.00	64.00	65.00	66.00	51.00
100.00	50.00	50.00	50.00	50.00	50.00	43.33	30.00	42.00	46.00	50.00	54.00	64.00	65.00	66.00	51.00

Throttle Position - Read-only **Duty Cycle**

Dynamically Adjusted input/output

Dynamic Advance Tables: Dynamic Advance

Calculated Load													
	0.70	0.86	1.00	1.12	1.26	1.40	1.52	1.64	1.74	1.84	1.94	2.04	2.14
800	0.00	0.00	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18
1200	0.00	4.94	7.41	8.12	8.12	8.12	8.12	8.12	8.12	8.12	8.12	8.12	8.12
1600	0.00	0.00	8.12	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18
2000	0.00	0.00	9.18	9.18	9.18	8.47	8.47	8.47	8.47	8.47	8.47	8.47	8.47
2400	0.00	0.00	7.06	8.47	8.47	8.47	8.47	8.47	8.47	8.82	8.82	8.82	8.82
2800	0.00	0.00	7.06	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	8.12	7.41
3200	0.00	0.00	7.06	9.18	9.53	9.53	9.53	10.24	9.88	9.18	9.18	8.12	7.41
3600	0.00	0.00	7.06	7.76	10.24	10.24	10.24	10.24	9.88	9.18	9.18	8.12	7.41
4000	0.00	0.00	5.65	8.47	9.18	10.94	9.53	8.12	8.82	8.12	8.12	8.12	7.41
4400	0.00	0.00	4.94	8.47	7.41	7.06	6.35	7.06	8.12	6.71	10.59	9.53	7.76
4800	0.00	0.00	3.88	7.06	6.35	8.12	9.18	9.88	12.35	12.71	12.35	12.35	9.88
5200	0.00	0.00	0.00	3.53	4.59	3.88	4.59	6.35	8.12	8.47	7.76	7.76	7.76
5600	0.00	0.00	0.00	3.18	3.18	3.53	3.88	4.94	8.12	9.88	9.53	9.53	9.53
6000	0.00	0.00	3.53	3.88	3.53	3.88	5.65	7.41	8.82	8.12	8.12	8.12	8.12
6400	0.00	3.18	5.65	7.41	7.06	7.41	8.47	10.24	8.82	8.47	9.18	9.18	9.18
6800	0.00	2.47	4.59	7.06	7.06	7.41	8.47	10.59	9.18	9.18	10.94	10.94	10.94

RPM **Dynamic Advance (Degrees)**