



Dr. NMS

or: How Facebook Learned to Stop Worrying and Love the Network

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Jose

David



ZERO IMPACT NETWORK

We'll be talking about



Facebook scale



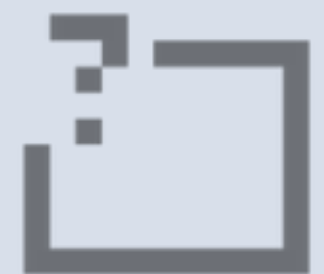
FDN



**Tales from
the real world**



**This journey
is 1% finished**



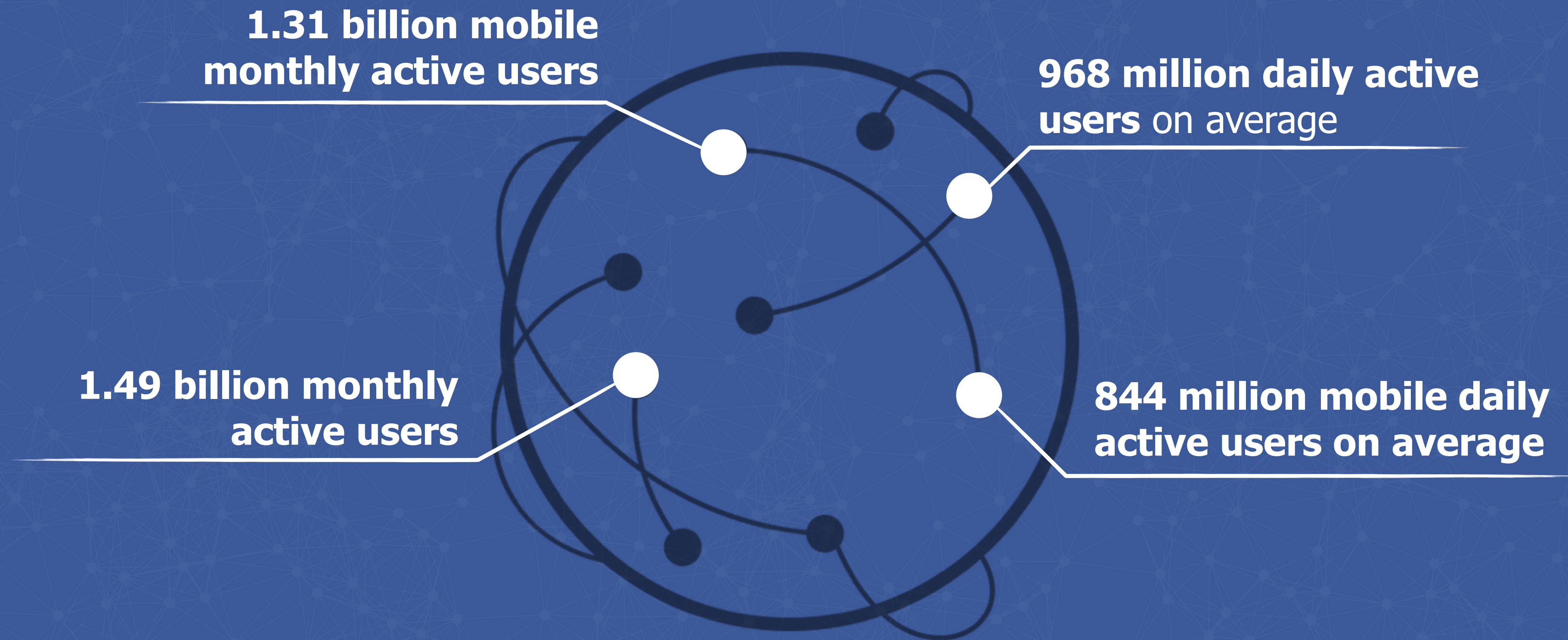
Q&A

A person in a white space suit is floating in the air, arms outstretched. The suit has a large blue visor showing a view of Earth from space. The person is in a room with a desk, a chair, and a picture of the sun on the wall. The text "Facebook scale" is overlaid in the center.

Facebook scale

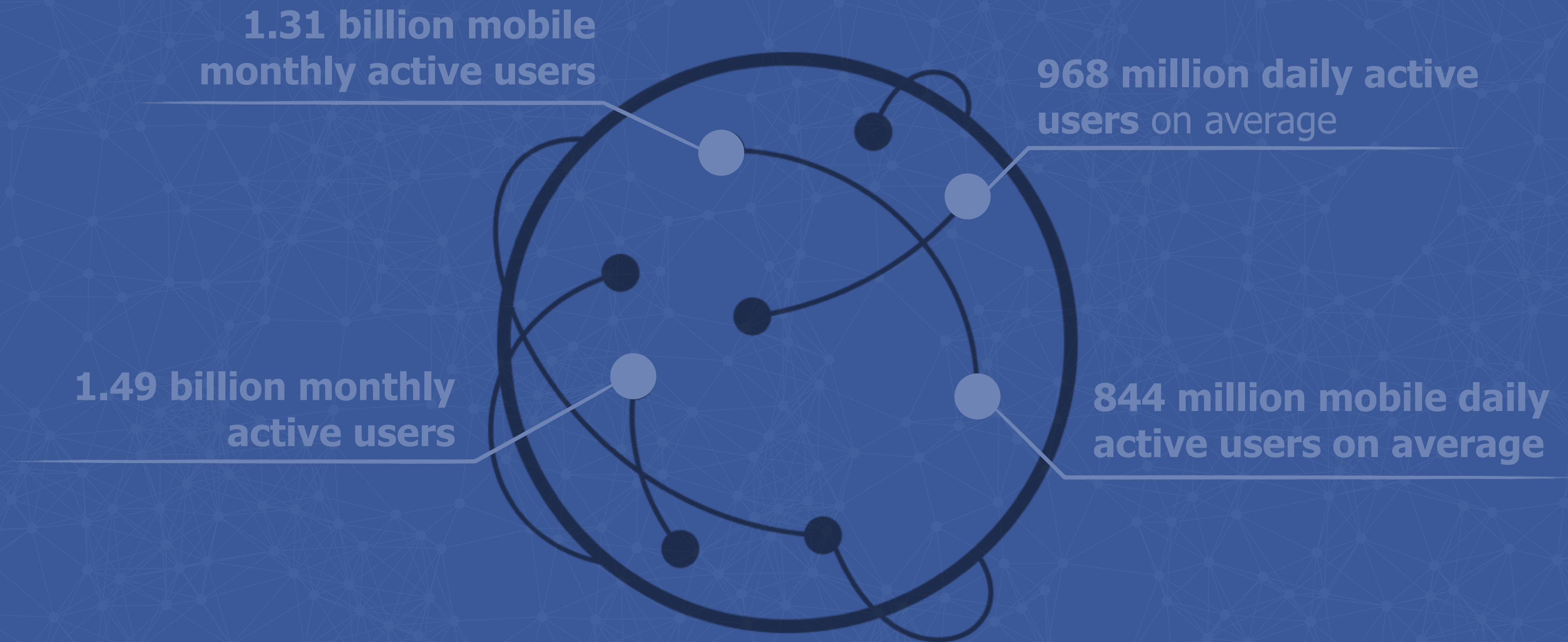
Facebook scale

as of June 2015



Facebook scale

as of June 2015



Approximately 83.1% of our daily active users are outside the US and Canada

A topographic map with contour lines and building outlines. A hand is visible in the bottom left corner, pointing towards the map. The map features various elevation markers and building footprints, with some areas labeled with numbers like 90, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

What does that mean for the Facebook Network?

Lots of traffic and global footprint

Network traffic



Machine to machine

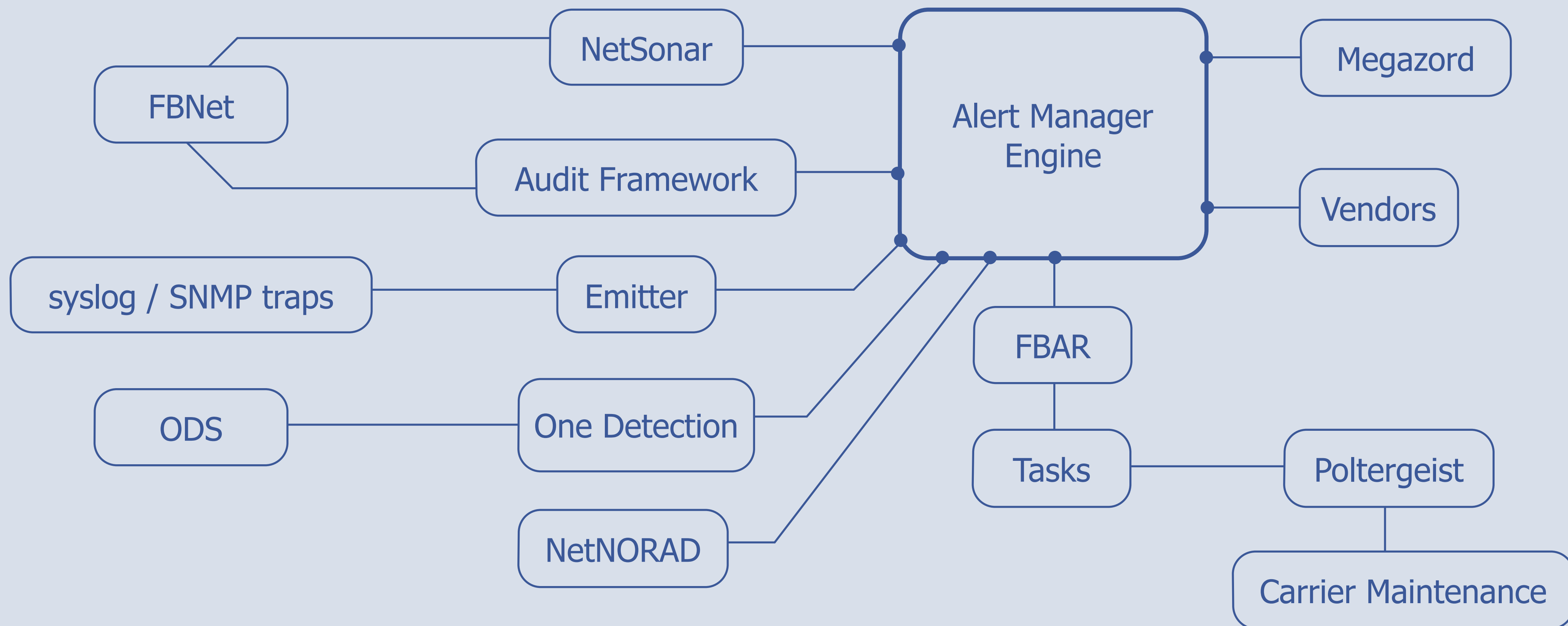
Machine to user

A LEGO minifigure of a female engineer with brown hair in a bun, wearing a white lab coat with blue markings, stands next to a custom-built LEGO robot. The robot is constructed from grey and white bricks, featuring a large grey arm with a claw-like hand. The robot's head area is decorated with a black and white circuit board pattern. The background is a dark, textured surface with a subtle pattern of interconnected lines and dots, resembling a network or circuit board. The text "Engineers build robots, robots manage the network" is overlaid in a large, white, sans-serif font.

**Engineers build robots,
robots manage the network**

Facebook Defined Networking

Facebook Defined Networking



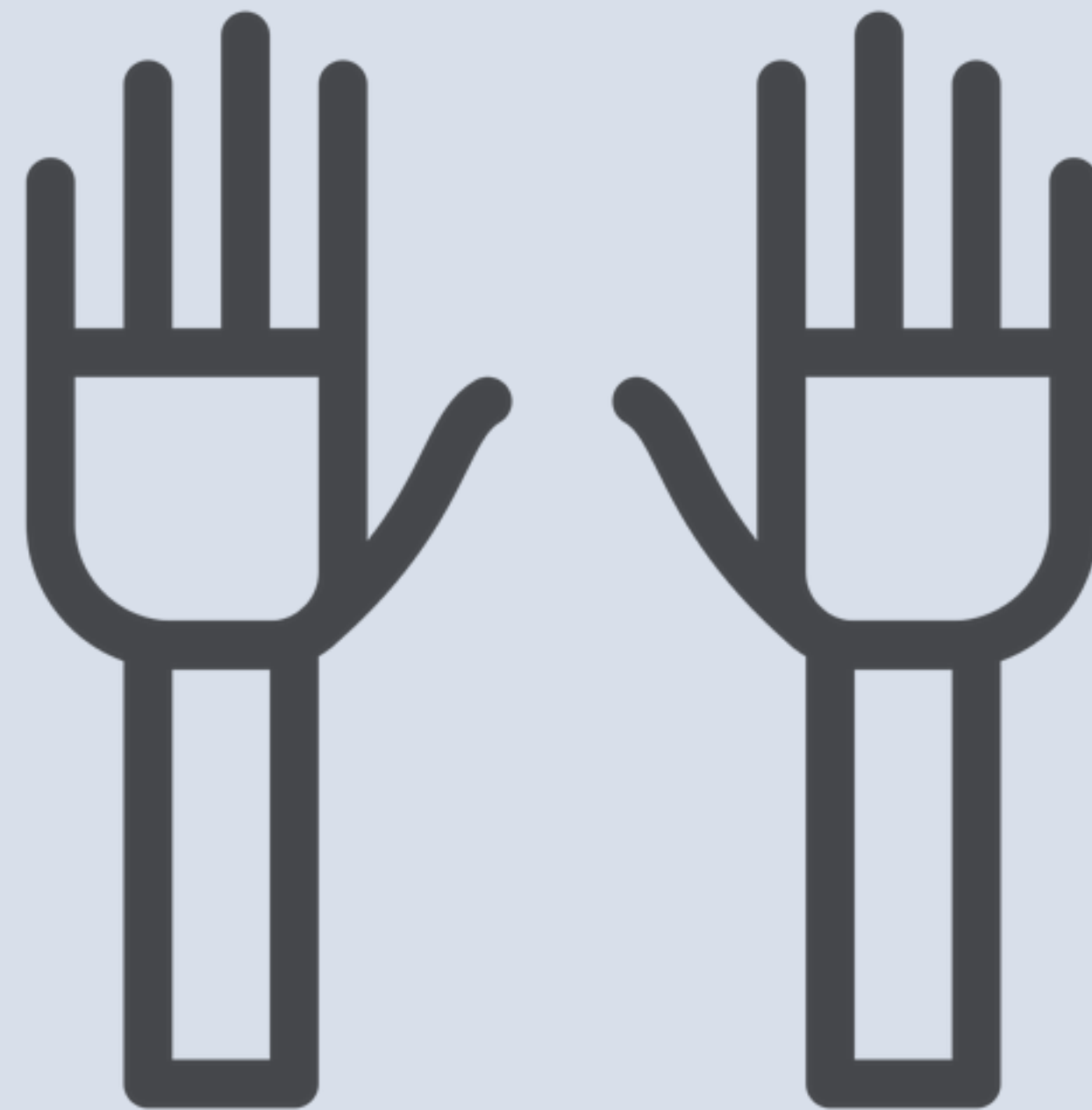
FBNet

The brains to help guide our robots run the network



Drain Services

The movers of traffic on the network devices



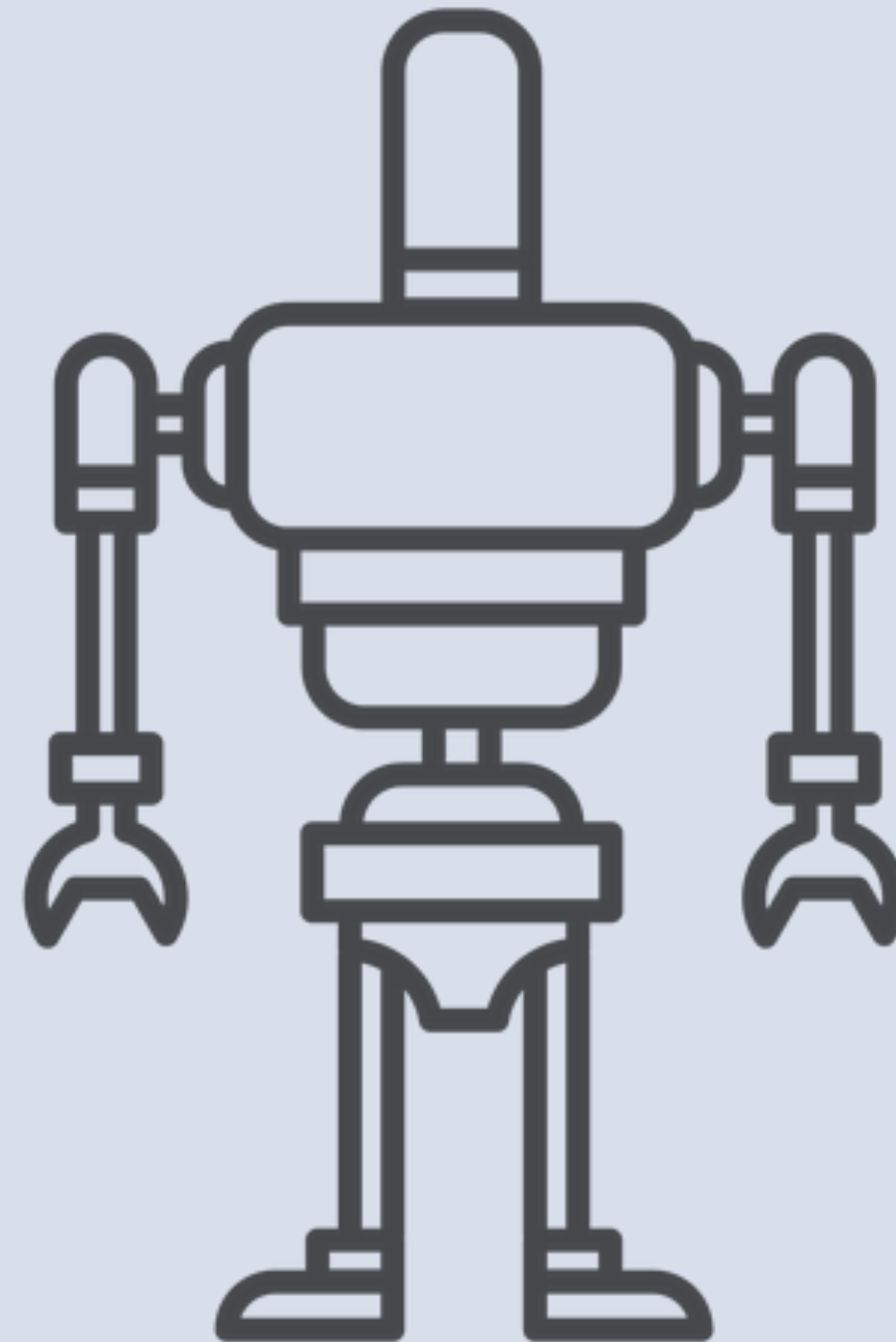
NetNORAD

Our Packet Loss detection system



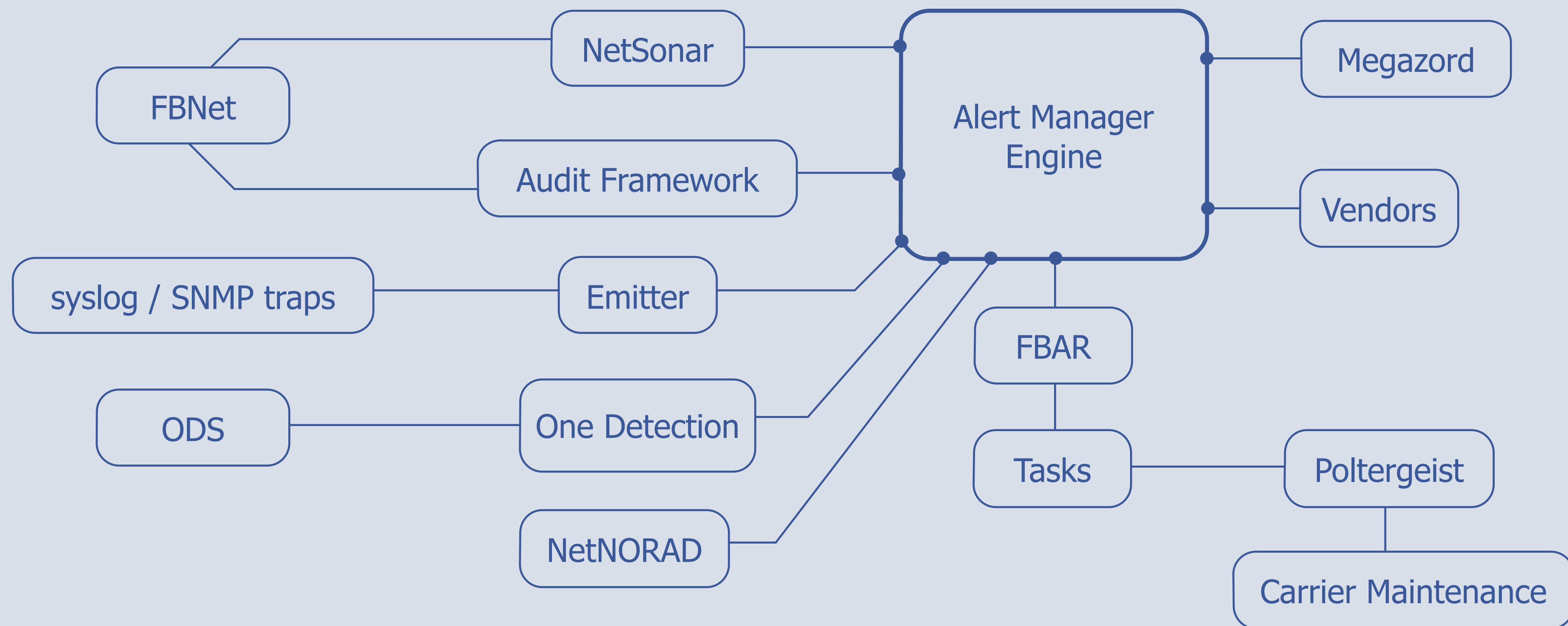
Megazord

Our alarm correlation engine



Facebook Defined Networking

all components in action





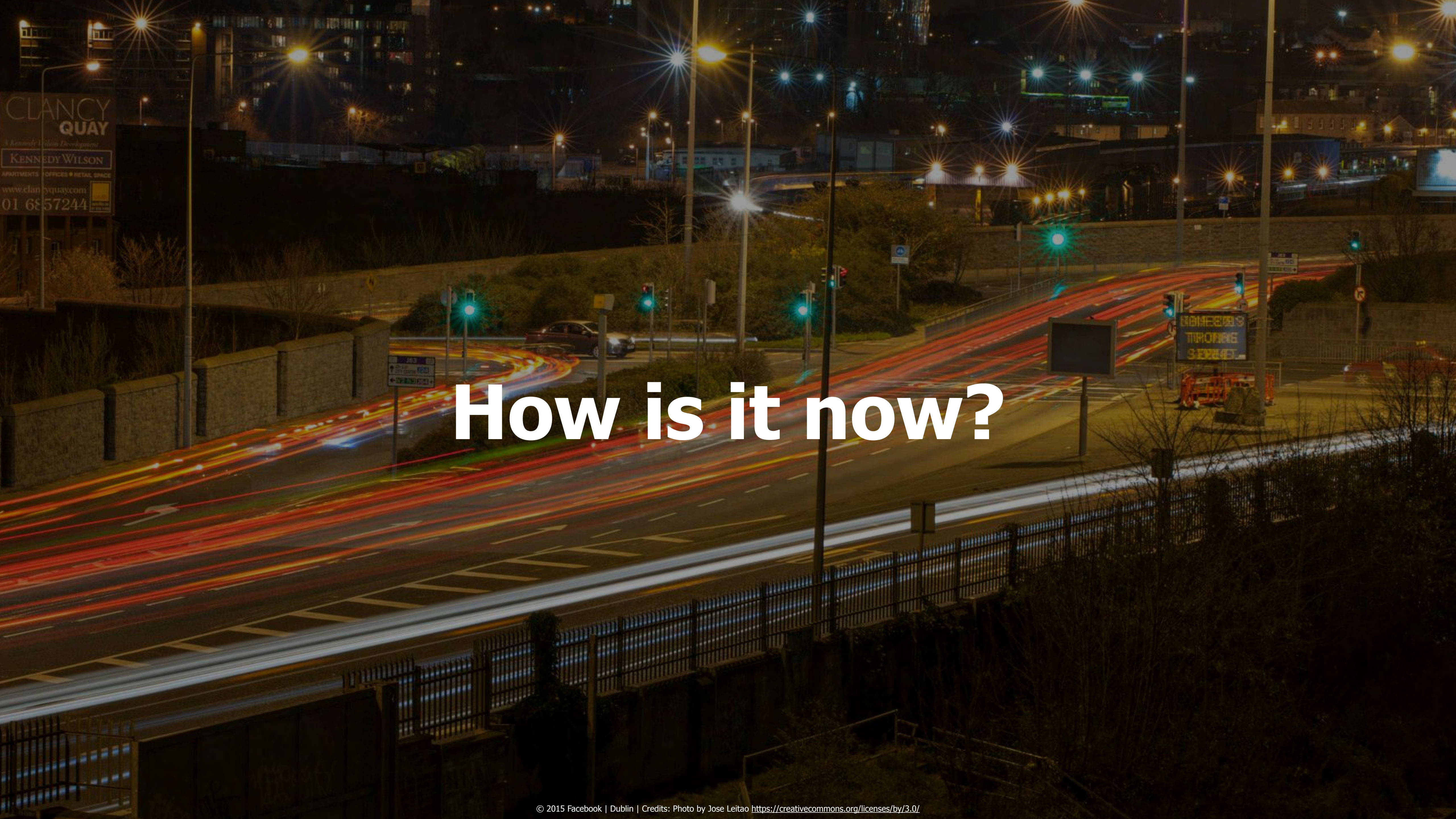
Tales from the real world

Circuits @ scale

Manual approach



Hybrid approach



How is it now?



Fully automated

How is it now?

**Notification
from vendor**



How is it now?

**Notification
from vendor**



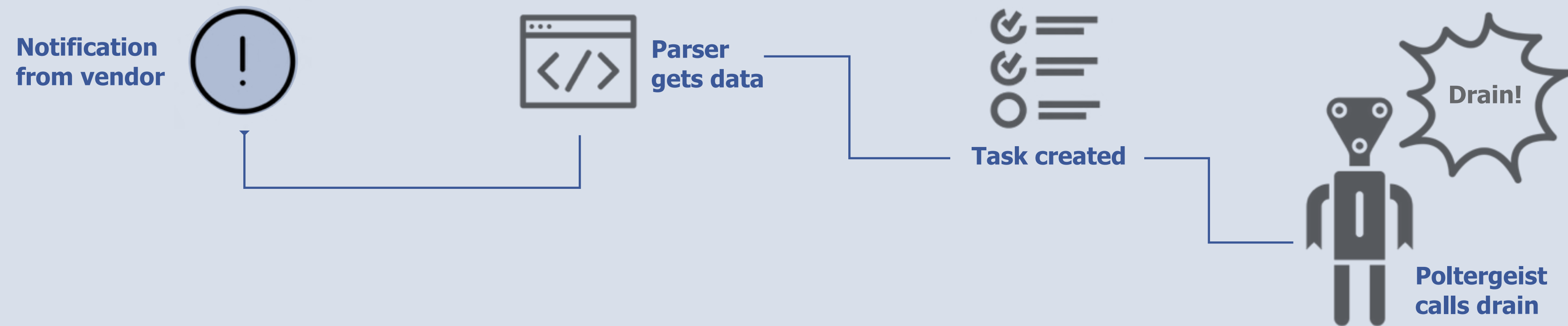
**Parser
gets data**



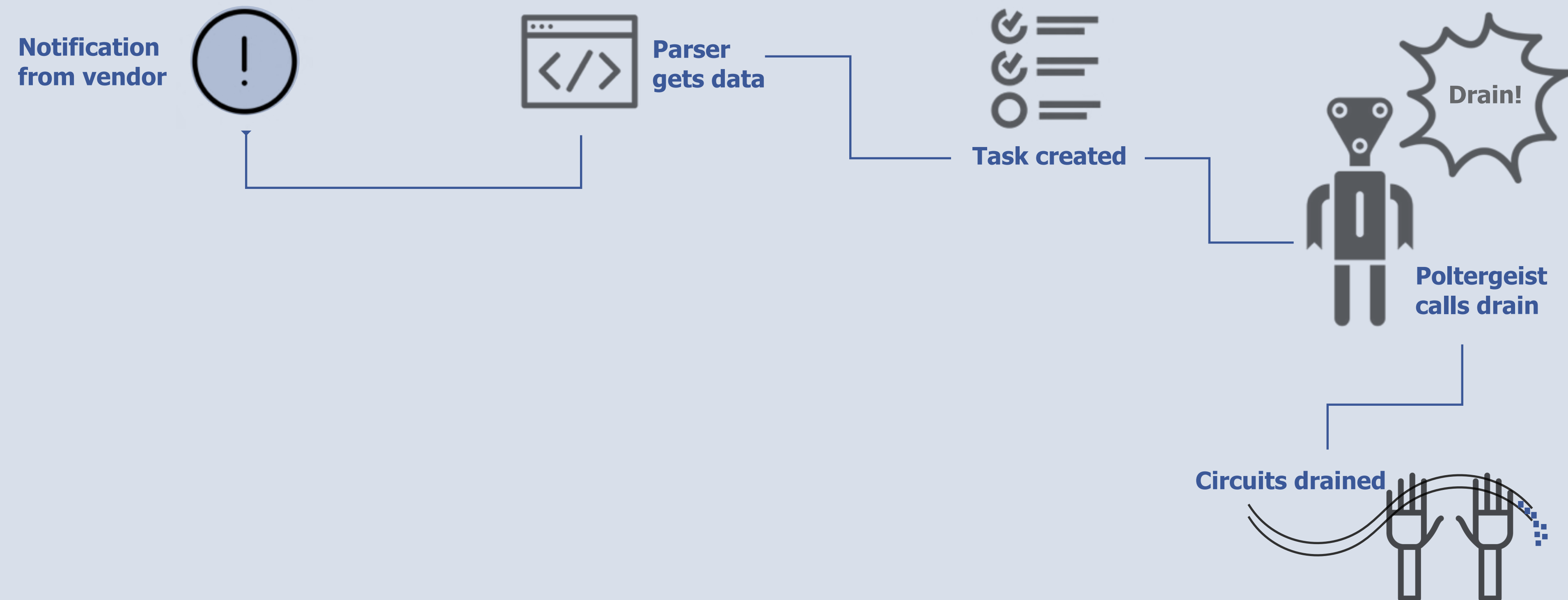
How is it now?



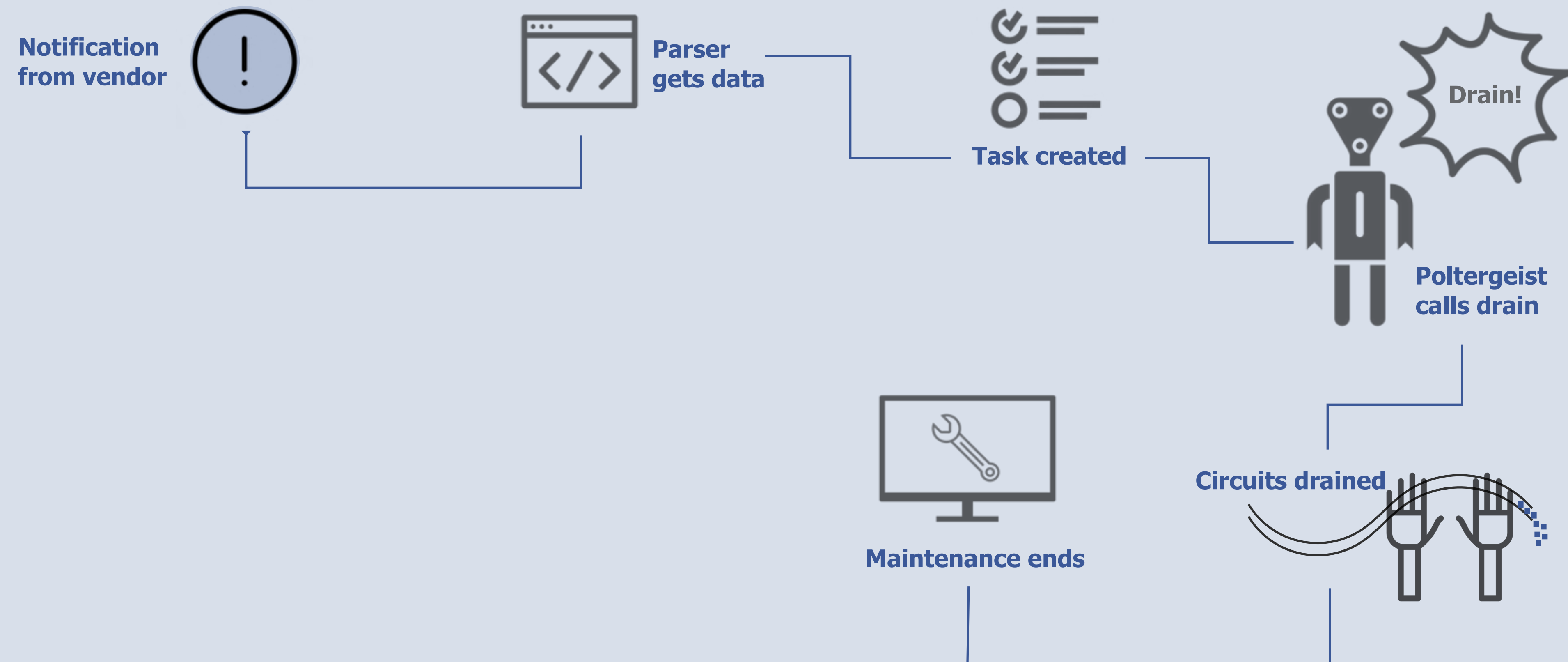
How is it now?



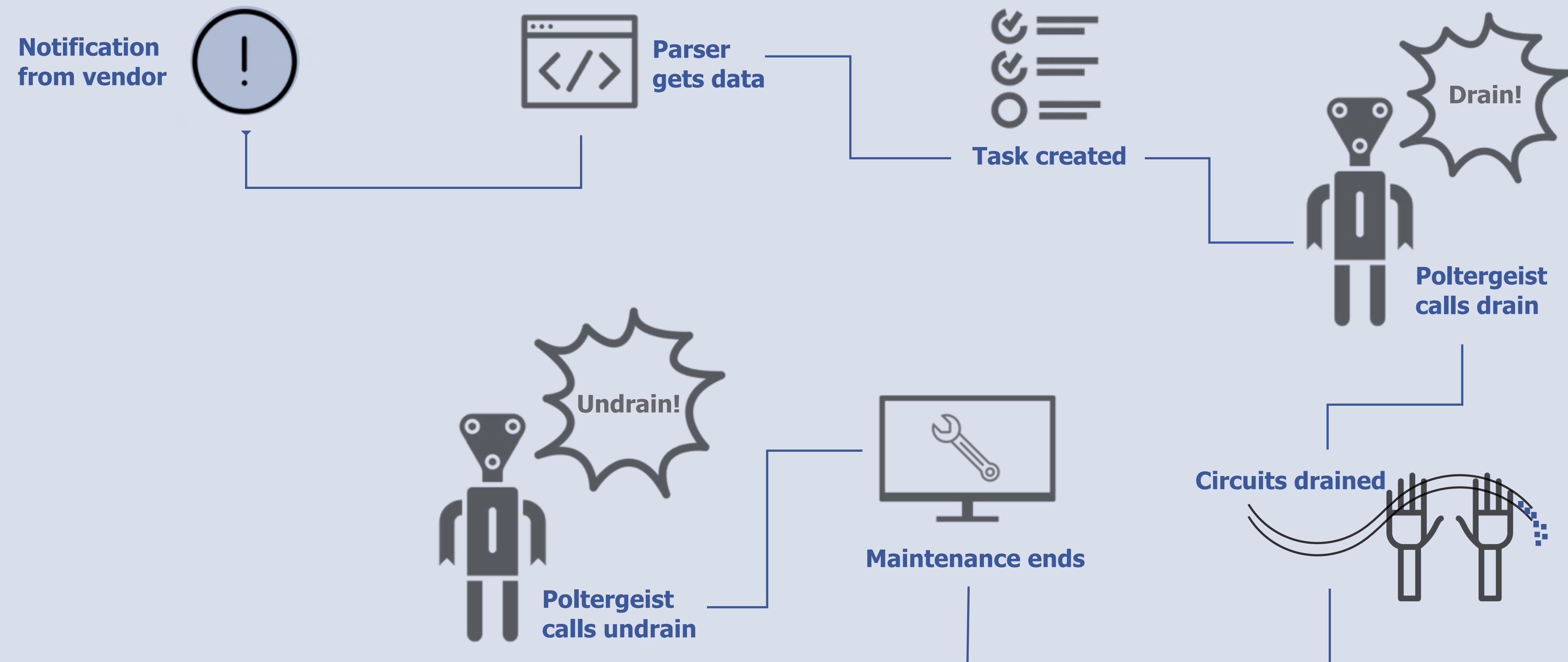
How is it now?



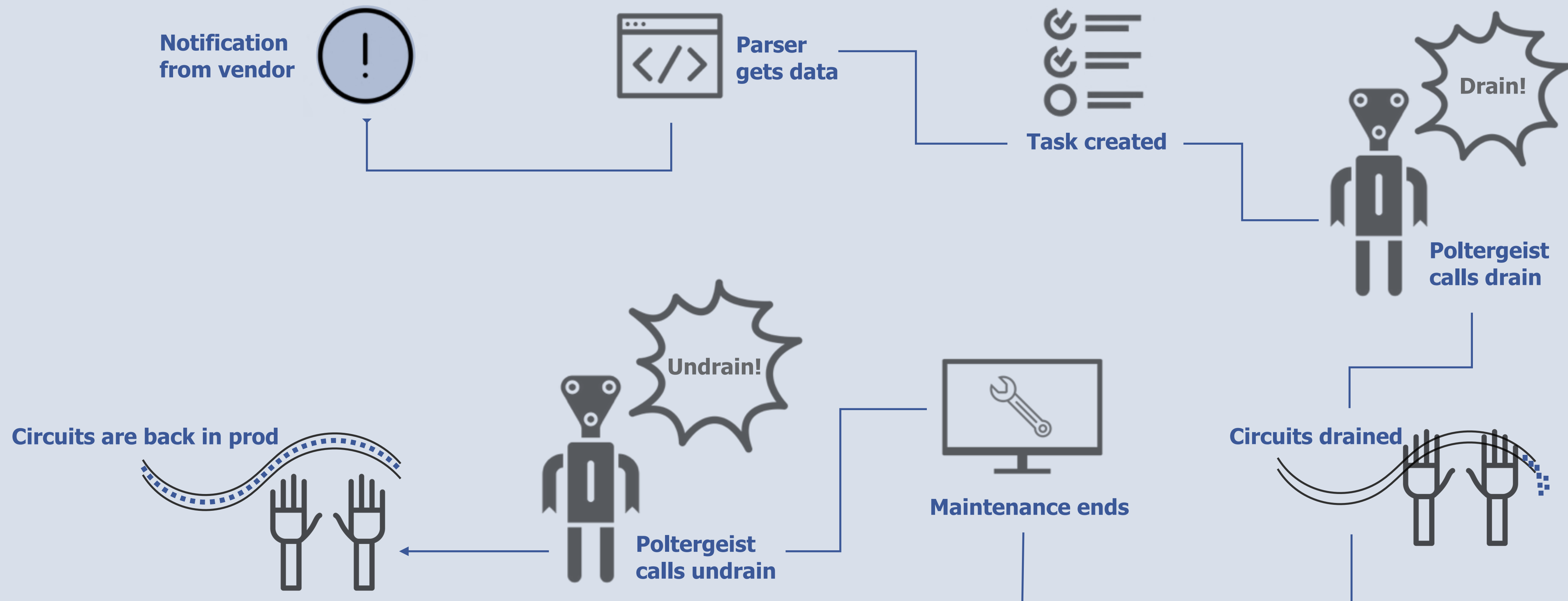
How is it now?



How is it now?



How is it now?



A large school of hammerhead sharks swimming in deep blue water. The sharks are silhouetted against the lighter blue background, creating a sense of depth and movement. They are swimming in various directions, some towards the camera and others away from it.

What about fiber-eating sharks?

Seriously...

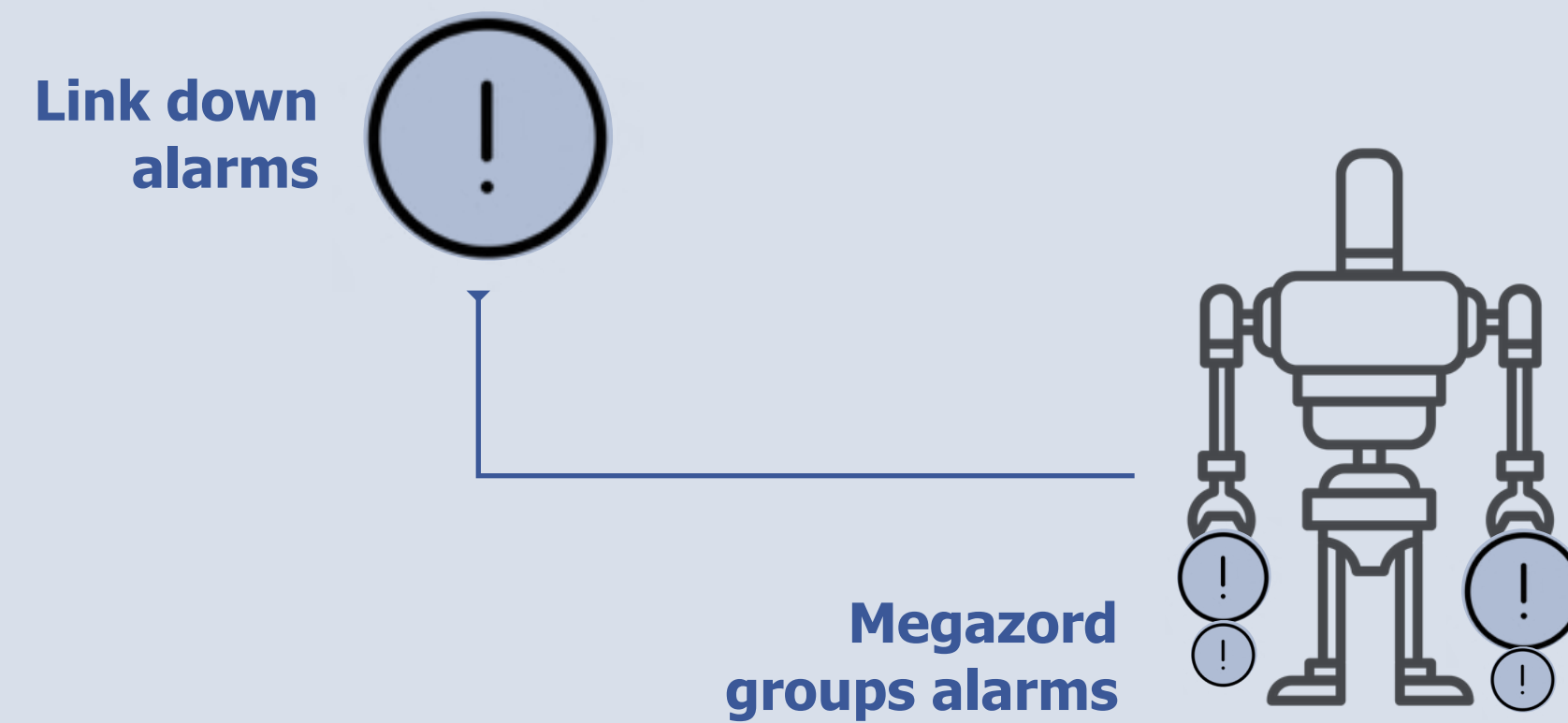


How is it now?

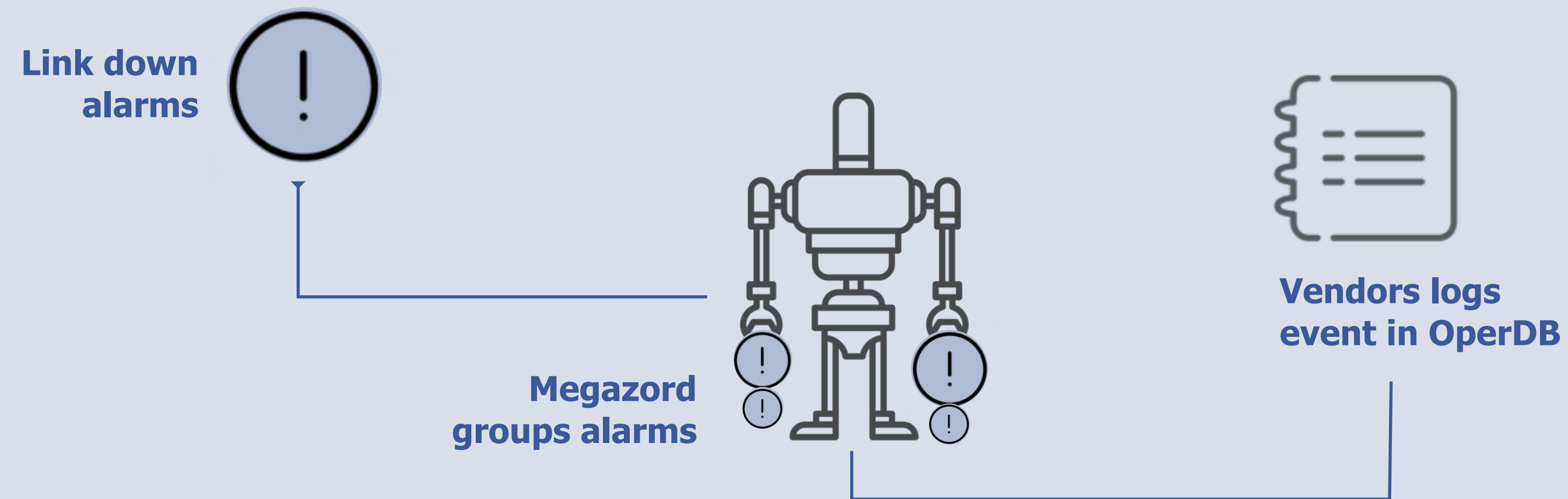
**Link down
alarms**



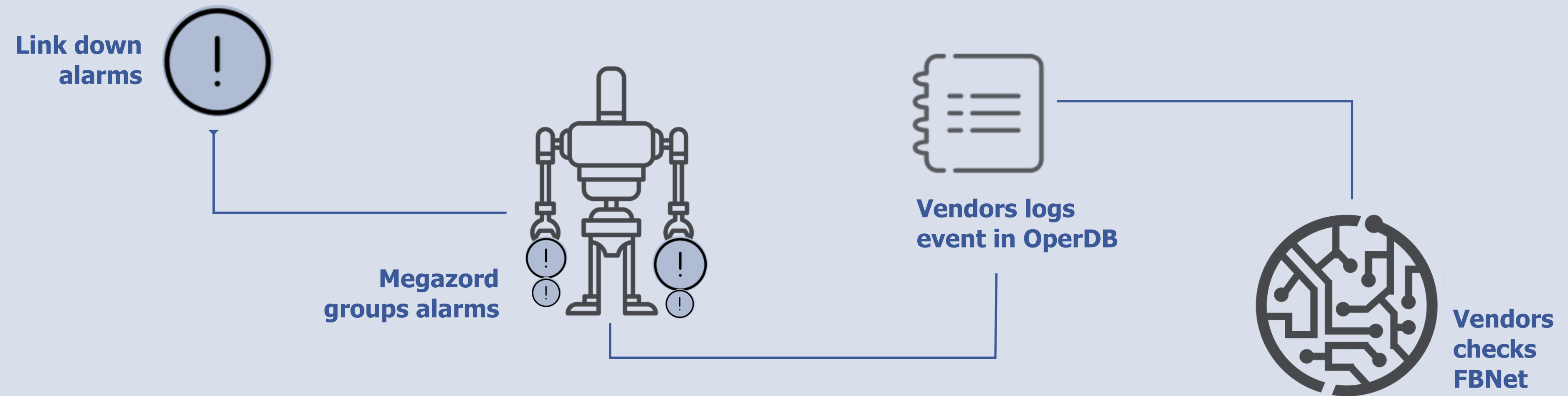
How is it now?



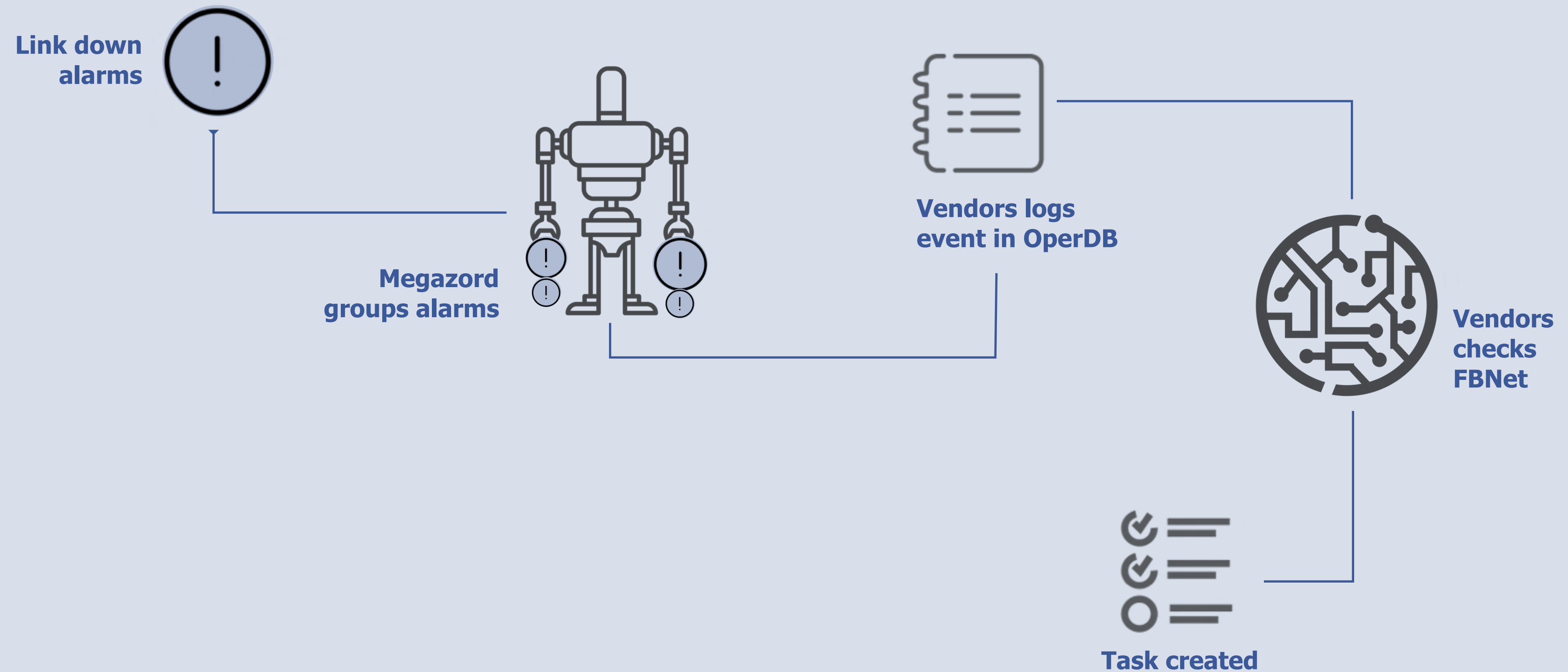
How is it now?



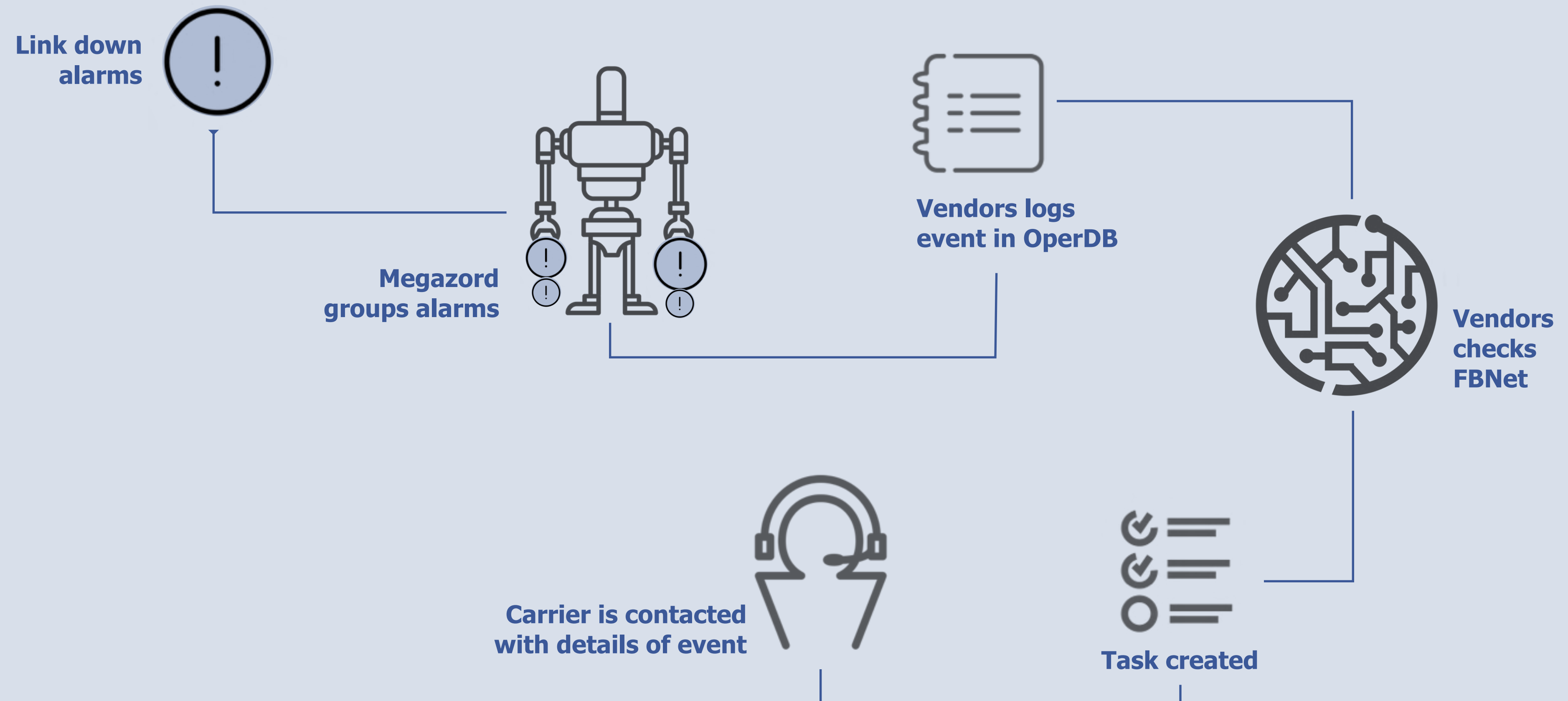
How is it now?



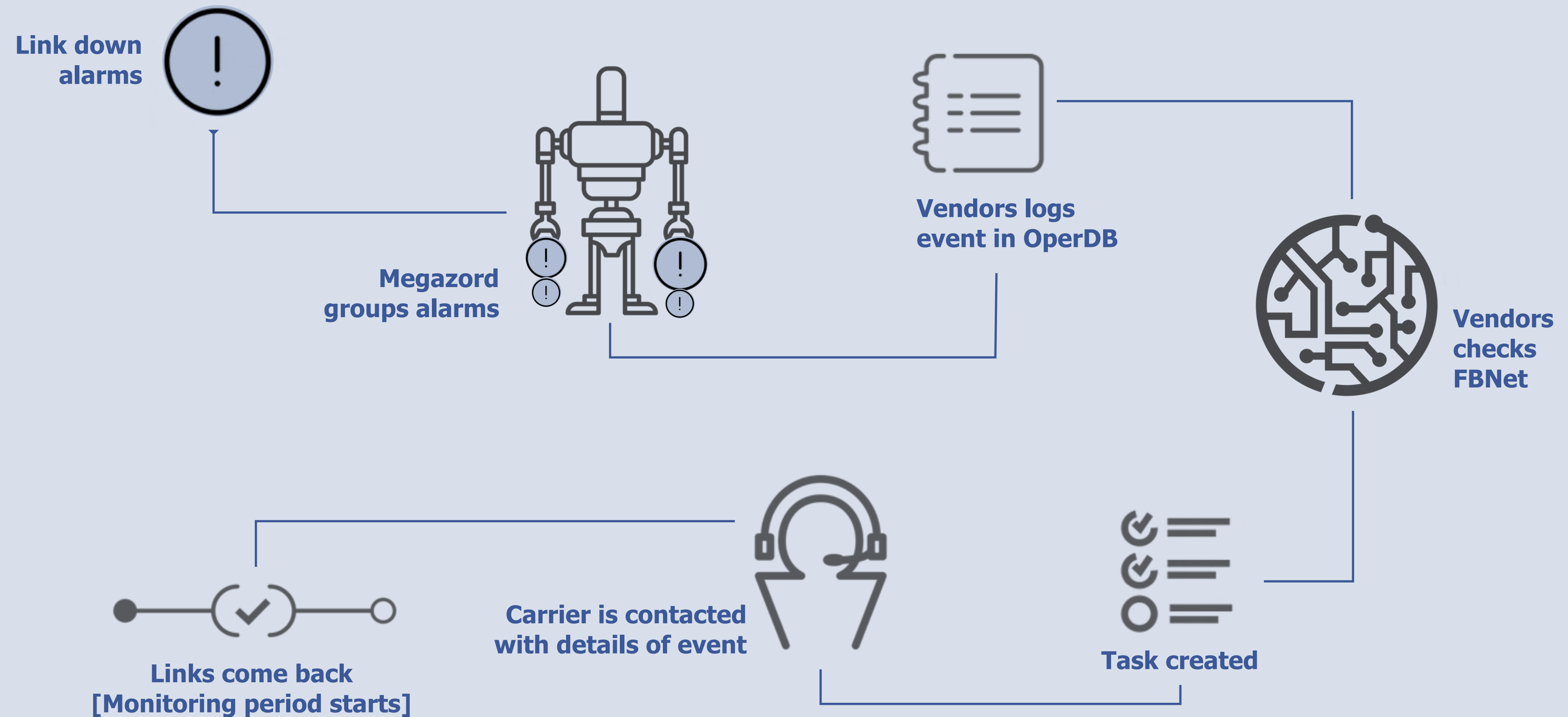
How is it now?



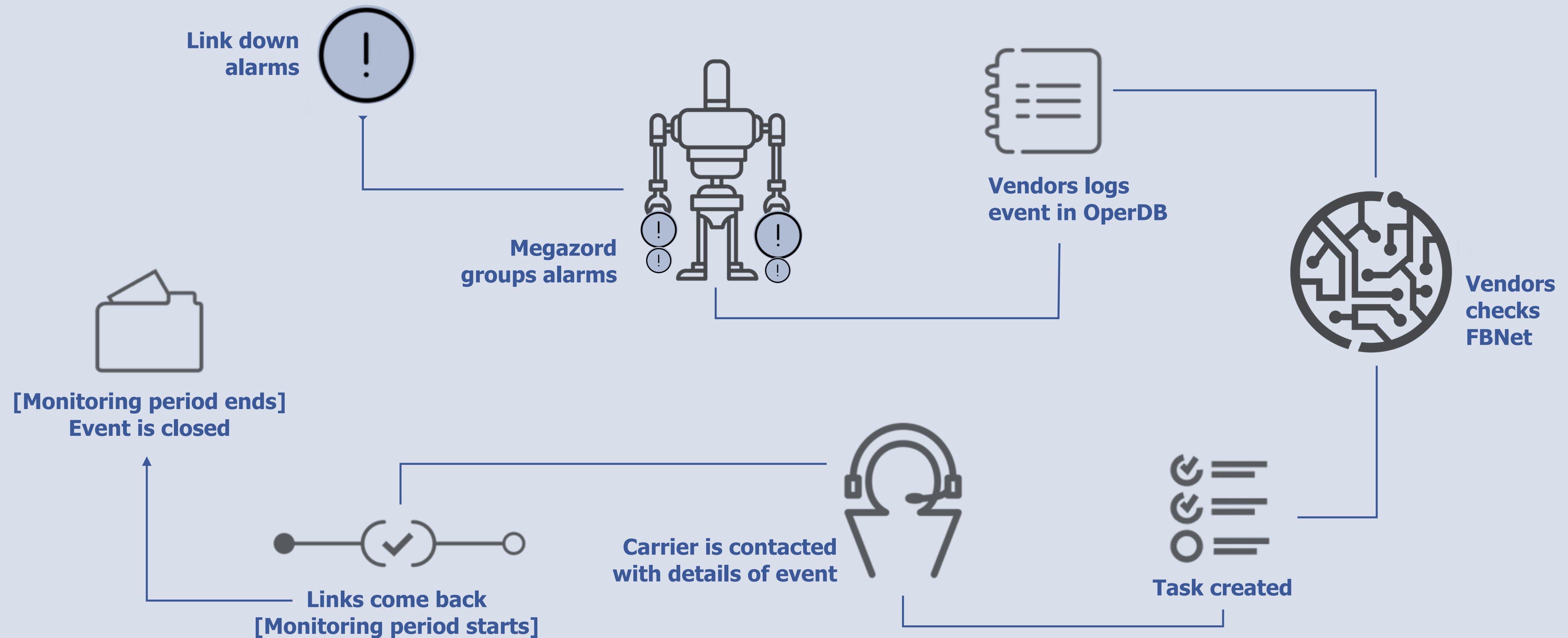
How is it now?



How is it now?

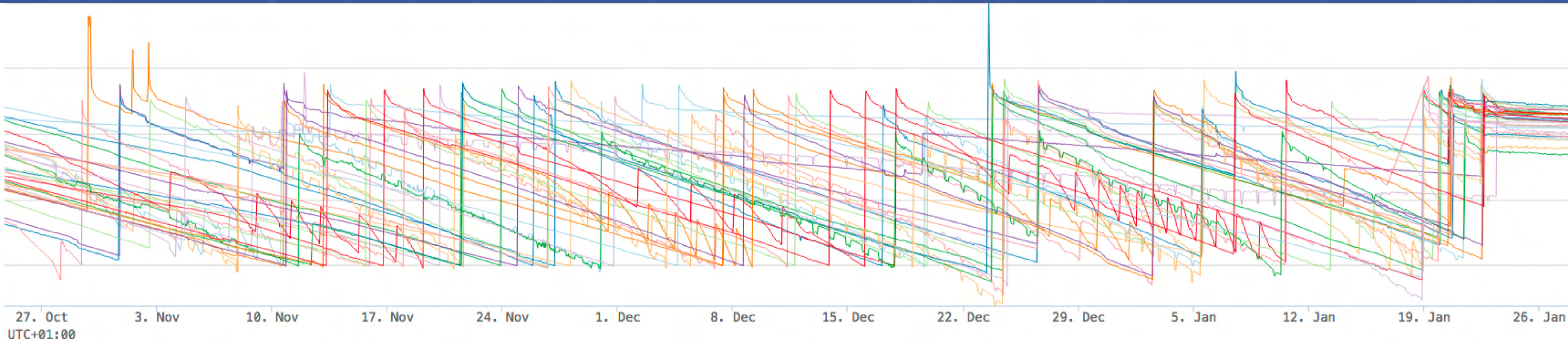


How is it now?



The memory leak debacle

Free memory over time



The background of the image is Raphael's famous fresco, 'The School of Athens'. It depicts a group of ancient Greek philosophers gathered in a grand, vaulted hall. Plato and Aristotle are the central figures, walking towards the viewer. Plato points his right index finger to the sky, while Aristotle holds his right hand palm-down, gesturing towards the earth. They are surrounded by other philosophers like Pythagoras, Euclid, and Socrates, each engaged in various intellectual activities. The architecture is highly detailed, with a coffered ceiling and statues in niches. The overall scene represents the pinnacle of human knowledge and reason.

How would this be solved with humans?



Lots of them + coffee

How is it now?



**ODS detector
for free memory
goes bellow threshold**

How is it now?

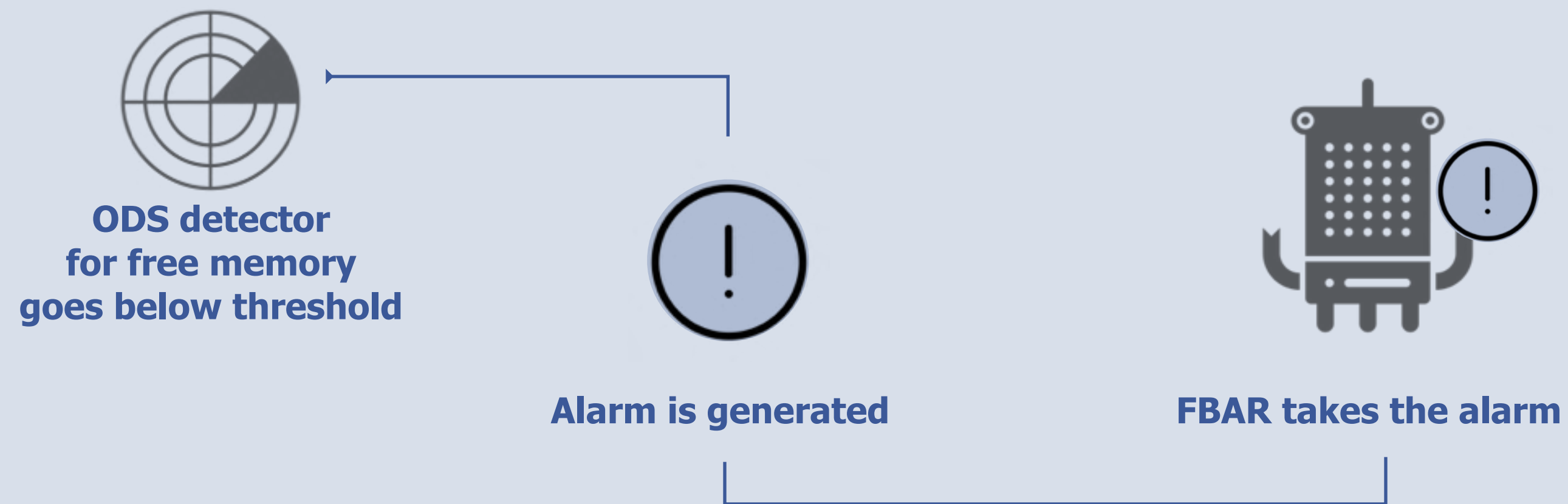


**ODS detector
for free memory
goes below threshold**

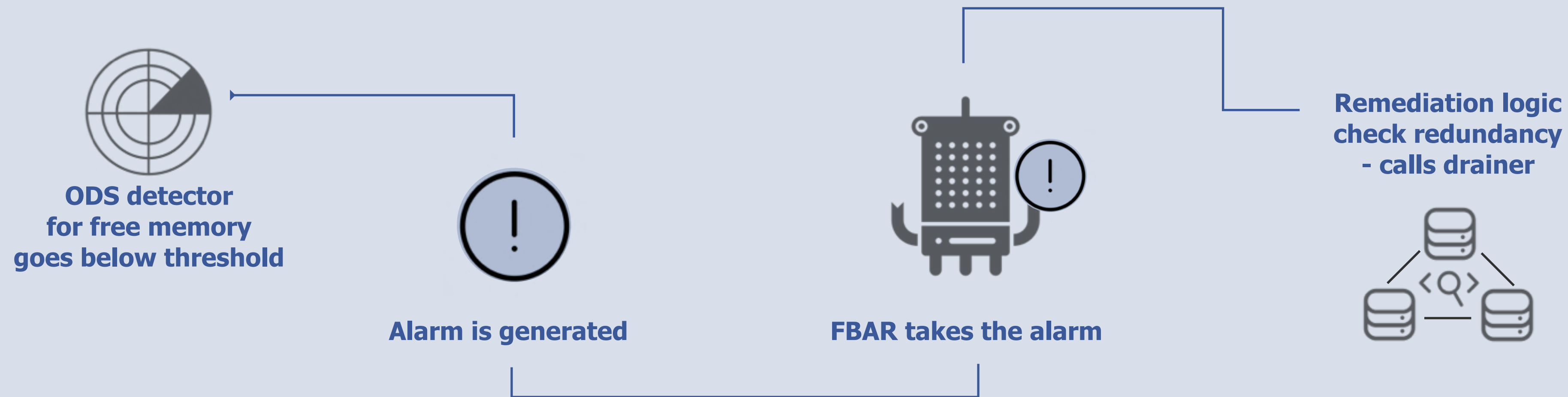


Alarm is generated

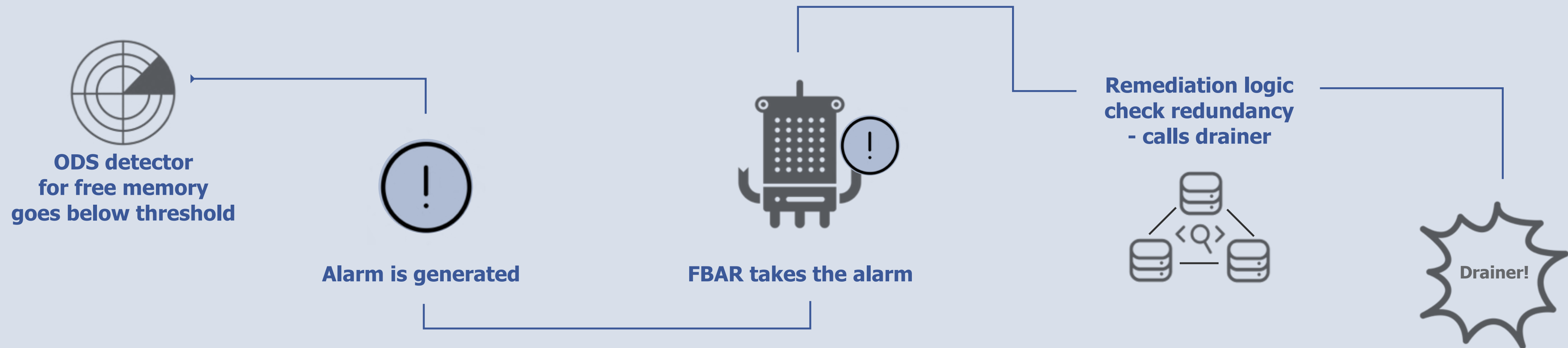
How is it now?



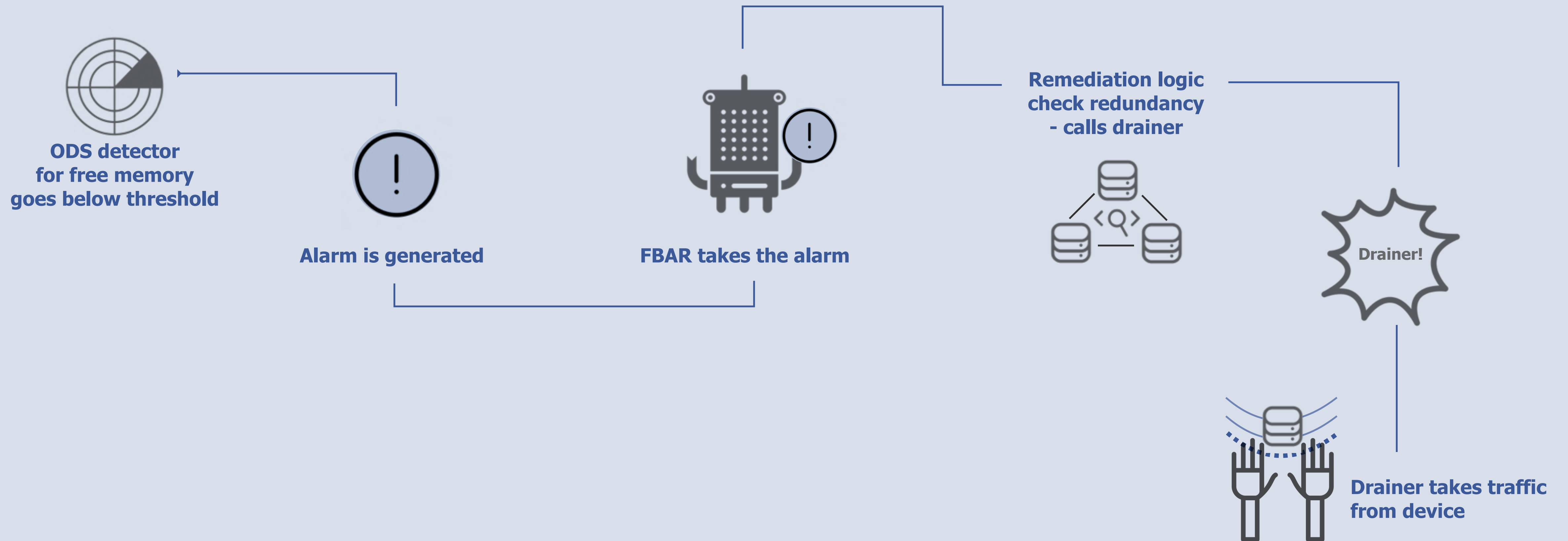
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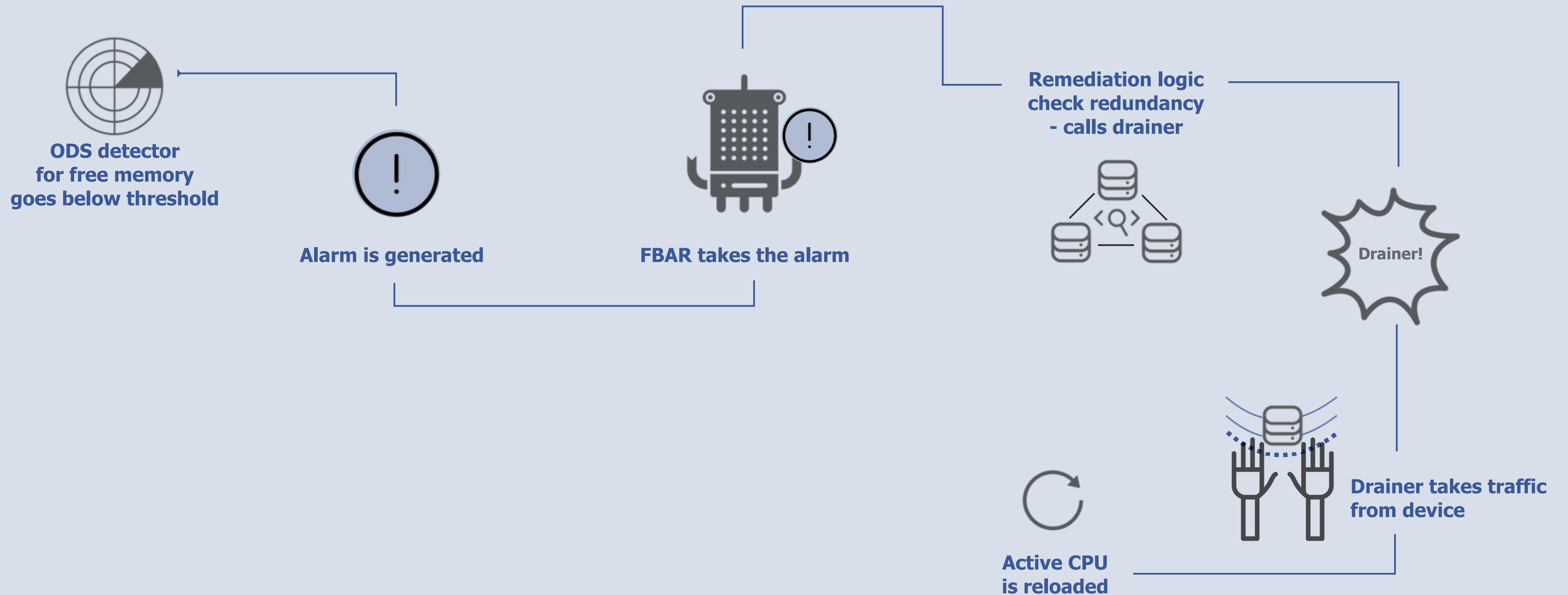
How is it now?



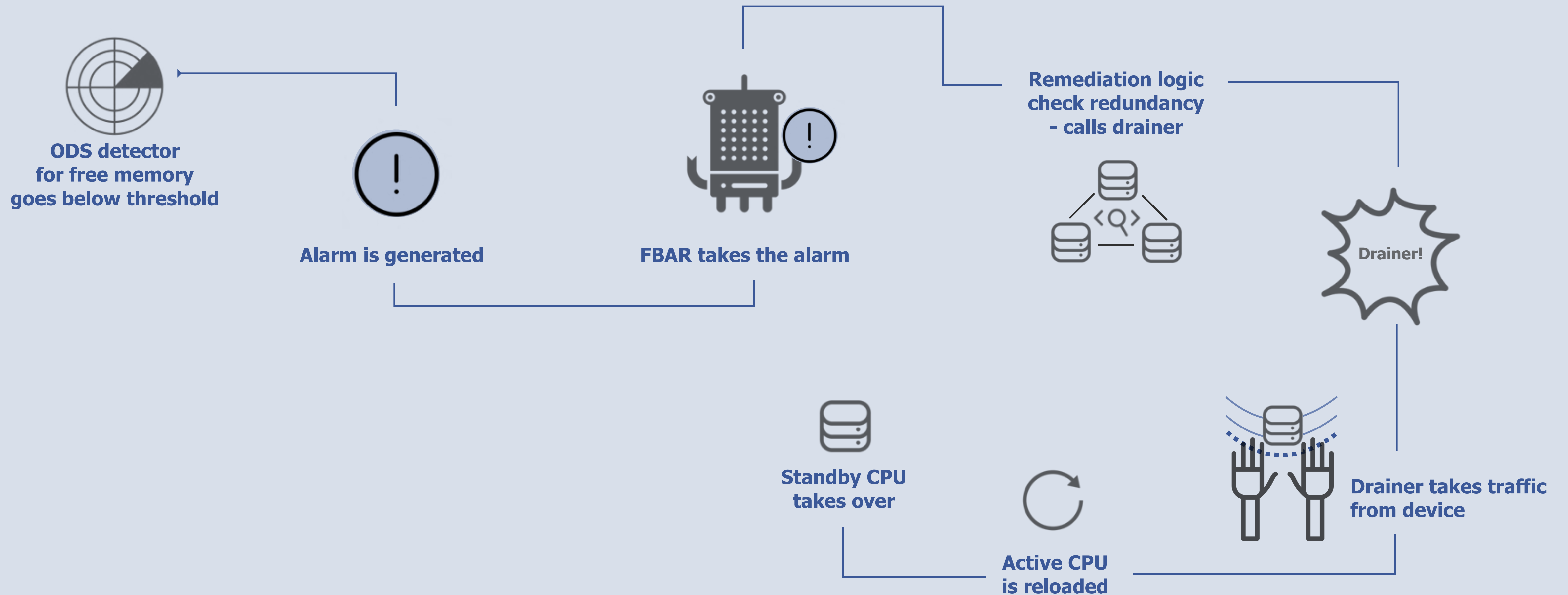
How is it now?



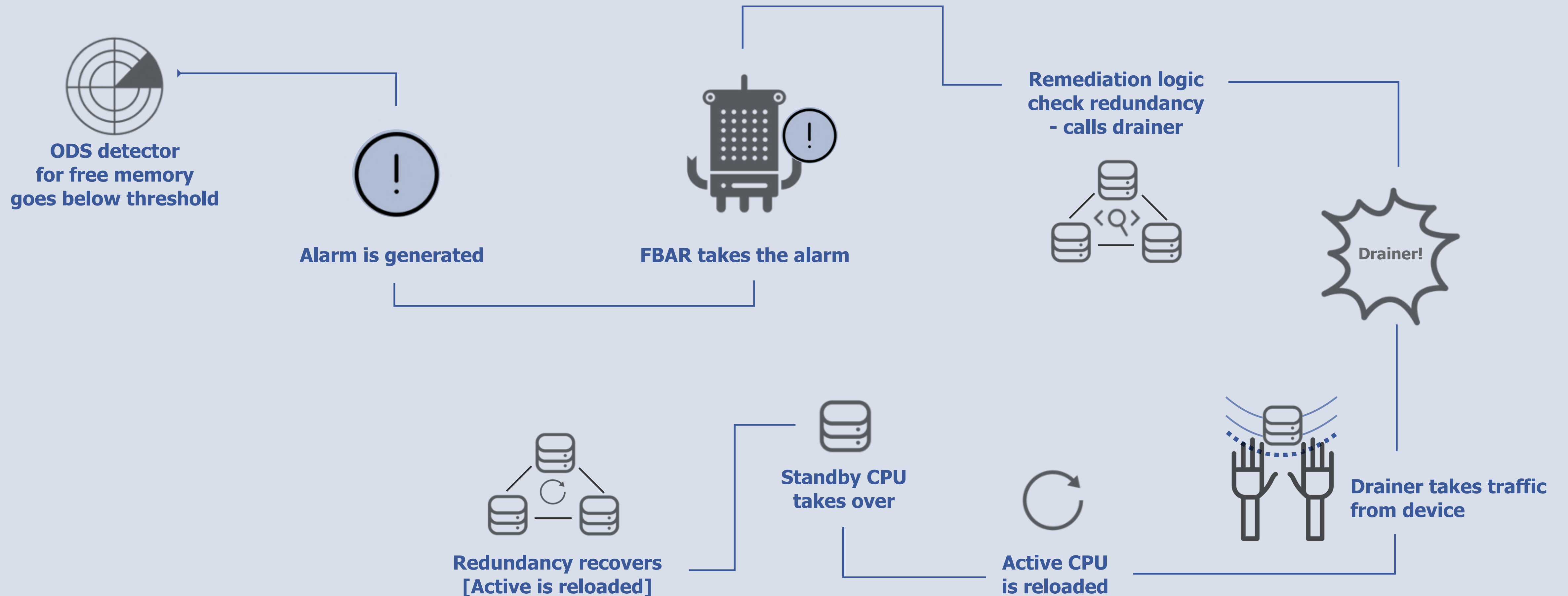
How is it now?



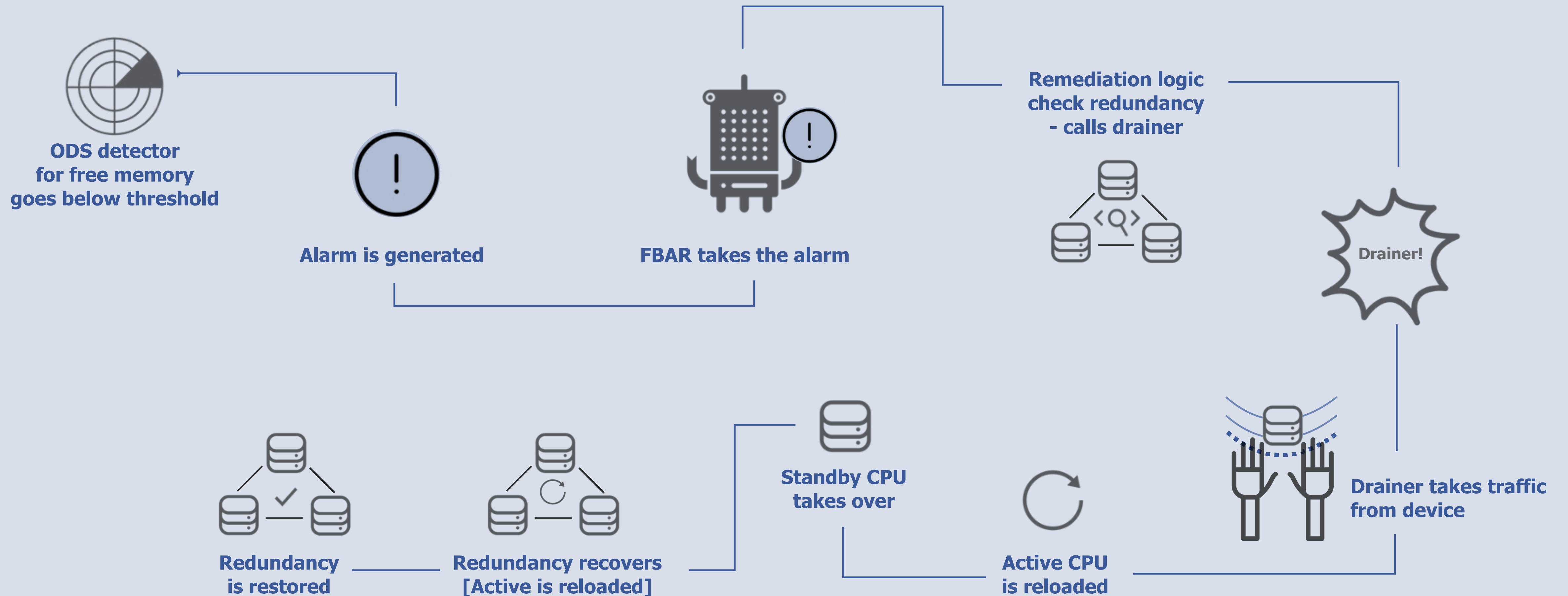
How is it now?



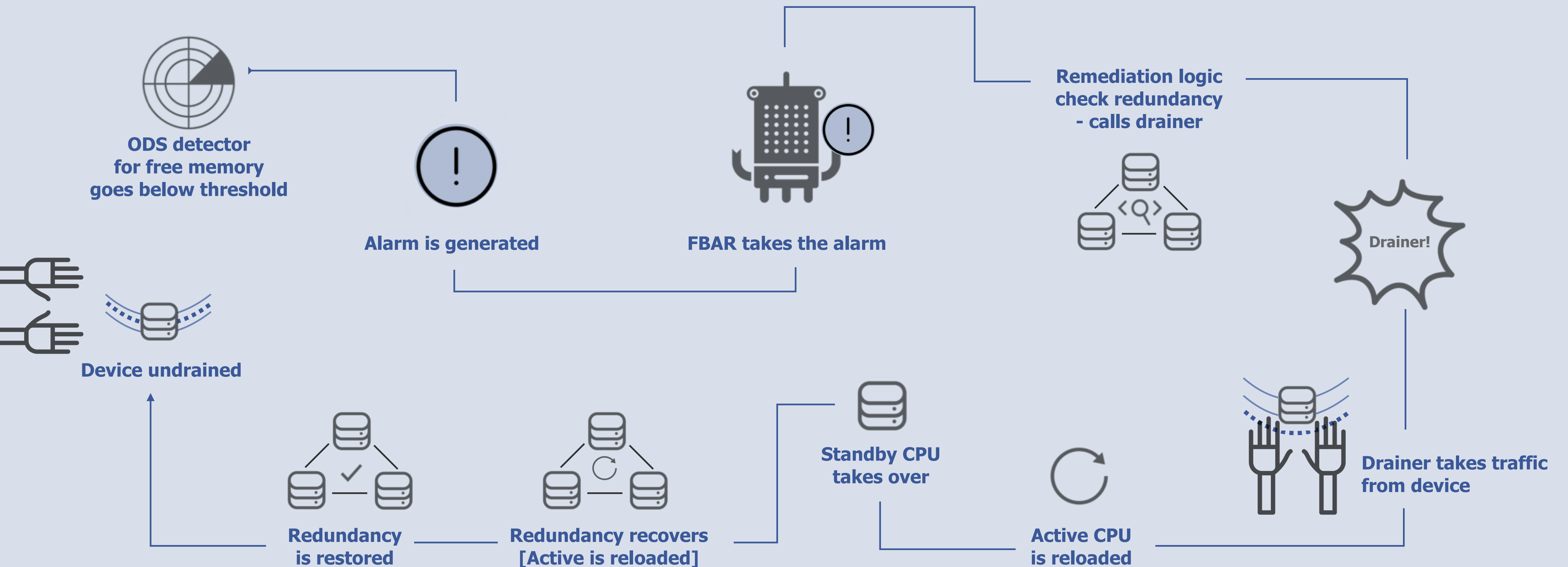
How is it now?



How is it now?

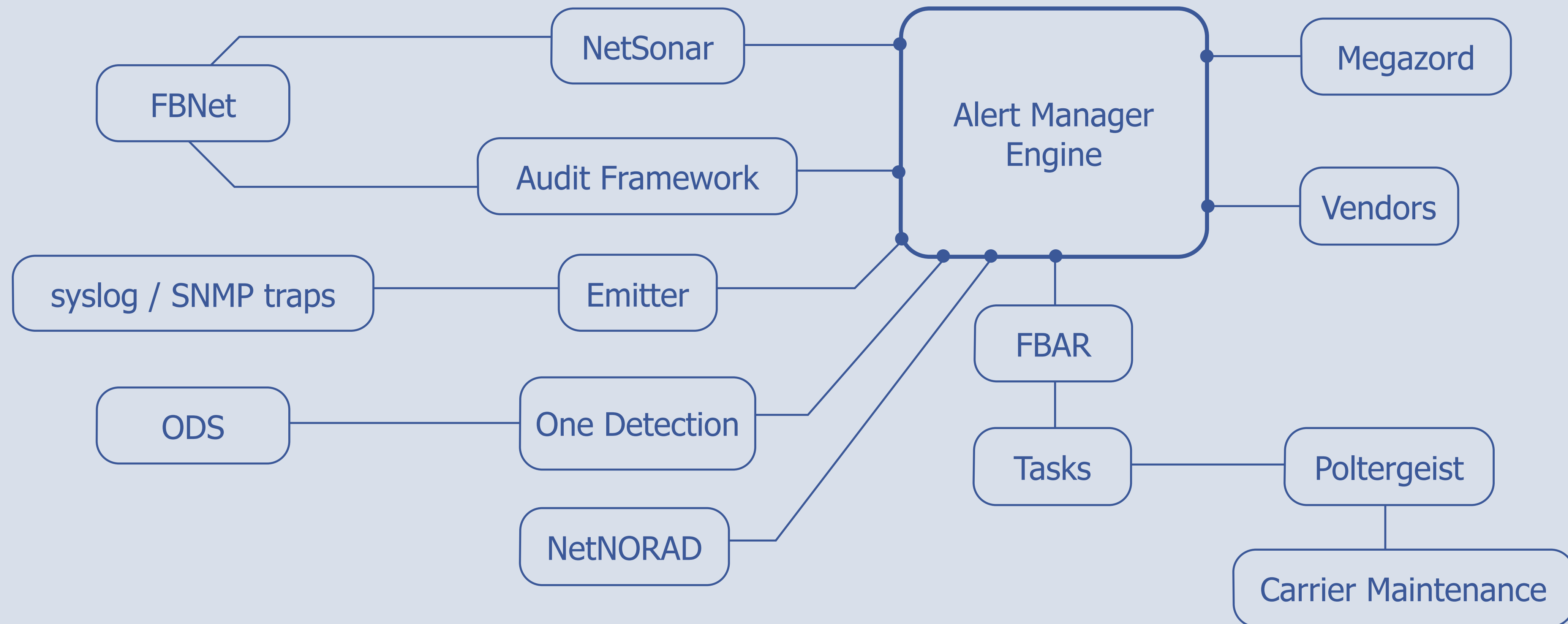


How is it now?



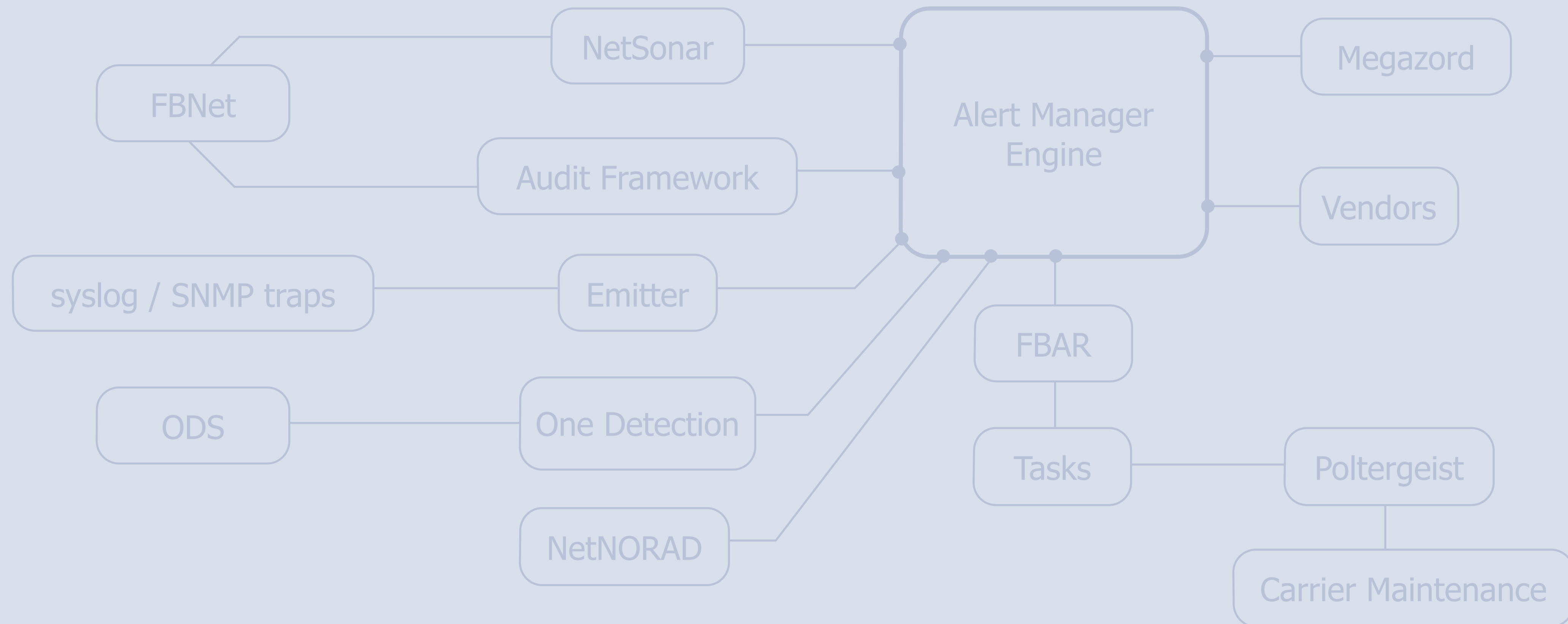
Facebook Defined Networking

all components in action



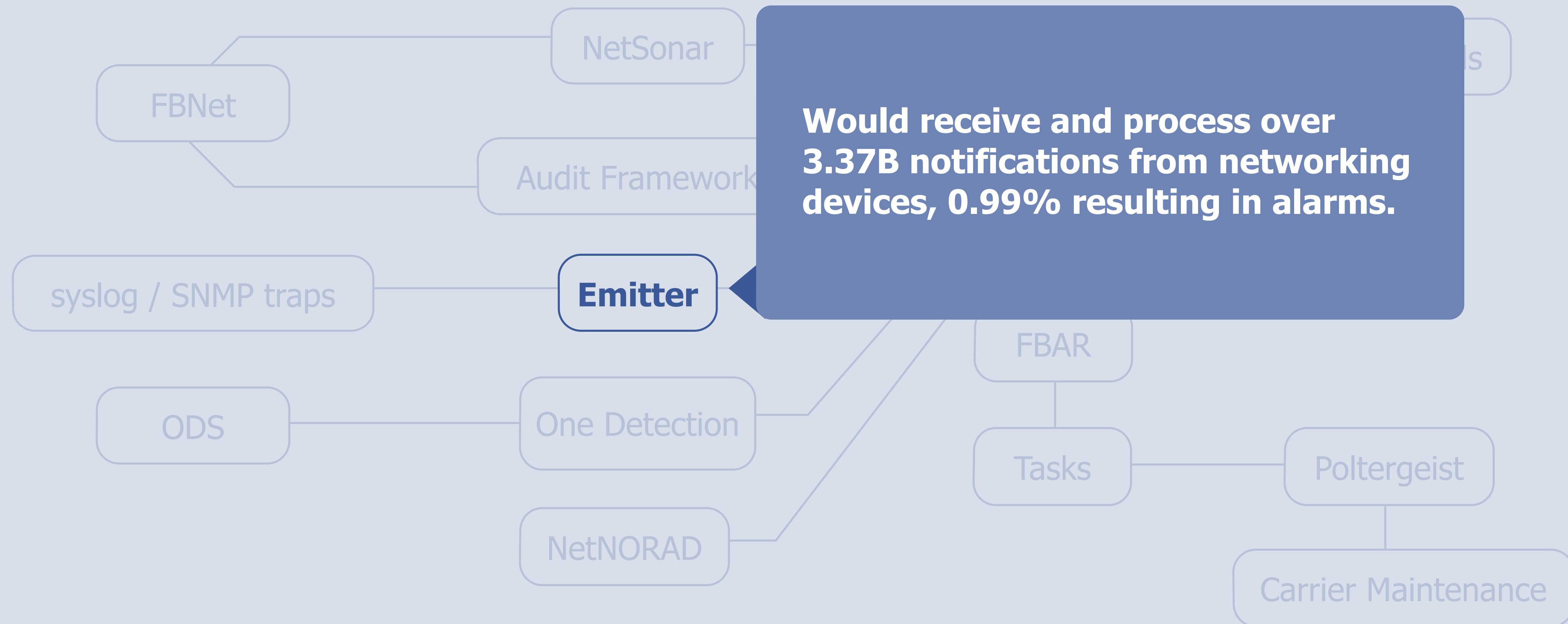
So, in 30 days...

all components in action



So, in 30 days...

all components in action



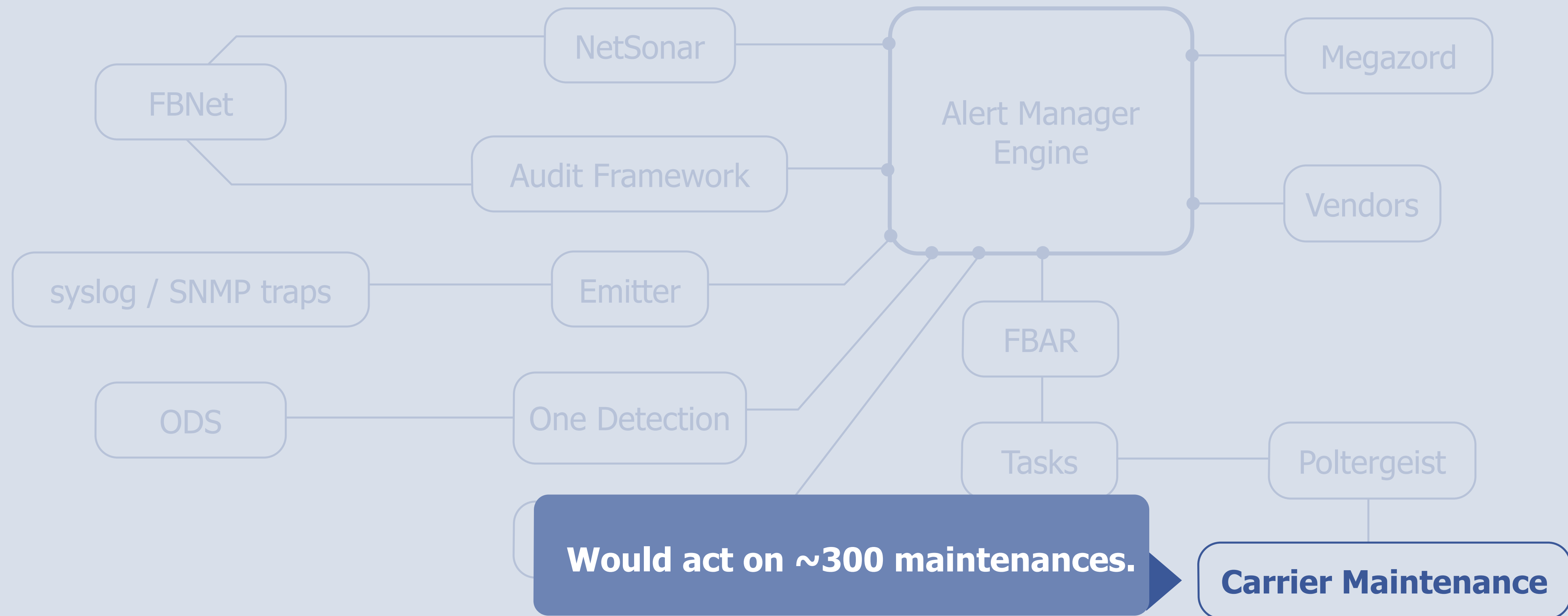
So, in 30 days...

all components in action



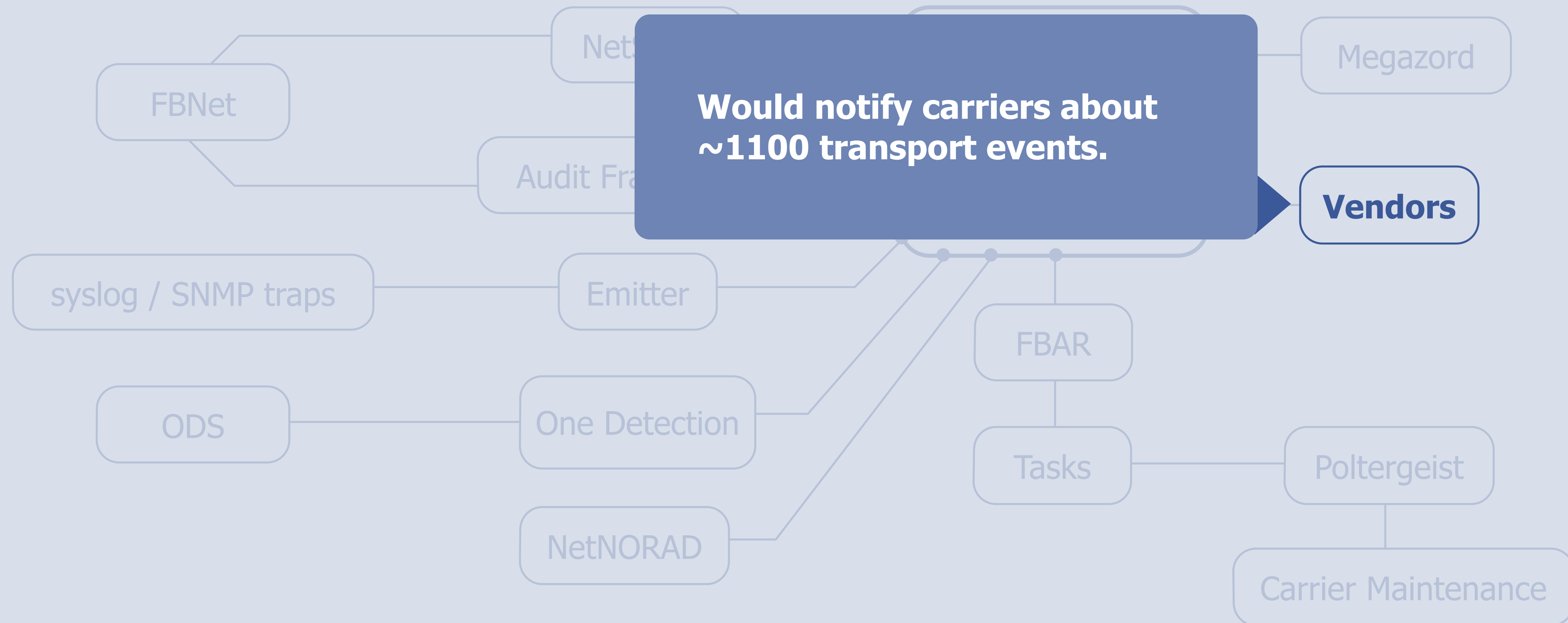
So, in 30 days...

all components in action



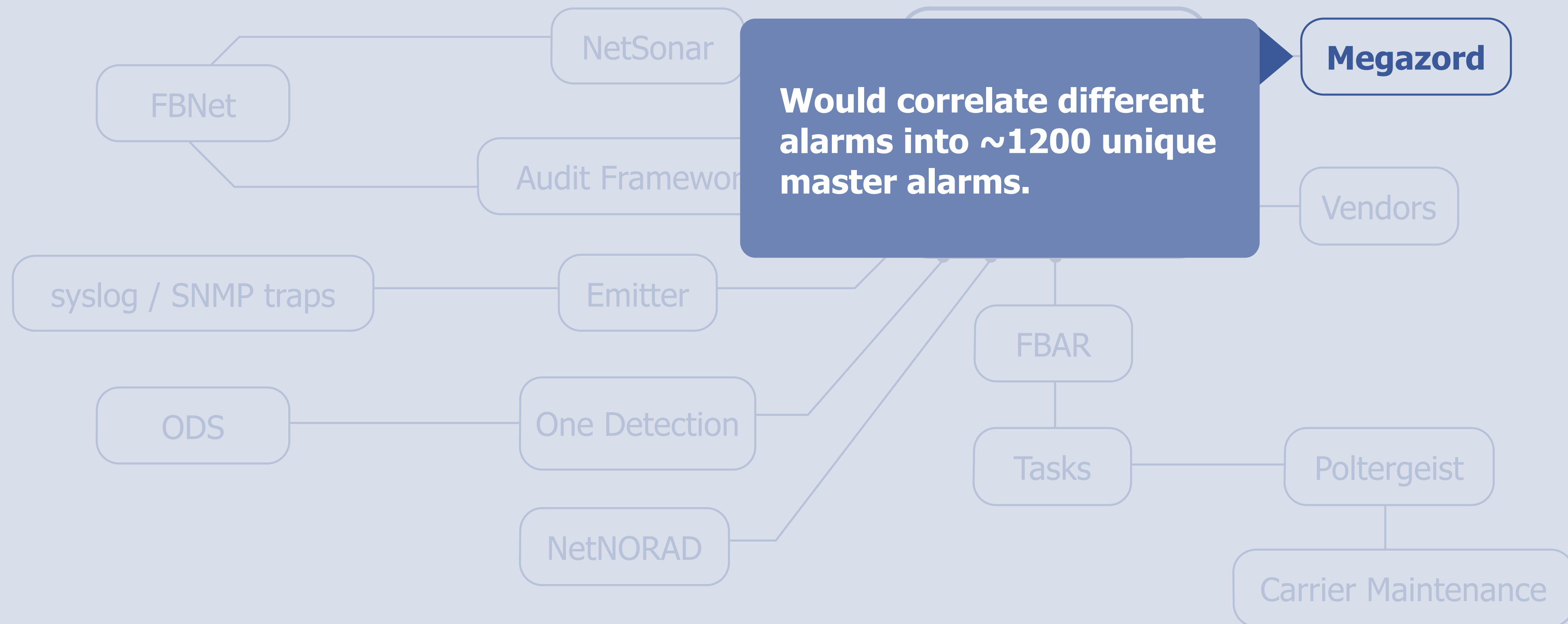
So, in 30 days...

all components in action



So, in 30 days...

all components in action



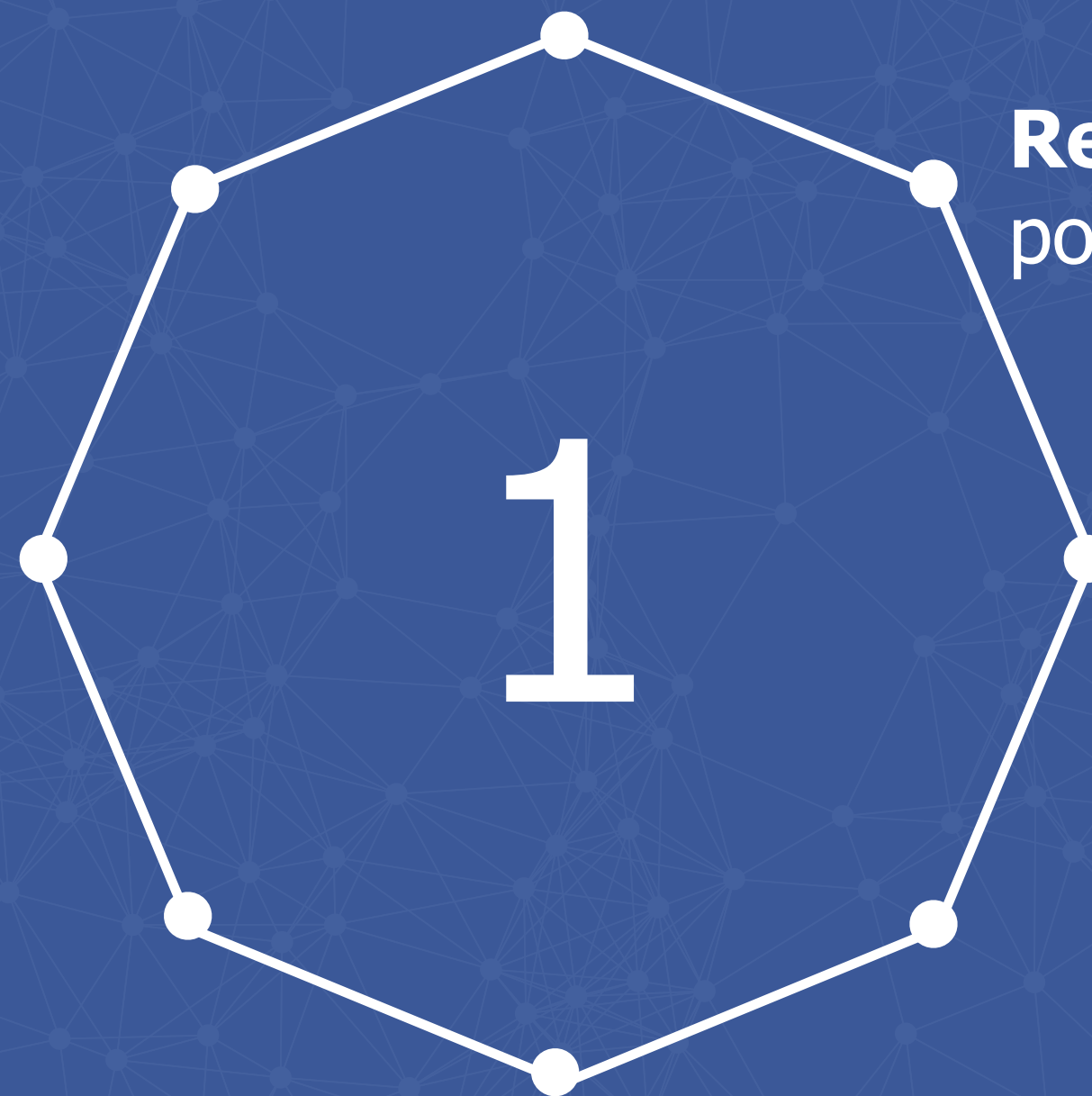
Three vintage tin wind-up robots are shown standing side-by-side. The robot on the left is silver with red eyes, a yellow mouth, and red feet. The middle robot is blue with yellow eyes, a yellow mouth, and black feet. The robot on the right is green with red eyes, a yellow mouth, and red feet. All three robots have a coiled spring on top of their heads and a winding key on their side. They are holding a small white object in their right hands. The background is a plain, light-colored surface.

**Single on-call in charge of the
whole network**



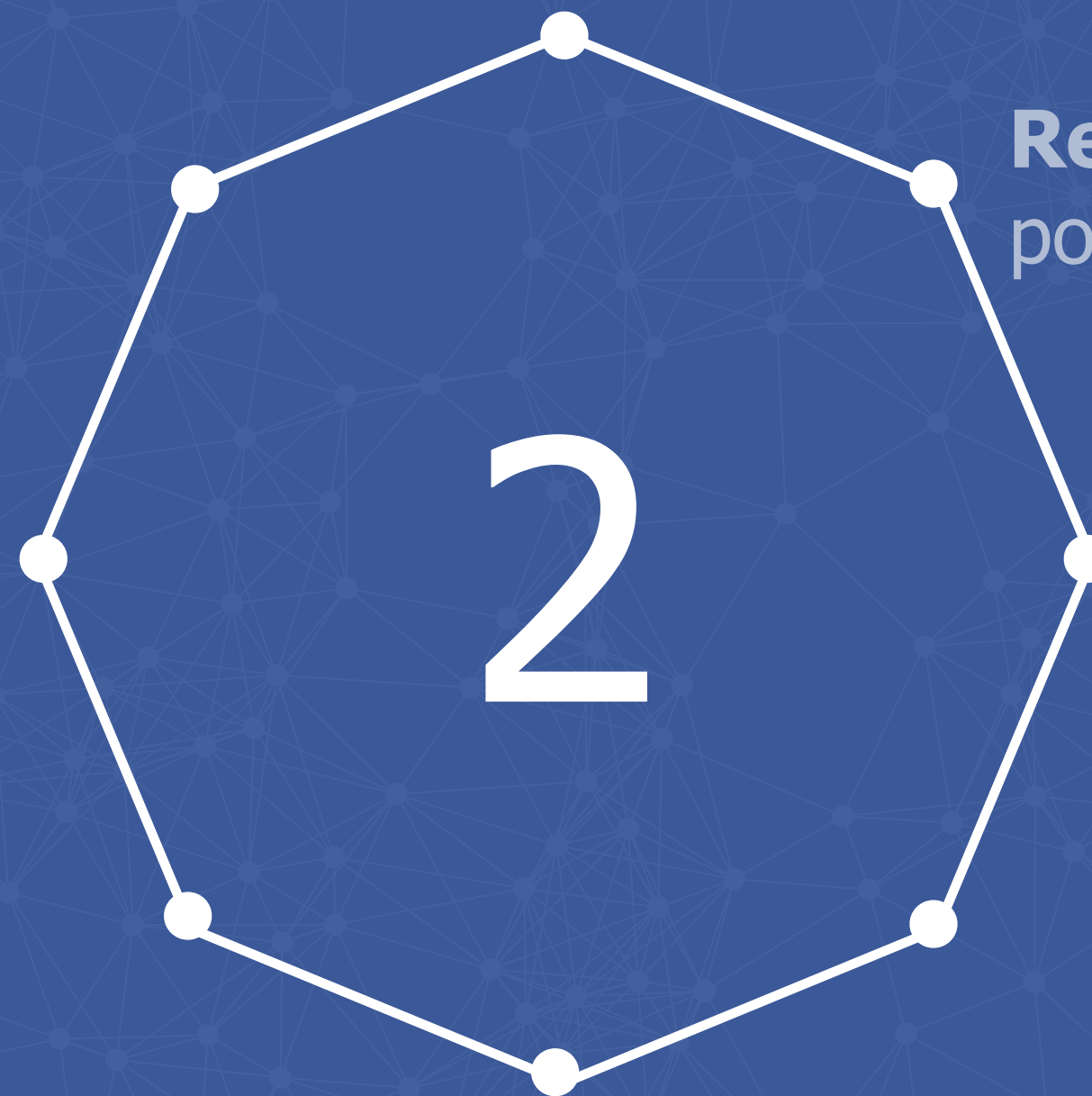
Lessons Learned & Recommendations

8 Lessons Learned & Recommendations



Re-use existing code/tools when possible and when it makes sense.

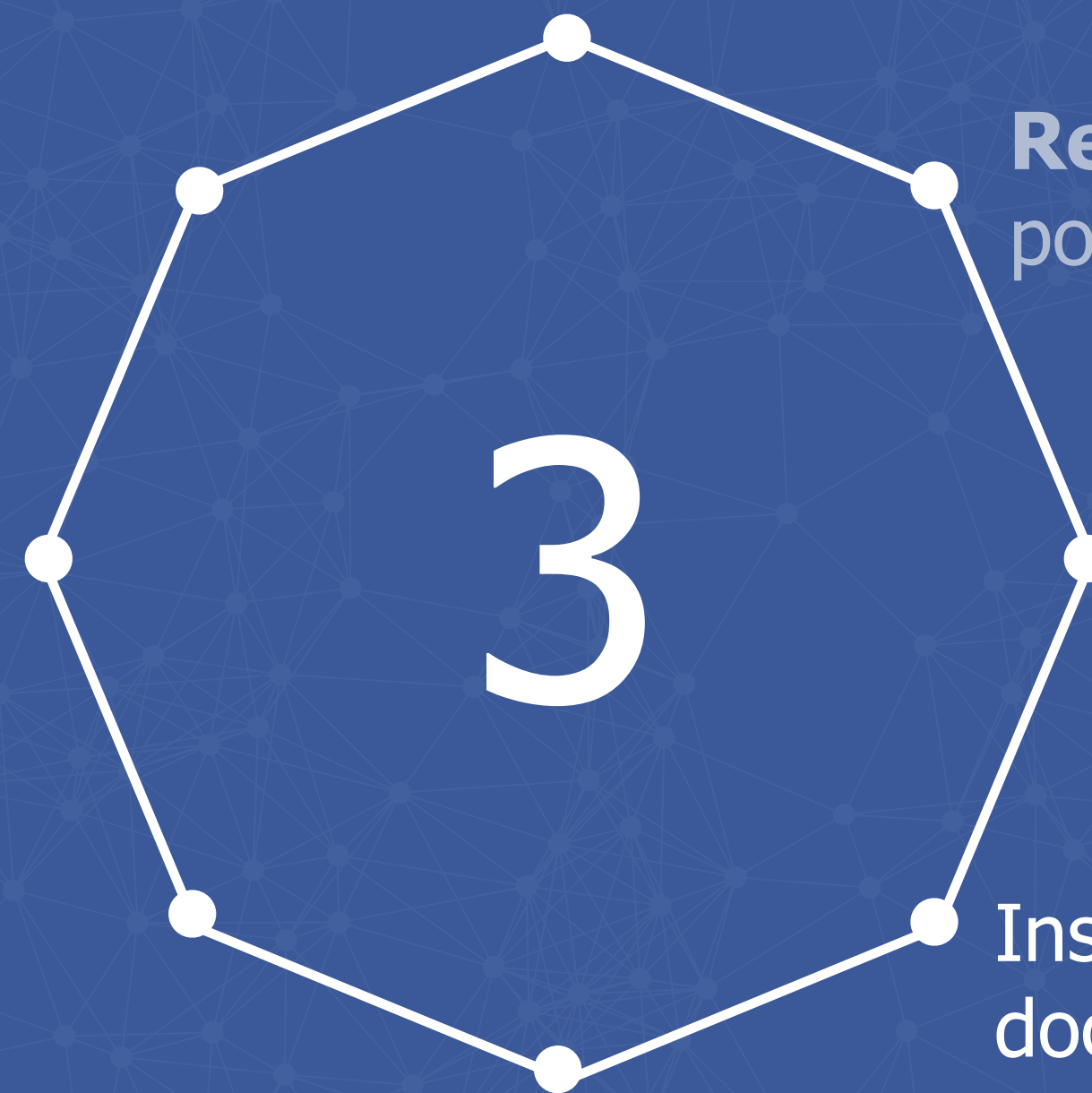
8 Lessons Learned & Recommendations



Re-use existing code/tools when possible and when it makes sense.

Hacks quickly become **important tools.**

8 Lessons Learned & Recommendations

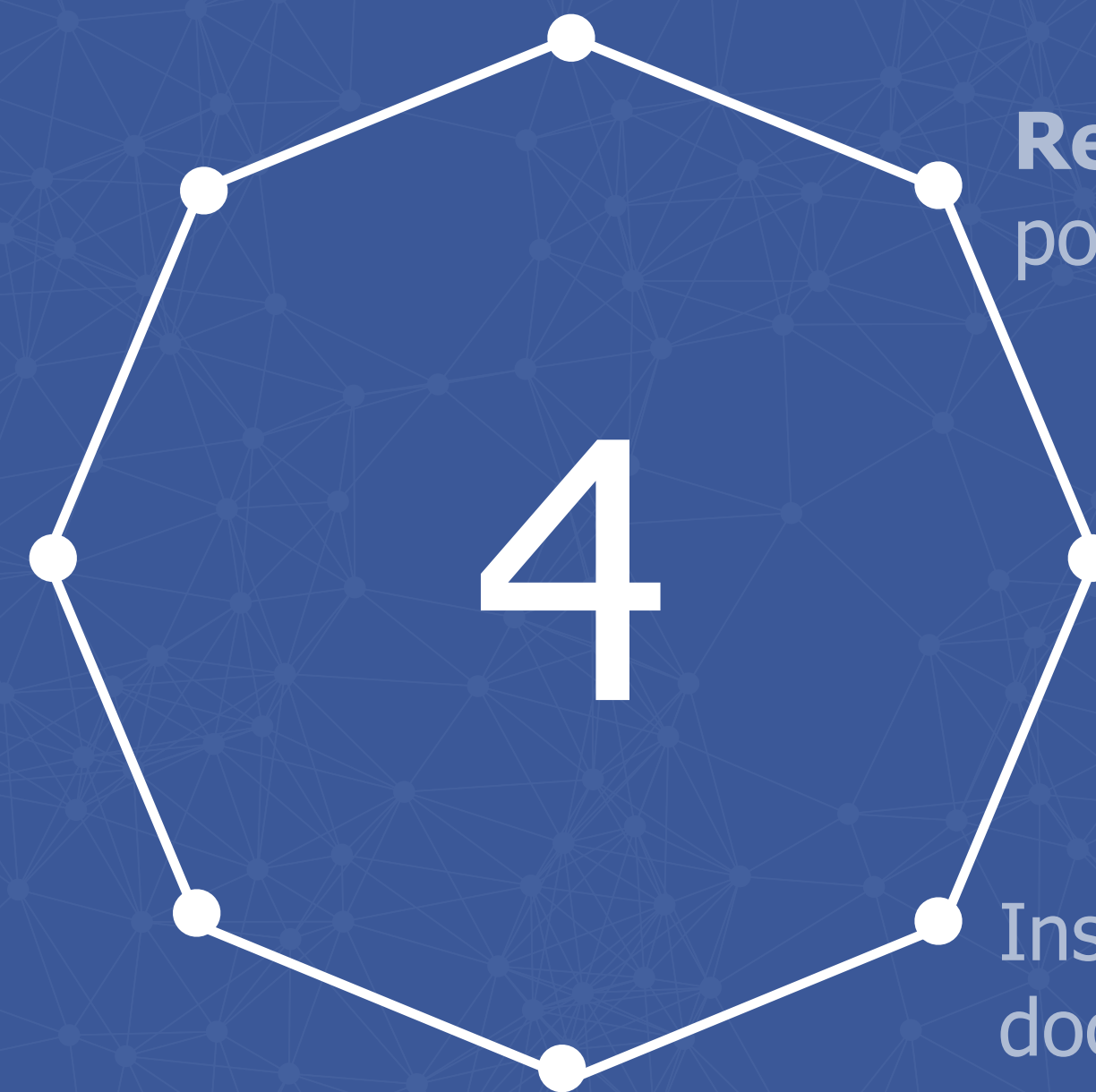


Re-use existing code/tools when possible and when it makes sense.

Hacks quickly become **important tools**.

Instrument / unit-test / document **all the things**.

8 Lessons Learned & Recommendations



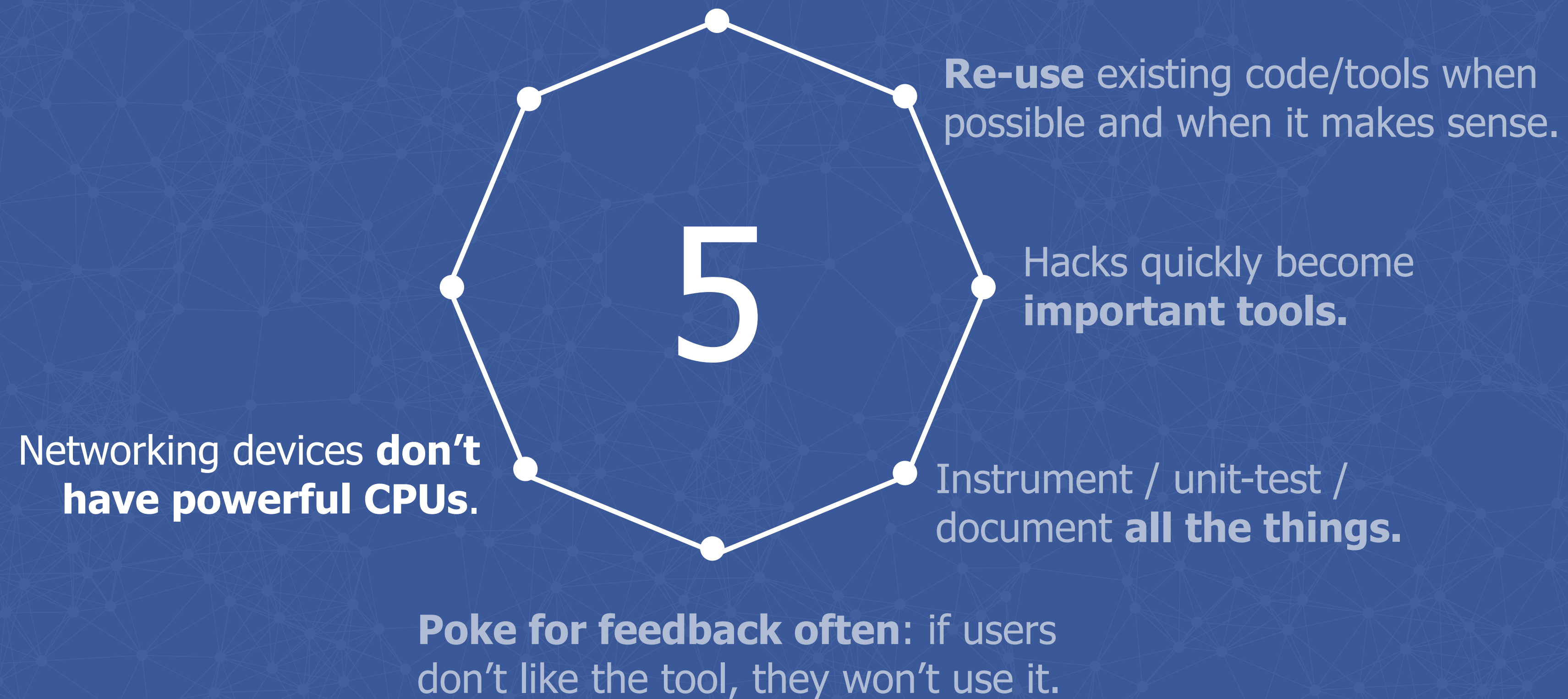
Re-use existing code/tools when possible and when it makes sense.

Hacks quickly become **important tools**.

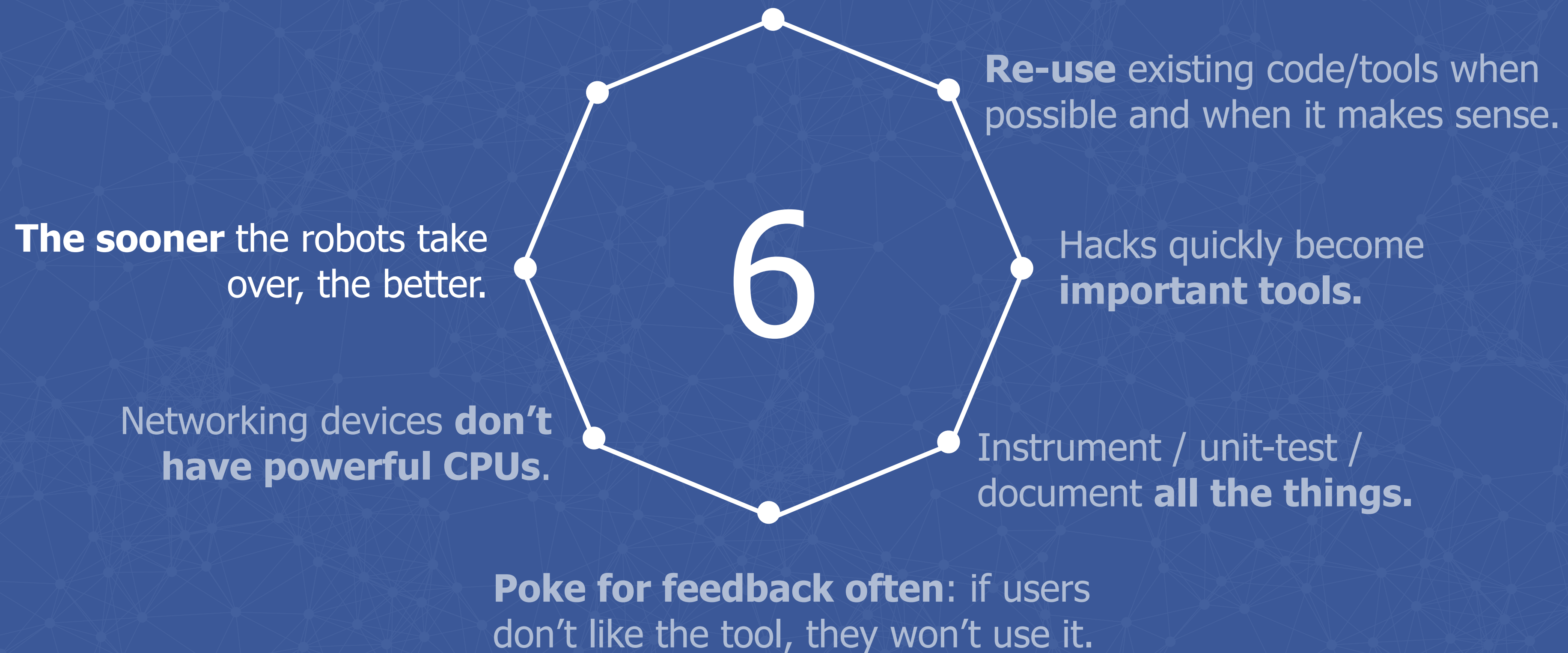
Instrument / unit-test / document **all the things**.

Poke for feedback often: if users don't like the tool, they won't use it.

8 Lessons Learned & Recommendations



8 Lessons Learned & Recommendations



8 Lessons Learned & Recommendations

Talk is cheap, **focus on impact.**

Re-use existing code/tools when possible and when it makes sense.

The sooner the robots take over, the better.

Hacks quickly become **important tools.**

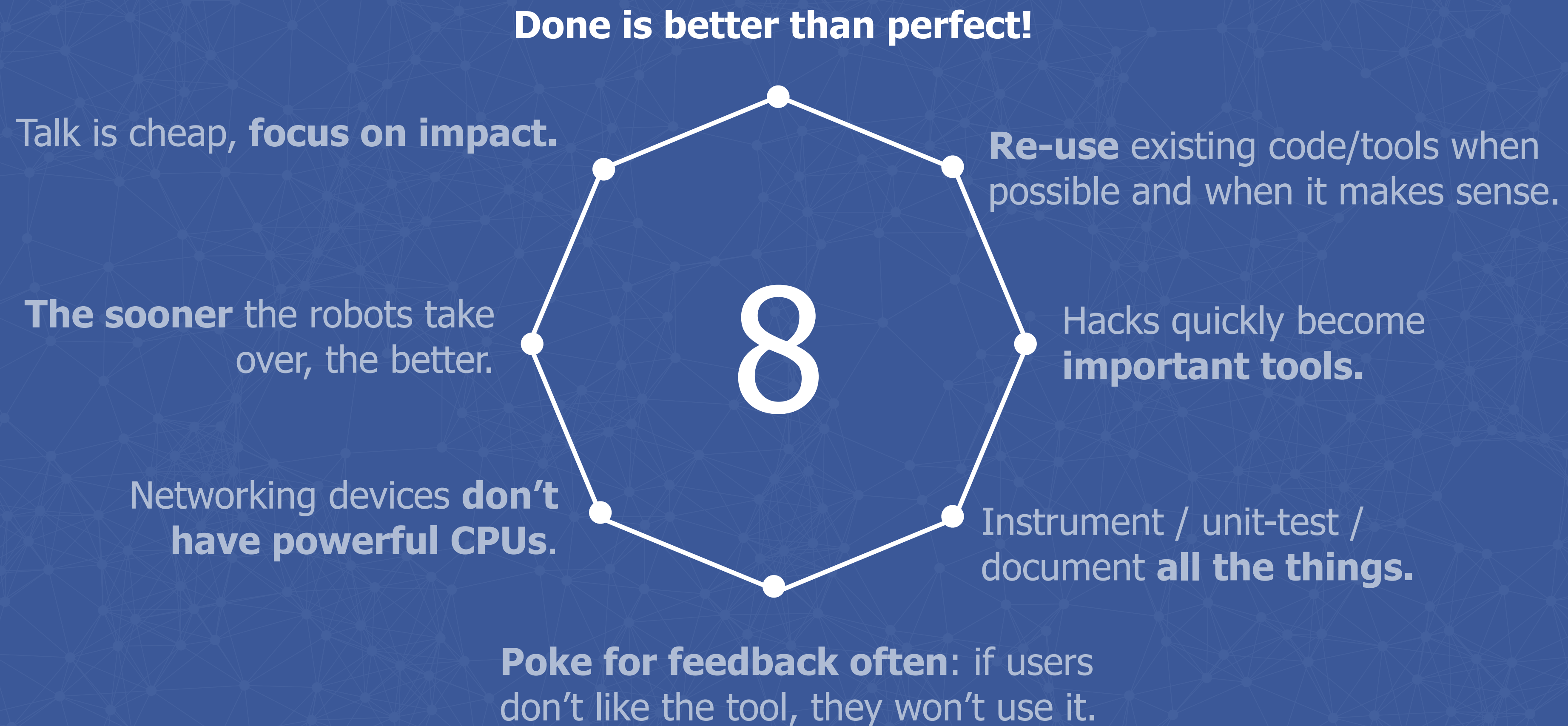
Networking devices **don't have powerful CPUs.**

Instrument / unit-test / document **all the things.**

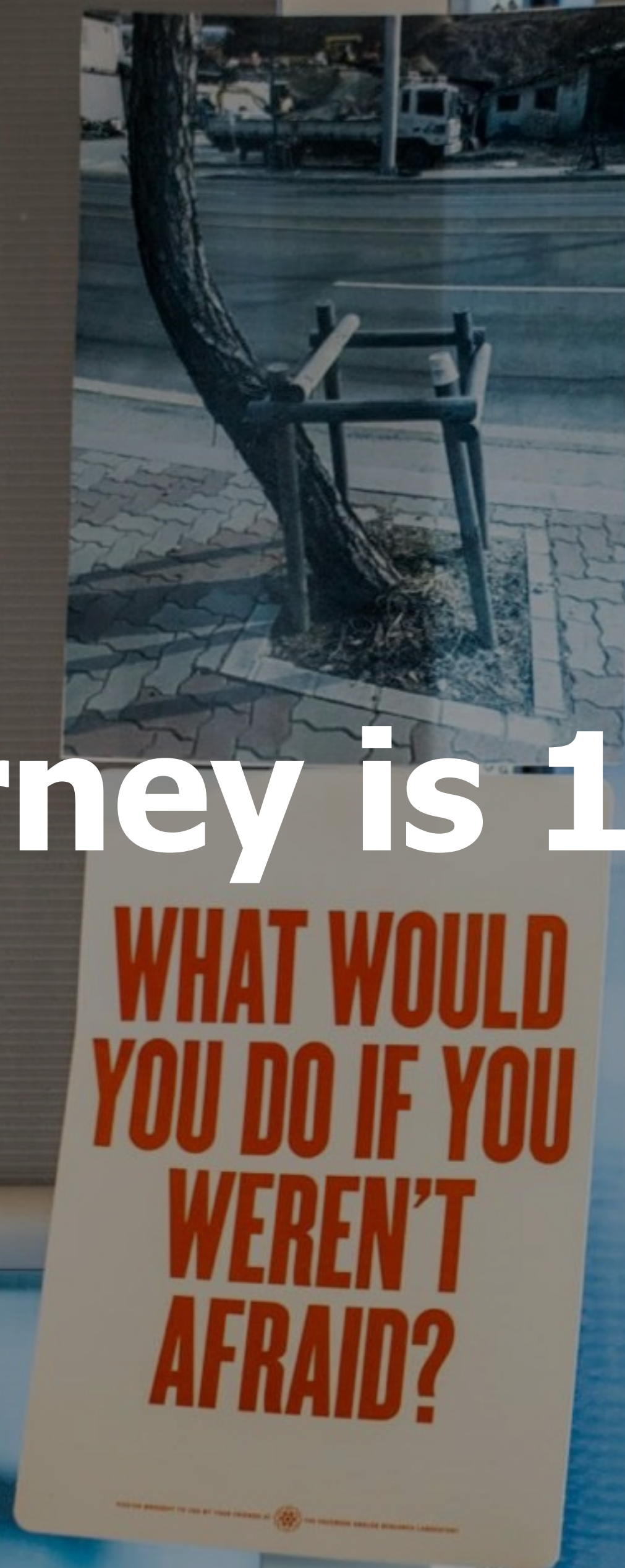
Poke for feedback often: if users don't like the tool, they won't use it.

7

8 Lessons Learned & Recommendations

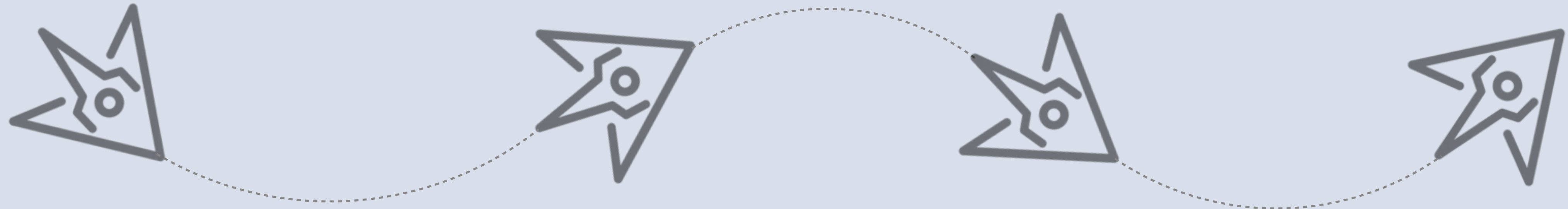


This journey is 1% finished



What's in the near future?

The journey is 1% finished



FBOSS / Wedge / sixpack
operationalization
improvements

Better visibility in the
WDM space and
correlation between the
Optical / IP worlds

PCE

Continuous development
of existing tools



**WHAT WOULD
YOU DO IF
YOU WEREN'T
AFRAID?**

POSTER BROUGHT TO YOU BY YOUR FRIENDS AT  THE FACEBOOK ANALOG RESEARCH LABORATORY

